Historic England

Devon

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 Laura Horner (Devon County Council), Stephen Parry and Graham Lott (British Geological Survey).

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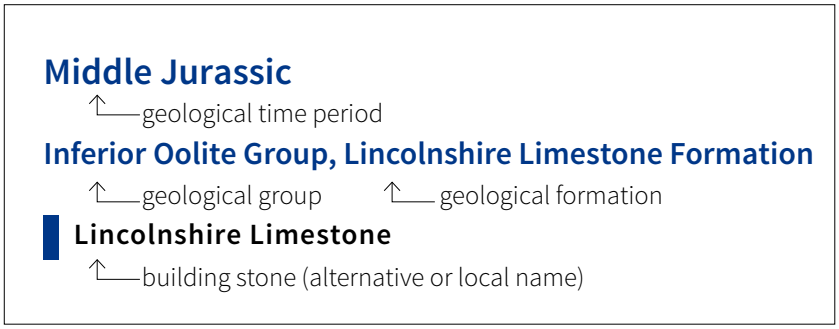
How to Use this Guide

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 areas of Devon County Council, City of Plymouth, Torbay, Dartmoor National Park, and Exmoor National Park (part); the unitary authority areas of the City of Plymouth and the City of Exeter; and the local planning authority areas of North Devon, Torridge, Mid Devon, East Devon, West Devon, Teignbridge, South Hams, Torbay and the national parks.

Contents

1 Introduction

The geology of Devon, encompassing some 420 million years of Earth's history, is highly varied, and this is reflected in its landscapes. Devonian period rocks are the oldest found at outcrop. They represent a time when the Devon area lay near the equator and was submerged beneath a tropical sea. The sands and muds deposited form the sandstones and slates found in North and South Devon. In shallow water areas, during the Middle and Upper Devonian, limestones accumulated, and these are now exposed around Plymouth, Torquay and Brixham. The lithologically diverse Devonian succession has produced some of the county's most important building stones.

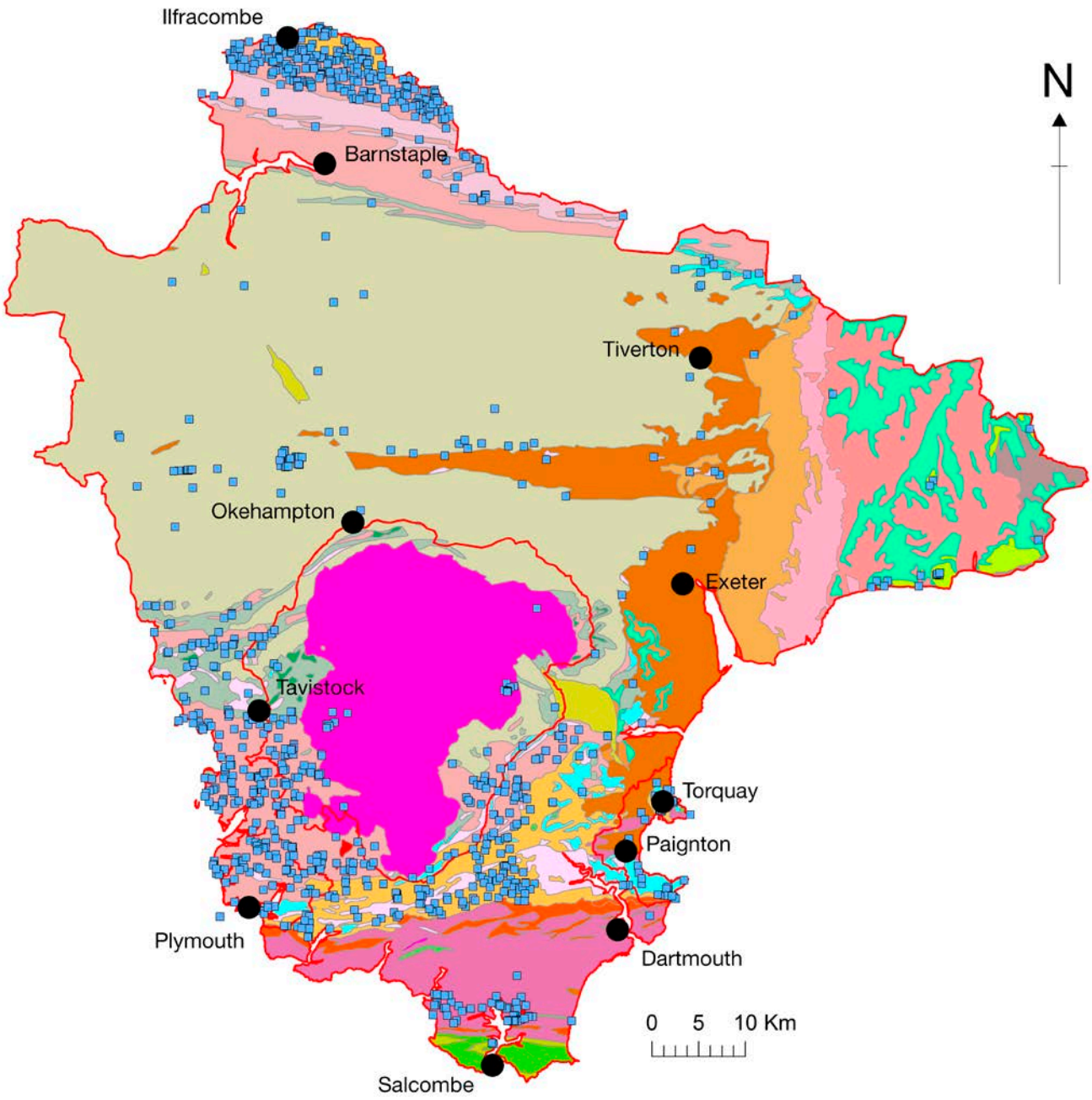
Carboniferous strata occupy large parts of central and northern Devon. The succession comprises thick developments of deep-water, basinal mudstones, with thin interbedded sandstones. The end of the Carboniferous Period was a time of major tectonic upheaval during which the Devonian and Carboniferous successions were deformed and altered to form the cleaved, slaty rocks that now characterise much of the county. Unlike many other parts of the UK, where Carboniferous sandstones, coals and limestones are the dominant rock types, there are no economic coal or limestone deposits.

Devon's Permian and Triassic vivid red sandstones, coarse breccias and conglomerates were deposited during arid desert like conditions. The Early Permian Period also saw significant intrusive and extrusive igneous activity. This produced lava flows and minor igneous intrusions, many of which have become significant sources of local building stone, most notably around Exeter. The substantial Dartmoor Intrusion, a major source of granite for both Devon and regions beyond, was also emplaced at this time.

At the end of the Triassic Period, tropical seas submerged the area and a long phase of marine sedimentation began extending through the Jurassic and into the Cretaceous Periods. Jurassic strata within Devon are limited to a few isolated outcrops of Lower Jurassic marine limestones, which have provided some local building stone. The rocks of the overlying Cretaceous succession contain several of the most significant building stones of southern and eastern Devon, and include the greensand, chalk and flint lithologies.

Over lying the Upper Palaeozoic and Mesozoic rocks of Devon are largely unconsolidated deposits of Quaternary age. These accumulated during a period of climatic instability that saw the advance and retreat of glaciers across Britain. Devon essentially lay to the south of the ice margins and the wide range of periglacial features are the result of permafrost conditions.

Bedrock Geology Map



Key

- Building stone sources

Bedrock geology

- Eocene to Miocene rocks — clay, silt, sand and gravel
- Bracklesham Group and Barton Group — sand, silt and clay
- Chalk Group — chalk
- Gault Formation and Upper Greensand Formation — mudstone, sandstone and limestone
- Lias Group — mudstone, siltstone, limestone and sandstone
- Triassic Rocks — mudstone, siltstone and sandstone
- Triassic Rocks — sandstone and conglomerate, interbedded
- Permian Rocks — mudstone, siltstone and sandstone
- Permian Rocks — sandstone and conglomerate, interbedded
- Unnamed extrusive rocks, Permian — mafic lava
- Dartmoor intrusion, early Permian — felsic rock
- Holsworthy Group — mudstone, siltstone and sandstone
- Dinantian Rocks — limestone with subordinate sandstone and argillaceous rocks
- Unnamed extrusive rocks, Dinantian — mafic lava and mafic tuff
- Unnamed extrusive rocks, Carboniferous — mafic lava
- Unnamed extrusive rocks, Carboniferous — mafic tuff
- Unnamed igneous intrusion, Carboniferous to Permian — mafic igneous rock
- Teign Valley Group — mudstone, siltstone and sandstone
- Upper Devonian Rocks — mudstone, siltstone and sandstone
- Upper Devonian Rocks — sandstone and conglomerate, interbedded
- Middle Devonian — mudstone, siltstone and sandstone
- Lower Devonian Rocks — mudstone, siltstone and sandstone
- Lower Devonian Rocks — sandstone and conglomerate, interbedded
- Devonian Rocks — hornblende schist
- Devonian Rocks — limestone, mudstone and calcareous mudstone
- Devonian Rocks — mica schist
- Unnamed extrusive rocks, Devonian — mafic lava and mafic tuff
- Unnamed extrusive rocks, Devonian — mafic lava
- Unnamed extrusive rocks, Devonian — mafic tuff
- Unnamed igneous intrusion, Devonian — felsic rock
- Unnamed igneous intrusion, Devonian — mafic igneous rock

