Historic England

Durham, Tyne and Wear, and Tees Valley

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 Andy King (Geckoella Ltd).

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Front cover: Stone buildings on The Bank, Barnard Castle. Stainmore Formation Sandstone. © David Taylor Photography / Alamy Stock Photo.

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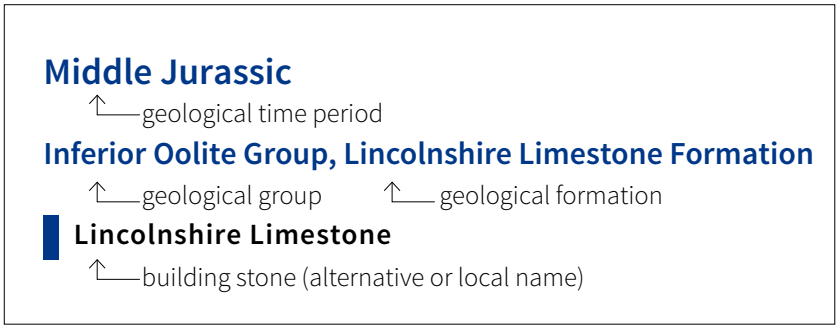
How to Use this Guide

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 and local authority areas of Durham County Council; Gateshead, Newcastle City, North Tyneside, South Tyneside, Sunderland, the Tees Valley Combined Authority; Darlington, Hartlepool, Middlesbrough, Redcar and Cleveland, and Stockton-on-Tees.

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1 Introduction

The oldest rocks occurring within the area covered by this guide are Ordovician slates assigned to the Skiddaw Group, although these are restricted to a very small inlier in Upper Teesdale. The bedrock geology of County Durham and Tyne and Wear is dominated by Carboniferous sediments, which extend all the way from Whitley Bay (in north-eastern Tyne and Wear) to Bowes (in south-western County Durham). These Carboniferous strata can conveniently be split into three distinct groups: Lower Carboniferous limestones and sandstones (Melmerby Scar Limestone Formation and Alston Formation), which crop out in western County Durham in the Teesdale and Barningham areas; Upper Carboniferous sandstones and 'grits' (Stainmore Formation), which occur in western and central County Durham; and the mixed lithologies of the Pennine Coal Measures Group, which cover an area taking in Tynemouth, Gateshead, Durham, Bishop Auckland, Tow Law, Consett, Newcastle, and Whitley Bay.

East of a line from South Shields to Gainford, the geology is younger and comprises sequences of Permian dolostones (the former Magnesian Limestone) and Permo-Triassic sandstones and mudstones, which extend east into Tees Valley. Much of the geology of the eastern Tees Valley area is Jurassic, with sequences extending through Liassic mudstones and sandstones (Staithes Sandstone Formation), into Middle Jurassic ironstones and sandstones, the Ravenscar Group and the Saltwick, Cloughton and Scalby formations.

The Carboniferous sediments have been intruded by a number of distinct igneous rocks. The Great Whin Sill crops outs in the Middleton-in-Teesdale area and gives rise to some of the best-known and most dramatic landscape features of Teesdale. The most extensive of the natural exposures are the sombre cliffs of Crossthwaite, Holwick and Cronkley Scars, and the waterfalls of High Force, Low Force and Cauldron Snout. In northern Tyne and Wear and central County Durham, a series of broadly east to west trending dolerite dykes of Tertiary (Palaeogene) age intrude the Carboniferous sediments. The latter have been much exploited for use as roadstone and aggregate.

Many Carboniferous sandstones and limestones have been quarried for building stones, roofing slates, walling and flagstones. The many abandoned quarries testify to the levels of former working. Despite the extent of quarrying in the past, huge reserves of Carboniferous sandstones and limestones remain in place.

The Roman Arbeia Fort at South Shields serves as one of the earliest examples of stone use within the area. The Romans quarried Permian Magnesian Limestone (Raisby Formation) from Trow Quarry for this structure, which became the maritime supply fort for Hadrian's Wall. Sandstones within the Stainmore Formation, the lower part of the Pennine Lower Coal Measures Formation and particular units within the Pennine Middle Coal Measures Formation (such as the Durham Low Main Post, High Main Post, Seventy Fathom Post and Grindstone Post sandstones) have all provided hard, high-quality building and dimension stone.