Stratigraphic Table

Geological timescale	Group	Formation	Building stone	Page
Cretaceous	Chalk Group	various	Flint	38
		Holywell Nodular Chalk Formation	Beer Stone, Sutton Stone	37
	Selborne Group	Upper Greensand Formation	Calcareous Grit Salcombe Stone Malmstone (Whitestaunton Stone) Green Glauconitic Sandstone Grey Glauconitic Sandstone	36 36 36 34 34
Lower Jurassic	Lias Group	Blue Lias Formation	Blue Lias Limestone	33
Triassic	Sherwood Sandstone Group	Otter Sandstone Formation	Red Sandstone, Otter Conglomerate	32
		Budleigh Salterton Pebble Beds Formation	Budleigh Buns	31
	Aylesbeare Mudstone Group	Exmouth Mudstone and Sandstone Formation	Exmouth Sandstone	31
Permian	Exeter Group	Dawlish Sandstone Formation	Poltimore Sandstone, Dawlish Sandstone	30
		Torbay Breccia Formation, Oddicombe Breccia Formation	Torbay Breccia (Paignton Breccia, Nethercombe Breccia, Torre Breccia, Oddicombe Breccia, Teignmouth Breccia, Watcombe Breccia) Red Rock Sandstone Porphyry boulders	29 28 28
		Heavitree Breccia Formation	Sampford Peverall Red Breccio-conglomerate Heavitree Breccia (Wonford Breccia, Exminster Breccia, Whipton Stone)	27 26
		Exeter Volcanic Series	Raddon Stone, Thorverton Stone, Posbury Stone, Killerton Stone, Pocombe Stone, Rougemont Stone	24
		Thorverton Sandstone Formation, Knowle Sandstone Formation	Thorverton Sandstone, Knowle Sandstone	24
	Dartmoor Granite Intrusion		Dartmoor Granite Giant Granite Blue Granite and Fine-grained Blue Granite	23 23 22
	Unnamed igneous Intrusions		Dolerite (Microgabbro)	22
			Halwill Freestone, Hatherleigh Stone, Elvan (Roborough Stone, Greenstone)	21

Geological timescale		Group	Formation	Building stone	Page
Upper Carboniferous		Holsworthy Group	Bude Formation	Bude Sandstone (Culm Sandstone including Dark Red Sandstone, Hensley Sandstone, Brownstone, Cinnamon-coloured Sandstone)	20
			Bideford Formation	Cornborough Stone	20
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Devonian	North Devon area		Baggy Sandstones Formation	Baggy Sandstone	16
		not defined	Pickwell Down Sandstone Formation	Pickwell Down Sandstone	15
			Morte Slates Formation	Morte Slate	14
			Ilfracombe Slates Formation	Ilfracombe Limestones (including Jenny Start Limestone), Kentisbury Slates, Combe Martin Slates	13
			Hangman Sandstone Formation	Hangman Grits	13
	South Devon area	not defined	Gurrington Slate Formation	Gurrington Slate	13
		Tamar Group	Tavy Formation	Tavy Formation Slates, Kate Brook Slate	12
			Plymouth Limestone Fromation	Plymouth Limestone	11
		Torbay Group	Ashprington Volcanic Formation	Ashprington Volcanics	11
			Nordon Slate Formation	Nordon Slate	11
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		not defined	Chercombe Bridge Limestone Formation	Ashburton Marble	8
		Meadfoot Group	various	Meadfoot Sandstone, Meadfoot Slate	8
		Dartmouth Group	Bin Down Formation	Dartmouth slates and sandstones	7
			Whitsand Bay Formation		
		Start Complex		Start Mica Schists, Start Hornblende Schists	6

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

2 Local Building Stones

Devonian, South Devon area

Start Complex

Start Mica Schists, Start Hornblende Schists

The schistose rocks of South Devon (the oldest in the county) form what is known as the Start Complex. This principally comprises two lithological types: green hornblende-bearing schists (Start Hornblende Schists) and grey mica-bearing schists (Start Mica Schists). The hornblende schists were formed by the metamorphism of igneous lavas, sills and tuffs, while the mica schists represent metamorphosed sedimentary shales, siltstones and sandstones. The mica schists have a well-developed schistosity, particularly when compared to the hornblende schists, which tend to be more massive. Both rock types are poor building materials due to the combined effects of the schistose fabric, relict bedding and veining, which impart a rough, jagged fracture and make the stones difficult to dress.

These rocks crop out in a roughly east to west trending belt, running between Bolt Tail and Start Point (via Bolt Head, Salcombe and Prawle Point). As a building material, the Start Complex lithologies have only a local significance, and it is the hornblende schists that have a greater prominence, being used for vernacular purposes rather than for higher status buildings.

Figure 1: Cottage, Salcombe. Start Hornblende Schist.

Dartmouth Group, Whitsand Bay Formation, Bin Down Formation

Dartmouth slates and sandstones

Slates occur widely within South Devon, their outcrop existing as a broad band that extends across the South Hams from Dartmouth to Plymouth. These slates form the bulk of the Dartmouth Group and Meadfoot Group and represent an important building stone resource for both Devon itself and areas beyond. At stratigraphically higher levels lie the slates of the Nordon Formation, Tavy Formation and Gurrington Formation.

The Dartmouth Group is divided into two formations at its western end, the Whitsand Bay Formation and the Bin Down Formation. The Whitsand Bay Formation is characterised by purple, occasionally green, slaty mudstone with thin variegated sandstone beds, whereas the Bin Down Formation (Pragian) comprises grey slaty mudstone and quartzitic sandstone with interbedded, silicified, basic lava and volcaniclastic rocks. Whitsand Bay Formation lithologies are particularly important as building stones, and Dartmouth Parish Church is an example of their use. The slabby nature of most of the material makes it particularly suitable for the construction of walls. The sandstones exhibit a range of sedimentary structures, such as cross-bedding, and are fairly weak and susceptible to weathering. As a result, they are commonly rendered.

Figure 2: St Saviour's Church, Dartmouth. Local rubblestone from the Whitsand Bay Formation, with Bath Stone and Salcombe Stone dressings.

Meadfoot Group, various formations

Meadfoot Sandstone, Meadfoot Slate

Slates occur widely within South Devon, their outcrop existing as a broad band that extends across the South Hams from Dartmouth to Plymouth. These slates form the bulk of the Lower Devonian Dartmouth Group and Meadfoot Group, and represent an important building stone resource for both Devon itself and areas beyond.

Both the slates and sandstones of the Meadfoot Group have seen general use in the construction of walls. The slates have also been used for roofing purposes. Meadfoot Group sandstone is a brownish-red colour, while the slates (a cleaved mudstone) are typically grey, weathering to a greenish-grey or orange-brown colour. In terms of construction work, the sandstones are quite strong, but the cleavage in the mudstones renders them fairly weak, making them unsuitable for quoins.

Figure 3: Public house, Holbeton. Meadfoot Group stone.

Group not defined, Chercombe Bridge Limestone Formation

Ashburton Marble

This is a highly significant stone, but it is now quarried only for aggregate within Dartmoor National Park. It has been used for decorative purposes throughout Devon and beyond. The stone itself often boasts spectacular coloured patterns involving veins of white calcite and streaks of red haematite set against various background shades of grey. This is particularly so in some of the limestones found around Newton Abbot, Buckfastleigh and Ashburton, which are able to take a hard polish. It should be noted that the stone is not a true marble because it has not been subject to the extremes of metamorphic heating and, consequently, the fossil corals present are beautifully preserved.

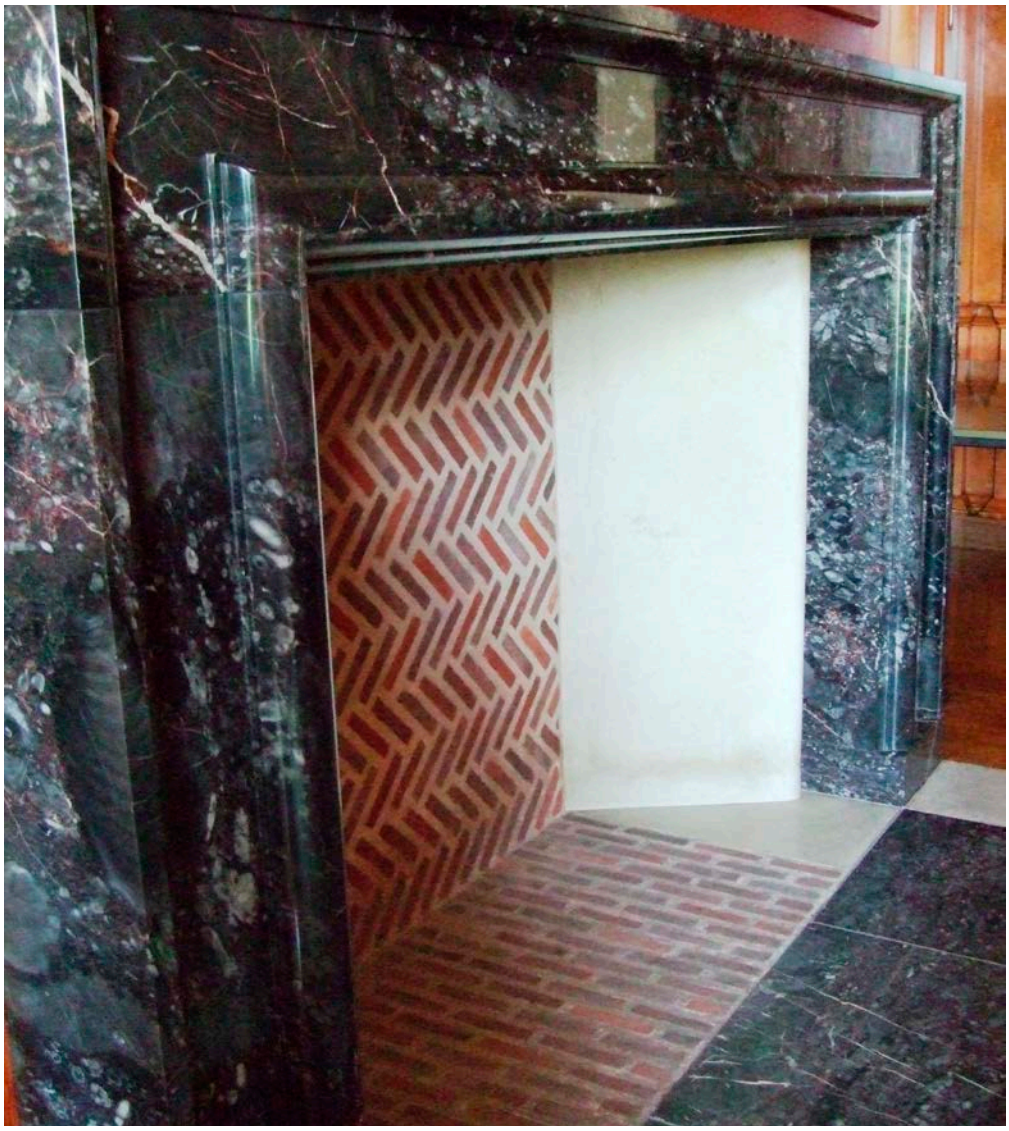

Figure 4: Fireplace inside County Hall, Exeter. Ashburton Marble.

Torbay Group, East Ogwell Limestone Formation, Torquay Limestone Formation

East Ogwell Limestone, Torquay Limestone (Pale Grey Torquay Limestone, Petitor Limestone, Walls Hill Limestone, Babbacombe Limestone, Lummaton Limestone)

The Torbay Group thick reef limestones accumulated around Torquay and Brixham (and also Plymouth) in the Middle to Late Devonian times. There are numerous old quarries around Torquay and on the headlands bordering Torbay (Hope's Nose and Berry Head) which allowed easy shipment of the stone.

The Torbay Group limestones were used for street paving in towns like Torquay, retaining walls and harbour works. Much of the mainline railway that follows the seawall between Teignmouth and Dawlish is faced with blocks of Devonian limestone brought by sea from Torbay.

The East Ogwell limestones have a uniform pink colour derived from haematite. Like Ashburton Marble, East Ogwell limestones are now a major source of aggregate rather than a building stone.

Figure 5: Cottages, Topsham. East Ogwell Limestone.

There are many different names for the typically pale grey limestones worked around Torquay and that are now assigned to the Torquay Limestone Formation. These include Petitor Limestone, Walls Hill Limestone, Babbacombe Limestone and Lummaton Limestone (the names generally deriving from quarry names). Pale Grey Torquay Limestone is a competent building stone that tends not to spall.

Like Ashburton Marble, these limestones are only partial metamorphised. The variegated and fossiliferous marbles have been used for decorative stonework as well as building stone. For example, Petitor and Ogwelll marbles (and others) have been used in St John's Church, Torquay and the Birmingham Art Gallery and Museum.

Torbay Group, Brixham Limestone Formation

Brixham Limestone (Mid-Grey Devonian Limestone, Berry Head Limestone, Sharkham Limestone, Goodrington Limestone)

Although paler grey limestones do occur within the Brixham area, the majority quarried from the Brixham Limestone Formation are mid-grey in colour. The most extensive extraction in the past was from around Berry Head. As a coastal location, it was ideally situated for the export of stone to neighbouring coastal settlements and those accessible by river, such as Exeter.

Like Pale Grey Torquay Limestone, Brixham Limestone sometimes contains fragments of tabulate and rugose corals and stromatoporoids, and it can be cross-cut by irregular calcite veins. It is also a competent building stone and tends not to spall upon weathering. Brixham Limestone is variously known as Berry Head Limestone, Sharkham Limestone and Goodrington Limestone.

Torbay Group, Nordon Slate Formation

Nordon Slate

The Nordon Slate Formation slate has been widely used in the area around Totnes, particularly for walling. They are grey when fresh, but weather to an orange cum brownish-grey colour. The slates are interbedded with siltstones, sandstones, tuffs and lavas; as a result, blocks of these particular lithologies are also seen in the fabrics of buildings.

Torbay Group, Ashprington Volcanic Formation

Ashprington Volcanics

The Ashprington Volcanic Formation (Eifelian to Frasnian stages in the Devonian epoch) principally comprises basalts that have a distinctive dark green colour, weathering purple, red and ochreous yellow. Some of the rocks are porphyritic, which gives them a mottled or spotted appearance, and in some places they are vesicular. The Ashprington Volcanics have a fairly limited outcrop to the west of Torbay and south of Totnes, notably around the village of Ashprington itself, where they are commonly used as a building stone.

Tamar Group, Plymouth Limestone Formation

Plymouth Limestone

Like the Torbay Group, the Tamar Group around Plymouth are also thick reef limestones which developed in the Middle to Late Devonian times. Like the Torbay Group subsequent tectonism during the Late Carboniferous led to the partial metamorphism of these limestones, thereby forming the variegated marbles that have been used extensively for both vernacular building stone and decorative stonework throughout the county and beyond.

The numerous old quarries around Plymouth bear testimony to the past importance of the Devon limestone industry. Many of the quarry sites are located close to the shore for ease of shipment, such as those around the Cattewater in Plymouth. Rough-cut stone has seen extensive use in the construction of vernacular buildings, but, historically, its most important use was as dressed and cut stone for public and other important buildings. It has also been employed during municipal and civil engineering projects. Slabs of Devonian limestone are still seen paving the streets of Plymouth, Torquay and, to a lesser extent, Exeter (where it is a significant building stone).

Plymouth Limestone is a massive, pale to mid-grey-coloured limestone. Occasionally, it is dark grey and well bedded, with a fine-grained calcite (and sometimes clay) matrix. Like the Torbay Group limestones, it may contain fragments of tabulate and rugose corals and stromatoporoids, and calcitic veining is often present. The darker coloured variety, with its associated clay layers, is more liable to spall upon weathering.

Tamar Group, Tavy Formation

Tavy Formation Slates, Kate Brook Slate

In the west, the Upper Devonian Tavy Formation (Frasnian to Famennian stages in the Devonian epoch) consists mainly of smooth slates, the cleavage surfaces of which have a greenish chloritic sheen. To the east, around Buckfastleigh, the upper part of the unit comprises greenish-grey slates, but the lower part contains purple and green mottled slates. The green Tavy Formation slates are an important building stone resource in Devon. The stone is currently worked at Mill Hill Quarry to the west of Tavistock, where blue-green slates are produced.

The Kate Brooke Slate represents a minor slate resource which has been used for not only for sills and occasionally roofing, but also for constructing internal and external walls. It is a fairly distinctive smooth, greyish green slate (weathering yellowish grey) with lustrous cleavage surfaces.

Figure 6: Cottage, Horrabridge. Tavy Formation slate walls.

Devonian, North Devon area

Group not defined, Gurrington Slate Formation

Gurrington Slate

The Gurrington Slate Formation crops out in the Ashburton–Buckfastleigh area. Its constituent slates are typically bright green or purple when fresh (weathering black or ochreous brown), but they can be mottled and, in some cases, poorly foliated. These slates have been used as a general walling stone, sometimes in association with deformed, vesicular, olive-brown lavas and tuffs, some of which are also vesicular and contain broken feldspar phenocrysts.

Group not defined, Hangman Sandstone Formation

Hangman Grits

Although the outcrop of the distinctive Hangman Grits lies just outside Devon within Exmoor National Park, these sandstones are used for decorative purposes within higher status buildings in Devon such as at Tavistock.

These medium-grained, massive to well-bedded sandstones show some colour variation, from red to purple to grey and greenish grey, although they are typically red.

Group not defined, Ilfracombe Slates Formation

Ilfracombe Limestones (including Jenny Start Limestone), Kentisbury Slates, Combe Martin Slates

These slates saw only limited use within Devon. They are generally well cleaved and grey in colour (weathering a yellowish brown) but can appear greenish grey or even purple. Thin sandstone and limestone bands are common in the succession, with some limestones thick enough to be quarried. Slate production was thus often a secondary concern in some quarries. In spite of the well-developed cleavage, the rock appears fairly strong and may have been used for the construction of walls that were subsequently rendered.

The name ‘Ilfracombe Limestone’ is applied to lenses of limestone occurring within the slate formations of North Devon. These tend to be less thinly bedded than the limestones of the younger Teign Chert Formation. They are greyish green in colour, ooidal in places and often show evidence of tectonism, consistent with their slate interbeds. In North Devon, the Ilfracombe Limestones have generally been used for wall structures and quoins, principally in churches and other high-status buildings. The Jenny Start Limestone found near Ilfracombe, is probably the best known.

Because of their friable nature, the Kentisbury Slates saw limited use as a roofing material and were, instead, largely employed for rubble walling and hanging tiles. They form part of a mudstone-dominated sequence of variably grey, greenish-grey and purple rocks, which include many thin sandstones and thin and thick limestones. The presence of bedding, cleavage and joint planes within the various lithologies of this unit makes the slates generally friable and weak, and their use was restricted to their outcrop area. The quarries that opened up within the Kentisbury Slates Member were most likely producing aggregate and a little building stone.

Figure 7: Trinity Rooms, Ilfracombe. Ilfracombe Limestone.

Group not defined, Morte Slates Formation

Morte Slate

Among the Devonian slate units of North Devon, the Morte Slates Formation is the most significant, both in terms of its geographical extent and its use as a building stone. This slate has a greenish-grey colour and a well-developed slaty cleavage (with lustrous sheen on cleavage surfaces), and it weathers to a distinctive silvery grey. It is fairly strong but shows some susceptibility to weathering, particularly frost action. Morte Slate has been used for roofing, wall hangings and general construction purposes, especially the more rubbly stone.

In Mortehoe itself, limestone has also been used for structural purposes and for quoins. This was most probably sourced from nearby, given that limestone is locally interbedded with the Morte Slates. The limestone is pale grey and contrasts with the greenish-grey colour of the Jenny Start Limestone. There is only one active quarry, which is owned by the National Trust and provides for its needs. The cottages at Mortehoe are built of Morte Slate rubble. The boundary walls are also of Morte Slate, with copings of limestone collected from the beach.

Figure 8: Cottages, Mortehoe. Morte Slate rubble.

Group not defined, Pickwell Down Sandstones Formation

Pickwell Down Sandstone

The Pickwell Down Sandstones (Famennian) are of deltaic origin. They form a near-continuous east to west outcrop, running from Morte Bay in the west to Dulverton and the Somerset border in the east.

The maximum width of the outcrop is about 8km, and its form suggests large-scale folding in places. The formation consists of purple, red, brown and greenish-grey, fine to medium-grained sandstone beds, which frequently show current bedding. These sandstones form units up to 3m thick, although most are less than this, and thin micaceous horizons are developed in places. Subordinate interbeds of red and grey shales are locally present, particularly towards the top and bottom of the formation. The actual base of the formation is marked by an occurrence of volcanic rock known as the Bittadon Felsite, or Bittadon Tuff Bed.

The most common form of Pickwell Down Sandstone, from a building stone point of view, is the deep purple variant. This was clearly considered to be a desirable building stone during the 18th and 19th centuries, and it has been used structurally and decoratively in the construction of both high-status and philanthropic buildings.

Devonian-Lower Carboniferous

Exmoor Group, Baggy Sandstones Formation

Baggy Sandstone

This formation is another deltaic sequence. It consists of interbedded, fine-grained, grey or greenish-grey sandstones, siltstones and shales, with thicker buff-coloured, fine and medium-grained feldspathic and micaceous sandstones in places. Owing to their micaceous nature, the sandstones tend to be thinly bedded and, consequently, split into slabs bounded by surfaces corresponding to the bedding planes. Despite its relatively limited outcrop, Baggy Sandstone has been used widely in both the general vicinity of its extraction and beyond, seen commonly in the Barnstaple, Braunton, Georgeham, Woolacombe areas. It was extracted at the now inactive Plaistow Quarry.

Figure 9: St Mary's Church, Croyde. Baggy Sandstone with Bath Limestone dressings.

Exmoor Group, Pilton Mudstone Formation

Pilton Slate

The Pilton Mudstone Formation is a transitional succession spanning the Devonian–Carboniferous boundary. Lithologically, it comprises a complex sequence of interbedded siltstones and sandstones. In the central part of the outcrop and towards its western end, there are thicker developments of hard, grey, fine-grained sandstone, with interbeds of hard, grey, silty shale, which are currently worked in the Bray Valley. The worked horizons comprise relatively thin interbeds of grey, variably flaggy, micaceous sandstone and calcareous siltstone, which alternate with thicker beds (generally up to 2m, or more rarely 4m) of grey, fine and medium-grained sandstone and hard, dark grey mudstone.

Although there is some record of the use of Pilton Slate in buildings, the more durable Pilton Sandstones have seen more extensive use as a local building material. They are still worked at Hearson Quarry, Barnstaple, for walling, rockery and paving stones.

Lower Carboniferous

Group not defined, Milton Abbot Formation

Hurdwick Stone

The Milton Abbot Formation largely comprises accumulations of basaltic lava and volcaniclastic material. This was quarried from small outcrops located to the north and north-west of Tavistock, most notably around Hurdwick Farm (from which the stone name derives).

The rock itself has a distinctive pale green colour and often a rough texture due to its vesicular nature. Unfortunately, the stone does not always weather well and tends to break down over a period of time. It has, nonetheless, been employed in Plymouth and around Milton Abbot, North Brentor and Dunterton, but its most extensive and noteworthy use is around Tavistock, particularly within the Cornwall and West Devon Mining Landscape World Heritage Site. The stone was used for the early 19th-century buildings in the planned townscape created by the Bedford Estate.

Figure 10: Bedford Square, Tavistock. Hurdwick Stone.

Group not defined, Lydford Formation

Lydford Slates

The Lower Carboniferous Lydford Slates have a localised area of use between Lydford, North Brentor and Chillaton. The slates are dark grey in colour, weathering to a brownish grey, and can be distinguished from other slaty rocks occurring nearby by virtue of their micaceous nature.

Upper Carboniferous

Teign Valley Group, Codden Hill Chert Formation

The Teign Chert Formation includes interbedded siliceous mudstone and chert, with local developments of limestone. The lensoid bodies of limestone have been exploited principally as a source of building stone, but they tend to be of limited size and many, for example those at Meldon Pool and Drewsteignton, have been worked out.

Codden Hill Limestone

The Codden Hill Limestones are generally thinly bedded, although some more massive limestones do occur. They have been extensively quarried and there are many examples of their use as a building stone within the area extending from South Molton in the east to Barnstaple in the west, including buildings within Castle Hill estate at Filleigh.

The chert, although hard, is much less suitable as a building stone.

Teign Valley Group, Bampton Limestone Formation, Westleigh Limestone Formation

Westleigh Limestone, Bampton Limestone

The Lower Carboniferous rocks of North and Mid Devon include relatively thin sequences of limestones, assigned to the Bampton Limestone Formation and the Westleigh Limestone Formation. The former comprises thinly bedded and rather impure limestones, interbedded with chert and mudstone. The more limestone-rich parts of the succession were formerly worked for building stone in the area around Bampton, and the eponymous limestone is a locally significant stone in this area. It can be distinguished from the Westleigh Limestone by virtue of its banded and thinly bedded nature, which gives rise to thin blockstone.

The Bampton Limestone passes laterally into the Westleigh Limestone, a unit characterised by generally thicker and more abundant limestone beds. At Westleigh Quarry, beds of pale grey, coarse-grained, sparsely fossiliferous limestone (calcarenite) are developed, with subordinate, mostly thin, interbeds of mudstone and calcareous mudstone. The individual limestone beds vary

in thickness from a few centimetres to 6m, and they show lateral persistence across the quarry faces. Each limestone bed has a sharp basal contact with the underlying mudstone, and many show graded bedding and gradational tops into the overlying mudstones. Westleigh Limestone is a building stone of local significance, but more recently it has been used for repair work and new-build projects over a much wider area due to the lack of other suitable materials.

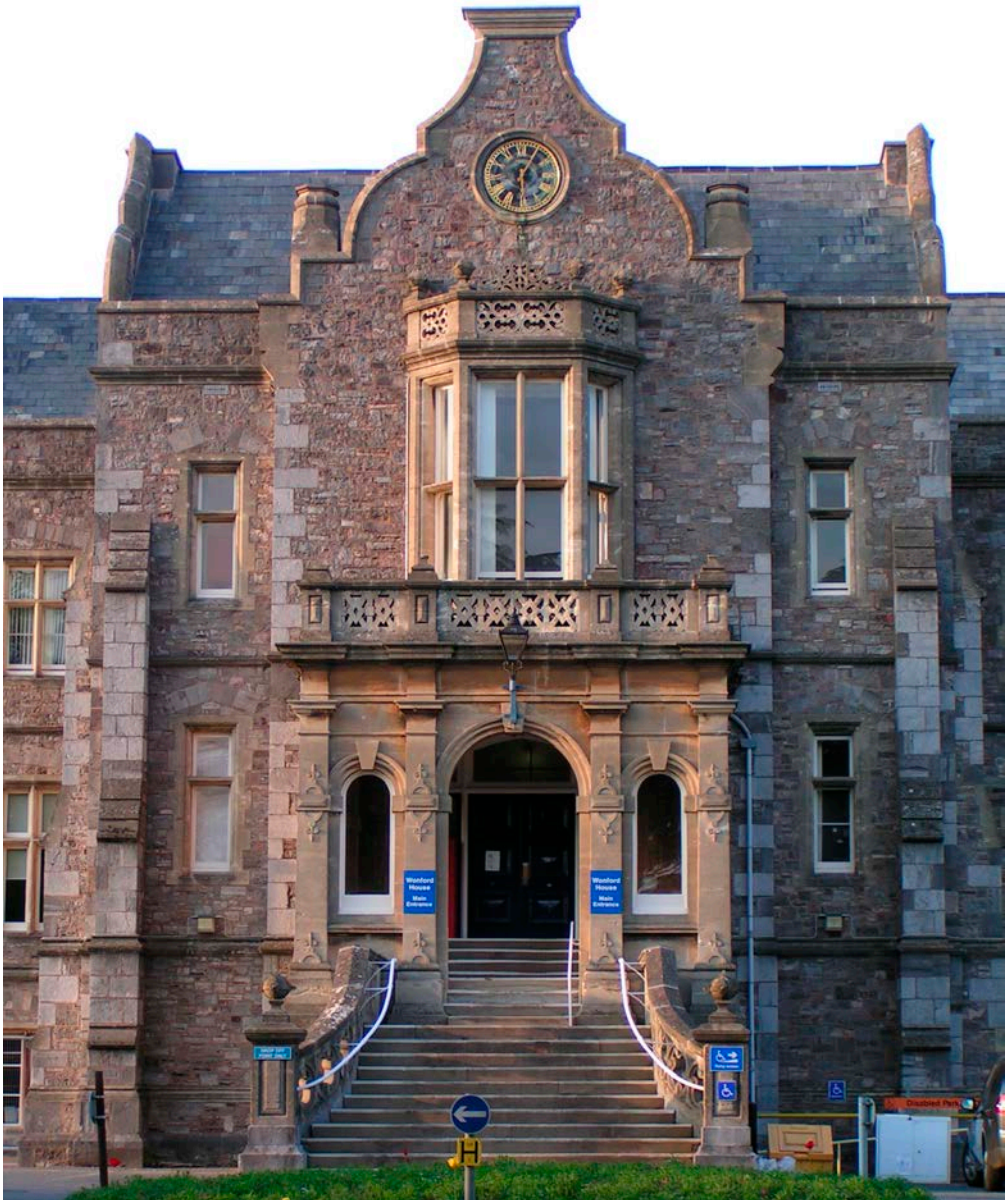

Figure 11: Wonford Hospital, Exeter. Westleigh Limestone walling with Torquay Limestone quoins.

Holsworthy Group, Crackington Formation

Crackington Slate, Crackington Sandstone

The Upper Carboniferous Crackington Formation has extensive outcrops in northern, central and western Devon. In general, it comprises rhythmically bedded, dark blue-grey mudstones and subordinate mainly grey sandstones and siltstones. Individual sandstone beds within the formation show sharp bases with load and groove casts. The sandstones are mostly fine grained and often fine upwards into siltstone; small-scale cross-bedding is present in some units. In certain areas, towards the base of the formation and also near its top, the sandstone beds coalesce to form units more than 1m thick.

The relatively coarse-grained and fine-grained lithologies are informally referred to as 'Crackington Sandstone' and 'Crackington Slate', respectively. Crackington Slate tends to be more common in the northern outcrops of the formation. Broadly speaking, Crackington Sandstone has been used only for walling, and dressed stone is not common.

Holsworthy Group, Bideford Formation

Cornborough Stone

The Bideford Formation is a fairly localised development of shallow water sediments that extends inland, in an easterly direction, for some 27km from the Bideford area. The abundant sandstones of the formation are mostly soft and (in part) feldspathic, and commonly have a 'sugary' texture. Most are fine to medium grained, but coarser layers are present, particularly at the bases of individual beds. The sandstones reach 30m in thickness, but are, in general, much thinner. They feature cross-bedding, mud flake conglomerates, erosive bases and carbonaceous debris.

The most important building stone yielded by the formation is the Cornborough Stone, a hard, dark grey, well-bedded sandstone that is finer grained on average than the sandstones of the Bude Formation. Like the Bude sandstones, it is often crudely cleaved with feathered fracture surfaces in the more massive parts. The weathered colour of Cornborough Stone is darker than that of the Bude Formation and Crackington Formation sandstones.

Holsworthy Group, Bude Formation

Bude Sandstone (Culm Sandstone) including Dark Red Sandstone, Hensley Stone, Brownstone and Cinnamon-coloured Sandstone

The Bude Formation has an extensive outcrop running from the North Cornwall/North Devon coast between Gull Rock and the southern part of Widemouth Bay eastwards towards Tiverton and the Exe Valley.

Lithologically, the Bude Formation differs from the underlying Crackington Formation due to the local presence of thick beds of rather soft, brown-weathering sandstones called Bude or Culm Sandstone. These are typically interbedded with grey or brownish-grey siltstones and mudstones, which are from the predominant 'rough' building stone over the outcrop. They tend to be used principally for rubble walling and are not suitable for quoins or structural work. Near to the base of the formation are hard, turbiditic sandstones, which include beds of the Bude Gritstone. This has generally been used for structural work.

Close to the boundary with the overlying Permian rocks, thick beds of brown, reddish-brown, purplish-brown and greenish-grey or olive-grey, massive, fine to medium-grained sandstone occur, which, individually, can be up to several metres thick. These have yielded the Dark Red Sandstone, Hensley

Stone, Brownstone and Cinnamon-coloured Sandstone, all of which are significant building stones.

Figure 12: Church of St Lawrence, Sheepwash. Bude Sandstone.

Permian

Unnamed igneous intrusions

Halwill Freestone, Hatherleigh Stone, Elvan (Roborough Stone, Greenstone)

Halwill Freestone is of local significance in the Holsworthy area. This is a fine grained lamprophyric rock generally micaceous and often contains 'blisters' of quartz. It is grey in colour, weathering to a brown-grey, and has a tendency to spall. Halwill Freestone has been used primarily for the building of railway bridges and churches, as well as some houses and farms.

Hatherleigh Stone was produced from the numerous quarries that once worked the lamprophyric minor intrusions occurring to the south and south-west of Hannaborough. The name 'Hatherleigh Stone' derives from the town to the north-east where the stone is mainly used. The stone itself is a buff or pale brown, medium-grained rock, which is strong but easily shaped. Some blocks can be quite pitted. The main distinguishing feature is the growth of lichen or, more likely, algae on exposed surfaces. This imparts a pink colour, allowing easy identification even at a distance. Hatherleigh Stone is widely used for quoins and dressings in the churches found around Hatherleigh and for the dressings of the later parts of Okehampton Castle. It has also been used in Winkleigh, South Molton and North Molton, for both quoins and walling.

Elvan Stone, Roborough Stone or Greenstone, are local names used in Devon and Cornwall for varieties of quartz porphyry. The names for this stone are often interchangeable. This is a grey, fine-grained rock with a spotted appearance arising from the sporadic presence of larger quartz and feldspar crystals set within the fine-grained matrix. The stone is soft to quarry but hardens upon exposure to the elements. It was used as a building stone but was also quarried as an aggregate. Elvan Stone use has been mainly confined to churches and other older higher status buildings, particularly to the west and south of Dartmoor. Some rounded stones used in villages to the south-west of Dartmoor have clearly been derived from secondary fluvial sources.

Dolerite (Microgabbro)

Spatially associated with the Dartmoor Granite mass are minor intrusions of dolerite (or microgabbro). A concentration of these intrusions occurs within the Teign Valley. The green-black dolerites of the Teign Valley characteristically develop ochreous crusts and exhibit 'onion skin' weathering. This weathering process frequently creates boulders of hard residual material, which have, historically, been used as walling stone. The Teign Valley dolerites are a significant building stone source in this area, and to a limited extent elsewhere. They feature in both field and house walls, and were frequently used as footings for cob-walled buildings.

Dartmoor Granite Intrusion

The granite of the Dartmoor Intrusion, in its various textural guises, underlies much of the high moorland of Dartmoor. This body was previously considered to be of Permo-Carboniferous age, but modern radiometric dating and revisions to the Permian–Carboniferous boundary age now places it firmly in the Early Permian. The granite formed from molten magma originating several kilometres down in the Earth's crust. This magma gradually penetrated higher crustal levels, then cooled and slowly solidified into the coarsely crystalline rock exposed at the surface today. It is a hard, strong and durable material, and one that takes a good polish, a characteristic that has led to it being widely used in monuments. The use of Dartmoor Granite as a building stone dates back to the Bronze Age.

Blue Granite, Fine-grained Blue Granite

Although coarse grained and mineralogically similar to Giant Granite, Blue Granite contains few or no megacrysts. It is found in the north-west of the Dartmoor massif, south of Okehampton, and in the south-west at Shell Top, north-east of the China Clay workings.

The Fine-grained Blue Granite (or microgranite) was used for fine carved work and it is usually seen as window mouldings in churches, schools and higher status buildings. It was also used for monuments. The Swelltor quarries were one of a number of sources of this stone type.

Giant Granite

Giant Granite is a coarse-grained, grey granite, containing large euhedral feldspar megacrysts (sometimes up to 30 per cent by volume). Quarried at Haytor, Princetown and Merrivale, principally for use outside the Dartmoor area (and indeed the county), it was generally considered to be a stone that was more suited to structural work. It does, however, feature prominently within the Cornwall and West Devon Mining Landscape World Heritage Site around Tavistock.

Figure 13: Dartmoor Prison, Princetown. Giant Granite.

Dartmoor Granite

Dartmoor Granite is composed principally of large milky-white crystals (phenocrysts) of feldspar, which reach 80mm in length and are rectangular in cross-section, set within a matrix of smaller crystals, including quartz and dark brown mica. The Blue Granites do not have well-developed phenocrysts.

The granite was difficult to work prior to the advent of iron tools, but loose stone blocks known as ‘moorstone’ are widely present across the high moorland, and some show clear evidence of attempts at splitting and shaping. In more recent times, the granite has been quarried extensively and it is an important stone not only in the Dartmoor towns, such as Chagford, but also in many churches and high-status buildings located outside Dartmoor. Granite from the Haytor quarries was used, in part, to construct the former London Bridge, with much of the rest of the stone seemingly derived from the quarries near Princetown. Quarrying of Dartmoor Granite, once key to the local economy, has progressively reduced over the past century and is now insignificant. Consequently, supplies of Dartmoor Granite for building and restoration work are limited.

Exeter Group, Thorverton Sandstone Formation, Knowle Sandstone Formation

Thorverton Sandstone, Knowle Sandstones

Sandstones assigned to these two formations are reported to be used for building purposes in and around the villages after which they are named. In the few cases where these sandstones can be identified, such as Thorverton Parish Church, the stone is found to be brick red and rather soft, akin to the younger Dawlish Sandstone. The sandstone is usually associated with lava of the Exeter Volcanic Series, and in some cases it forms inclusions within the lava blocks.

Figure 14: Church of St Thomas of Canterbury, Thorveton. Thorverton Sandstone with Bath Stone dressings.

Exeter Group, Exeter Volcanic Series

Raddon Stone, Thorverton Stone, Posbury Stone, Killerton Stone, Pocombe Stone, Rougemont Stone

The Exeter Volcanic Series comprises extrusive and shallow-level intrusive volcanic rocks that occur at or near the base of the Permian succession lying to the north and west of Exeter. Typically found as small, isolated outcrops, these generally basaltic rocks are best developed around Silverton, Thorverton and Budlake in the north, and around Ide and Dunchideock further south-west. The stones have been widely used for construction purposes across Devon, particularly for higher status buildings, and are an important group of building stones.

Typically, the Exeter Volcanic Series lavas are pink, purple, grey or violet-coloured, fine-grained, vesicular rocks, although local variations occur. The building stones are commonly named after their quarries of origin such as

Thorverton Stone, Posbury Stone, Killerton Stone, Pocombe Stone, and Rougemont Stone. Some buildings include different stone varieties, which are used as decoration or, indeed, at random. The common feature of these rocks is their constituent mineralogy, including the iddingsite (a distinctive red mineral), and the presence of vesicles (gas escape cavities) and/or amygdales (vesicles infilled by a mineral phase).

Rougemont Stone is a dark-coloured rock with vesicles that are variably filled with white carbonate, zeolites, chlorite and other alteration products. Distinctive, random, quartz-filled vesicles and veins run through the stone and the flow alignment can be seen. This was an important building stone, originally sourced from Rougemont Gardens in Exeter. Pocombe Stone shows similar characteristics to Rougemont Stone, except that it is slightly paler purple in colour and has parallel bands of quartz-filled vesicles and veins. It is seen with some regularity in the village of Ide. Posbury Stone is a spotted, dark-coloured rock, with small quartz phenocrysts. It is vesicular and/or amygdaloidal in part, with the vesicles being filled with carbonate or 'clay' minerals. Veining is not prominent. This is the most widely used building stone within the Exeter Volcanic Series.

The Raddon and Thorverton Stones are also dark-coloured rocks, with vesicles and amygdales in part and the vesicles again being filled with carbonate or 'clay' minerals. Raddon Stone tends to have a distinctly pinker colouration. Inclusions of red-brown Thorverton sandstone are often present. These stones are not only the most common building stone type encountered in the Thorverton and Raddon areas, but they have also been used in Cullompton, Down St Mary, Stockleigh English and the Creedy Valley, including in higher status buildings. Despite the relatively limited geographical spread of these stones, they might be considered key Devon building stones simply because of the many buildings in which they are found.

Finally, the Killerton Stone is a dark-coloured, lamprophyric rock containing abundant biotite. It was used in the Killerton and Broadclyst areas, and saw extensive use on the Killerton Estate, including the nearby chapel.

The Exeter Volcanics, generally, were widely used in and around the City of Exeter, in an area extending from Ide in the south-west to Thorverton, the Clyst Valley and Whimple in the east. They are also a minor constituent of buildings over a much larger area, taking in Pitminster in the Vale of Taunton Deane (Somerset), Sidmouth and South Brent. Specific examples include the city walls of Exeter, Rougemont Castle and many of Exeter's churches. The stone was quarried from the Exeter's Rougemont and Northernhay areas in Roman and medieval times. Later buildings in the city employed Pocombe Stone, easily identified by its sub-parallel veins of carbonate, from the quarry at Exonia Park. The pink, highly vesicular lava used for Crediton Church, meanwhile, originated from Posbury Clump. The Bishop of Exeter maintained a quarry at Barley on the outskirts of Exeter from where stone for the interior of the walls of Exeter Cathedral was quarried.

Figure 15: Chapel Of The Holy Evangelists, Killerton. Killerton Stone.

Exeter Group, Heavitree Breccia Formation, Torbay Breccia Formation, Oddicombe Breccia Formation

The Exeter Group principally comprises a series of formations that are dominated by beds of coarse-grained breccia (angular clasts) and conglomerate (rounded clasts). These rocks were locally important as sources of building stone.

It is generally believed that the breccias lying stratigraphically beneath the Newton St Cyres Formation and Heavitree Formation are too soft to be used for building purposes. However, some examples of breccia blocks matching published descriptions of the Bow and the Alphington Breccias have been observed, notably in Bow and in the tower of the Church of St Michael and All Angels at Dunchideock.

Exeter Group, Heavitree Breccia Formation

Heavitree Breccia (Wonford Breccia, Exminster Breccia and Whipton Stone)

The Heavitree Breccia consists of angular clasts of a range of rock types, principally derived from the subjacent formations, set within a matrix of coarse-grained red sandstone. The clasts reach small cobble size and are mainly of low-grade metamorphic lithologies. These include red, brown and black fine-grained sandstones, greywackes, slates and hornfelses, with, in many cases, a significant component of fine and medium-grained igneous rocks and fragments of alkali feldspar. The clasts are angular and poorly sorted. At the scale of a building stone block, the clasts show very little preferred orientation and bedding is generally absent.

The rock has a variable degree of cementation, and the best quality stone (generally, that with a porous sandstone matrix) is well cemented by white calcium carbonate. Individual blocks can be large. Because of the coarse

nature of the stone, these blocks were evidently hard to dress and sometimes have somewhat rounded margins. A common practice when using this stone is to pack out the voids between the rounded blocks with smaller pieces of another stone (galleting).

Heavitree Breccia is widely used in Exeter and nearby parts of eastern Devon, extending southwards as far as Dawlish. It was used in Cathedral Yard, Exeter, in conjunction with Rougemont Stone, which was used for the archway.

Important quarries that produced Heavitree Breccia from the second half of the 14th century onwards are found within modern-day Exeter and its immediate surroundings. These quarries, such as Heavitree, Wonford, Whipton and Exminster, all lend their names to the stone type they produced. The various names are interchangeable, but Heavitree Breccia is the most common.

Figure 16: Cathedral Yard, Exeter. Heavitree Breccia rubble walls. Rougemont Stone ashlar archway.

Sampford Peverell Red Breccio-conglomerate

At Sampford Peverell, Exeter Group breccia was worked for building stone in the old quarries lying close to the A361. It is distinct from the breccias found in buildings elsewhere in Devon. The clasts are angular to rounded, of granule and pebble grade (or, in some cases, cobble sized), and set within a coarse-grained sandstone matrix. Many of the pebbles are oblate, with their long axes tending to lie parallel to and, indeed, defining, the bedding. They are sometimes imbricated. The clasts include fragments of dark red, grey and black sandstone and greywacke, white vein quartz and pale grey limestone; vein quartz is especially abundant. The limestone clasts tend to be better rounded than those of the other lithologies. Fragments of igneous origin appear to be entirely absent, which stands in contrast to the Heavitree and Newton St Cyres Breccias used further south. The matrix is rather muddy, and differential compaction of the mud fraction serves to emphasise the bedding. Breccias of this type have been used for building in the Uplowman, Halberton, Sampford Peverell, Burlescombe, Ayshford area (and also in Bathealton in Somerset), and mostly in and around the first three of these villages. The breccia is also much used for bridges and bank

reinforcement along the Grand Western Canal. The Sampford Peverell Red Breccio-conglomerate may be a correlative of the Cadbury Breccia, lying at the base of the Exeter Group, but the muddy nature of the Cadbury Breccia has precluded its use as a building stone.

Exeter Group, Torbay Breccia Formation, Oddicombe Breccia Formation

Porphyry boulders

Rounded boulders and pebbles of quartzo-feldspathic porphyry have been used for rough walling in and around Dawlish, Teignmouth and Shaldon, and in other nearby villages. These are believed to derive from the Exeter Group breccias of the local area, but they were likely quarried, or, more accurately, gathered, from river or stream sediments, as opposed to being extracted directly from the breccias.

Red Rock Sandstone

A hard, red sandstone distinct from that occurring as bands and lenses within the Permian breccia succession is found at the base of the Torbay Breccia Formation. It is medium grained and, usually, well sorted, and has sub-angular to well-rounded grains. Typically, it lacks bedding or other sedimentary structures, although, at times, bedding is defined by variations in grain size and degree of cementation. The sandstone is composed of quartz grains cemented by calcite. Partial infilling of the voids between the grains by later silica cements has produced patches within the sandstone that have a ‘glassy’ appearance and that sparkle in the sunlight. A small proportion of the blocks of this sandstone encountered during this study are coarser grained, with grains up to granule grade.

The sandstone is widely used for quoins and dressings in medieval and early modern high-status buildings, including many of the churches in the Brixham–Chudleigh–Buckfastleigh–Totnes area. They include Torre Abbey, Buckfast Abbey (medieval parts) and Berry Pomeroy Castle. The local school of Norman font carvers favoured the stone, and it was clearly much sought after in those times due to its workability, toughness, resistance to erosion and attractive appearance.

This sandstone is the main building material of Bishopsteignton, perhaps originating from an outcrop on the slopes just north of the village (although the particular sandstones are now considered to form part of the Heavitree and Alphington Breccias). Red Rock Sandstone is also common in parts of Teignmouth, Ideford and nearby Luton. The pinnacles of St Andrew’s Church at Harberton incorporate a distinctive red sandstone that is believed to be Red Rock Sandstone.

In Brixham, a very large proportion of the walls contain a few blocks of Red Rock Sandstone.

Figure 17: St Mary the Virgin, Churston Ferrers. Red Rock Sandstone quoins.

Torbay Breccia (also known as Paignton Breccia, Nethercombe Breccia, Torre Breccia, Oddicombe Breccia, Teignmouth Breccia and Watcombe Breccia)

These principally red breccias, which crop out in the Teignmouth and Torbay areas, contain prominent clasts of medium and pale grey Devonian limestone, which distinguishes them from the other breccias of the Exeter Group. The clast population, in general, comprises limestone, porphyry, vein quartz, slate, red and black sandstone and greywacke (more or less foliated), grey banded quartzite, schorl and murchisonite.

The clasts are mainly angular, but those of limestone and porphyry may be moderately to well rounded. The bedding, especially in the finer grained horizons, is accentuated by variations in the proportion, average size and/or composition of the clasts. The matrix, meanwhile, is of poorly sorted, fine to coarse-grained sandstone, with variable amounts of siltstone and mudstone, and is carbonate cemented. Quartz grains predominate, with subordinate

feldspar and lithic fragments. The matrix appears red or maroon because of the iron oxide grain coatings. Bands and lenses of pebbly sandstone are variably present.

The Torbay and Oddicombe Breccias are widely used for building in their outcrop areas. Nearly all the houses and garden walls of the Maidencombe area of Torquay are constructed of this kind of red breccia, giving the area a very distinctive character.

Exeter Group, Dawlish Sandstone Formation

Poltimore Sandstone, Dawlish Sandstone

These brick to dark red sandstones shows a wide range of characteristics. They can be fine or coarse grained and are well to poorly sorted. The constituent grains are mainly of sub-angular to sub-rounded quartz, feldspar and lithic fragments. Some sandstones contain a distinctly coarser grained fraction of well-rounded grains with a ‘frosted’ surface finish. The well-sorted varieties may have sparse carbonate cement, whereas poorly sorted varieties may contain pebbles and, indeed, lenses of breccia or conglomerate. Other varieties have a muddy matrix. In general, albeit with a few exceptions, these sandstones are rather soft, and individual blocks in buildings tend to have rounded outlines and surfaces smoothed by erosion.

Poltimore Sandstone is used in a few buildings in Exeter and along the Exe estuary, but it features most prominently around Poltimore and Broadclyst. Thin blocks of this sandstone are used to even up the courses of walls constructed largely of Permian breccia in the Sowton and Clyst Honiton area. Considering the extensive and striking exposures of red sandstone in the Dawlish area, it is used surprisingly little as a building stone in the town itself, perhaps because of its poorly cemented nature.

Figure 18: Bus shelter, Broadclyst. Poltimore Sandstone.

Triassic

The sandstones, pebble beds and mudstones of Devon's Triassic succession are mainly 'red bed' sediments, laid down under tropical desert conditions dominated by wide river floodplains and temporary lakes. At the top of the succession, there are greenish-grey mudstones and limestones, which mark the transition to the marine conditions that largely prevailed during the subsequent Jurassic.

Aylesbeare Mudstone Group, Exmouth Mudstone and Sandstone Formation

Exmouth Sandstone

Although similar in character to the Permian Dawlish Sandstones that crop out on the opposite side of the Exe estuary, sandstones from this formation are less widely used as a building stone. The sandstones are typically mottled in shades of fawn, red and pale pink, and are mainly medium grained and well sorted. There are some less well-sorted, gritty layers that consist of poorly cemented, sub-rounded to sub-angular grains of quartz. These layers are more porous and permeable. A crude bedding fabric is usually present, defined by variations in grain size and colour, and highlighted by variable resistance to weathering. Cross-bedding is visible in some large blocks. This sandstone has been used only locally, presumably due to the availability of other superior building stones close by. The best examples are in the Woodbury–Exmouth area.

Sherwood Sandstone Group, Budleigh Salterton Pebble Beds Formation

Budleigh Buns

The term 'Budleigh Buns' refers to the well-rounded cobbles and pebbles derived from the Budleigh Salterton Pebble Beds. They are mainly grey, yellow, brown and liver-coloured (meta-)quartzite. The Budleigh Buns were an important local source of building material.

The formation includes a small proportion of clasts, usually less well rounded, of dark-coloured tourmalinite. Pebbles are quite widely seen as a decorative finish to walls, carefully selected by size.

Erosion and reworking of the Budleigh Salterton Pebble Beds during the Quaternary have led to their constituent clasts being widely distributed downstream of their outcrops. The use of Budleigh Buns in the coastal towns of East Devon probably reflects their presence in the river gravels and beach shingle of these towns. Although the outcrop of the source unit continues to the north, they have not been used for buildings beyond Plymtree.

Figure 19: Cobble wall, Budleigh Salterton. Budleigh Buns.

Sherwood Sandstone Group, Otter Sandstone Formation

Red Sandstone, Otter Conglomerate

Red sandstone is the most abundant lithology within the Otter Sandstone Formation, and it has been used for building in the Lower Otter Valley. It is typically a medium-grained sandstone, composed of grains of quartz set in sparse calcite cement. Mica is locally present. Bedding is evident in many wallstones, and some blocks show cross-bedding. Rounded edges and corners are a feature of most blocks of this stone.

In the buildings of the Otter Valley, relatively good quality sandstone of the type described above is accompanied by a range of other softer sandstones, composed of quartz grains set within a muddy or marly matrix.

The Otter Conglomerate is a red, occasionally almost black, comprising rounded muddy sandstone fragments of up to 30mm in size, set within a medium-grained, calcareous sandstone matrix. Many of the blocks of this stone seen in buildings also include some angular fragments and pebble size stones of harder sandstone, greywacke and hornfels derived from the Devonian and Carboniferous successions. Usually, the conglomerate has pronounced bedding defined mainly by the alignment of the fragments in the rock. Being softer than the matrix in most cases, these fragments weather out and give the rock a curious pock-marked appearance. The Otter Conglomerate is easily distinguished from the Budleigh Salterton Pebble Beds lithologies because the latter are too poorly cemented to be used.

Otter Congolmerate is employed for building in the Lower Otter Valley as far north as Ottery St Mary and Feniton. This would appear to be the limit of its use. As a rule, only the individual pebbles (Budleigh Buns) are incorporated into buildings.

Figure 20: Church of St Mary, Ottery. Otter Conglomerate.

Lower Jurassic

Lias Group, Blue Lias Formation

Blue Lias Limestone

Limestones and mudstones of Lower Jurassic age are present only in the extreme east of Devon, cropping out along the Dorset coast near Lyme Regis and inland to the north and east of Axminster and into Somerset.

Blue Lias Limestone is perhaps best known as a building stone in Somerset, however there are small developments in Devon that extend southwards as a discontinuous series of inliers, through the Blackdown Hills, and continue through Axminster and Uplyme to the south coast. None of these Devon outcrops are quarried today.

Blue Lias Limestone is a grey or pale yellow-brown, fine-grained, soft, muddy limestone that sometimes contains fossils. Hard, blocky limestones of no more than 150 to 300mm thick are interbedded with softer, more thinly bedded, argillaceous limestones. The building stones principally come from the blocky limestone beds. When fresh, the rock is dark to light grey, but it weathers fawn or buff. Blue Lias Limestone is not very durable over the long term, and most of the locally produced stone shows signs of weathering.

Cretaceous

Selborne Group, Upper Greensand Formation

The Upper Greensand Formation was deposited in warm, shallow, tropical seas, which contained an abundance of life. It is well exposed in eastern Devon, especially along the Sidmouth sea cliffs, and inland in the Blackdown Hills, and in the Haldon Hills west of Exeter. The formation reaches 50m in thickness.

The greensand gets its name from the slightly greenish colour imparted by the iron-bearing silicate mineral glauconite. When exposed to the elements, however, it is commonly oxidised to a rusty yellow or brown colour. Fossils including molluscs, brachiopods, echinoids, ammonites, foraminifera and fish teeth are common in these rocks.

Grey Glauconitic Sandstone

This very coarse to medium-grained, grey or yellowish sandstone consists of sub-rounded quartz and subordinate calcite grains, with scattered greenish glauconite and/or black iron oxide grains. Hard and well-cemented, friable, dark grey and compact varieties all occur. In the Sidmouth area, the sandstone is very soft and tends to form rounded cobbles and boulders. In contrast, in the Combpyne Rousdon–Lyme Regis area, the sandstone tends to be coarse grained and well cemented. In general, however, the rubbly and coarse-grained nature of Grey Glauconitic Sandstone makes it less useful as a building stone.

Green Glauconitic Sandstone

This is a green-grey to pale brown-coloured, medium-grained sandstone, composed mainly of angular quartz grains with disseminated, rounded, green glauconite grains (often weathering black). The framework is cemented by chalcedonic silica, but may be highly porous with many voids. The combination of angular quartz grains and irregular cement distribution gives the rock a very rough, ragged appearance. Some blocks are rich in acicular sponge spicules, and some contain distinctive, scattered, orange-stained millet seed quartz grains. Where the glauconite is disseminated and the siliceous cement well developed, the surface of the rock tends to have a ‘compact’, glassy appearance and the individual clastic grains are barely discernible. Some surfaces are characterised by a pimply appearance.

Wallstone blocks are generally small (about the same size as a standard brick), irregular and often lack obvious bedding. However, large slabs of this sandstone (usually with a crude, but well-defined bedding fabric) were used for the dressings, and especially the quoins, of medieval churches, and this rock type was clearly prized. Lichen and moss tend to thrive on Green Glauconitic Sandstone and, although this obscures the nature of the rock beneath, this is, in fact, one of its secondary characteristics.

Figure 21: Church of St Paul, Honiton. Green Glauconite Sandstone and Beer Stone tracery.

Green Glauconitic Sandstone has a well-defined distribution on the western slopes of the Blackdown Hills, extending from Blackborough as far south as Whimple and Combe Raleigh. It is also found in the Lower Sid Valley. It is far less common on the tops of the Blackdown Hills. This distribution closely matches the localities where siliceous Devonshire Batts (whetstones) were formerly mined. The distribution further south would suggest that the building stone was widely transported as a by-product of whetstone mining. The Green Glauconitic Sandstone is another key vernacular building stone in the county. It was used in the walling, with Beer Stone in the tracery, at the Church of St Paul at Honiton.

Malmstone (Whitestaunton Stone)

This is a rather porous, light grey, medium-grained, calcareous sandstone of late Albian age. It consists of poorly sorted grains of translucent quartz and chalky calcite sparsely cemented by powdery calcite. The proportions of quartz and calcite grains vary, and varieties in which one greatly predominates over the other are common. Green glauconite and black iron oxides derived from it are common components of this stone. Bedding is evident in many blocks, usually poorly defined by variations in grain size, clast composition, degree of cementation and colour. The presence of the fine-grained carbonate cement encourages the growth of a characteristic crimson lichen or alga (especially on north-facing walls), which can help to distinguish this stone from those originating from the Permian and Triassic successions.

The Malmstone or Whitestaunton Stone was formerly quarried around Whitestaunton, Chard, Tytherleigh and Chaffcombe on the Devon–Somerset border, where it features widely in buildings. Its presence is restricted to areas where the Upper Greensand Formation is overlain by the Chalk Group. The stone is of good quality and is easily dressed. It was used for quoins and dressings throughout the Blackdown Hills and beyond.

Salcombe Stone

Salcombe Stone is a fawn, grey-weathering, medium to coarse-grained calcareous sandstone. It is composed of poorly sorted, sub-rounded to sub-angular clasts of calcite, with subordinate quartz grains, cemented by porous carbonate. Around Chard, close to the Somerset–Devon border, there is a gradual increase in the proportion of fine-grained carbonate cement, an increase in the proportion of quartz clasts and a consequent loss of the distinctive colour of true Salcombe Stone. It is often still difficult to tell these varieties apart, however, and there is likely to be a substantial overlap in the use of the stone originating from the two areas.

Salcombe Stone is widely used for building around the source quarries at Salcombe and Dunscombe, near Sidmouth. Most famously, it is the main building stone of Exeter Cathedral. The traditional quarries have been reopened from time to time for repairs to the cathedral and other local churches (notably at Salcombe Regis), but there is no on-going production. Due to the local use of the stone in high-status buildings in Devon, Salcombe Stone is considered to be a key building stone.

Calcareous Grit

This is a medium to fine-grained calcarenite, composed of sub-angular grains of carbonate set within a finer grained calcareous matrix. The rock weathers to a pale grey colour, with the carbonate clasts standing out from the matrix. The Calcareous Grit bears some resemblance to Beer Stone, which, when not affected by spalling, may also show carbonate clasts standing proud of the grey weathered surface. The Calcareous Grit was commonly used in

buildings in association with Beer Stone. For example, in several churches in the Newton Abbot area, Beer Stone is used for the dressings and Calcareous Grit blocks for the quoins. Calcareous Grit often resembles Beer Stone wallstone blocks.

Chalk Group, Holywell Nodular Chalk Formation

The Chalk Group is largely composed of chalk, with layers and nodules of flint. In Devon, this unit is around 100m thick, and it forms a rounded elevated plateau inland and spectacular high cliff at the coast. The chalks crop out in the upper parts of the sea cliffs and also inland within an area to the east of Sidmouth, notably around Branscombe and between the mouth of the River Axe and Lyme Regis. The best exposures are provided by the cliffs at Beer. Away from the coast, the chalks are most extensively developed near Membury.

The chalks themselves comprise the remains of coccoliths and other microscopic algae. Larger fossils are abundant and include bivalves (molluscs) and echinoids (sea urchins).

Beer Stone, Sutton Stone

The name ‘Beer Stone’ applies to a development of hard, homogeneous, white or pale cream-coloured chalk occurring within the Holywell Nodular Chalk Formation at the base of the local Chalk Group succession. It is particularly suitable for use as freestone. When freshly quarried, the stone is soft and easily sawn and shaped, but it hardens on exposure to the air. The beds are around 5m in thickness and the stone has been worked in both surface quarries and underground. When used externally, it tends to suffer from flaking, but because of its general characteristics, it was much sought after and used for decorative work.

The qualities of Beer Stone have been known since at least Roman times. The main workings are at the Beer Quarry Caves between Beer and Branscombe. There is evidence of both Roman and Norman activity within the more recent early 20th-century excavations. The location of the quarries, near to the coast, enabled the stone to be shipped much further afield, and Beer Stone was used in many cathedrals and parish churches, including Westminster Abbey, London, Rochester Cathedral, Kent, and Windsor Castle, Berkshire. More locally, it has been used in Exeter Cathedral and Guildhall, and in many of Devon’s parish churches. In Beer, it has also been used for wallstone in houses and cottages. Given its widespread use in some of the most important buildings in Devon, and southern England generally, Beer Stone can be regarded as one of the county’s primary building stones.

Until recently, a small amount of Beer Stone was extracted from a surface working located along Quarry Lane, after the overlying chalk was removed. In addition, some material was worked underground in the caves there.

Sutton Stone, originating from Sutton Quarry near Offwell, is similar to Beer Stone. It was used for local buildings in the Widworthy–Offwell area of eastern Devon.

Figure 22: Quarry caves, near Beer. Beer Stone.

Flint

Flint nodules, composed of dark grey or black cryptocrystalline silica, have, generally been used as decorative material rather than structural purposes. The flints may have been obtained directly from the Chalk Group or in reworked form from superficial deposits of Tertiary or Quaternary age.

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.

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Figures

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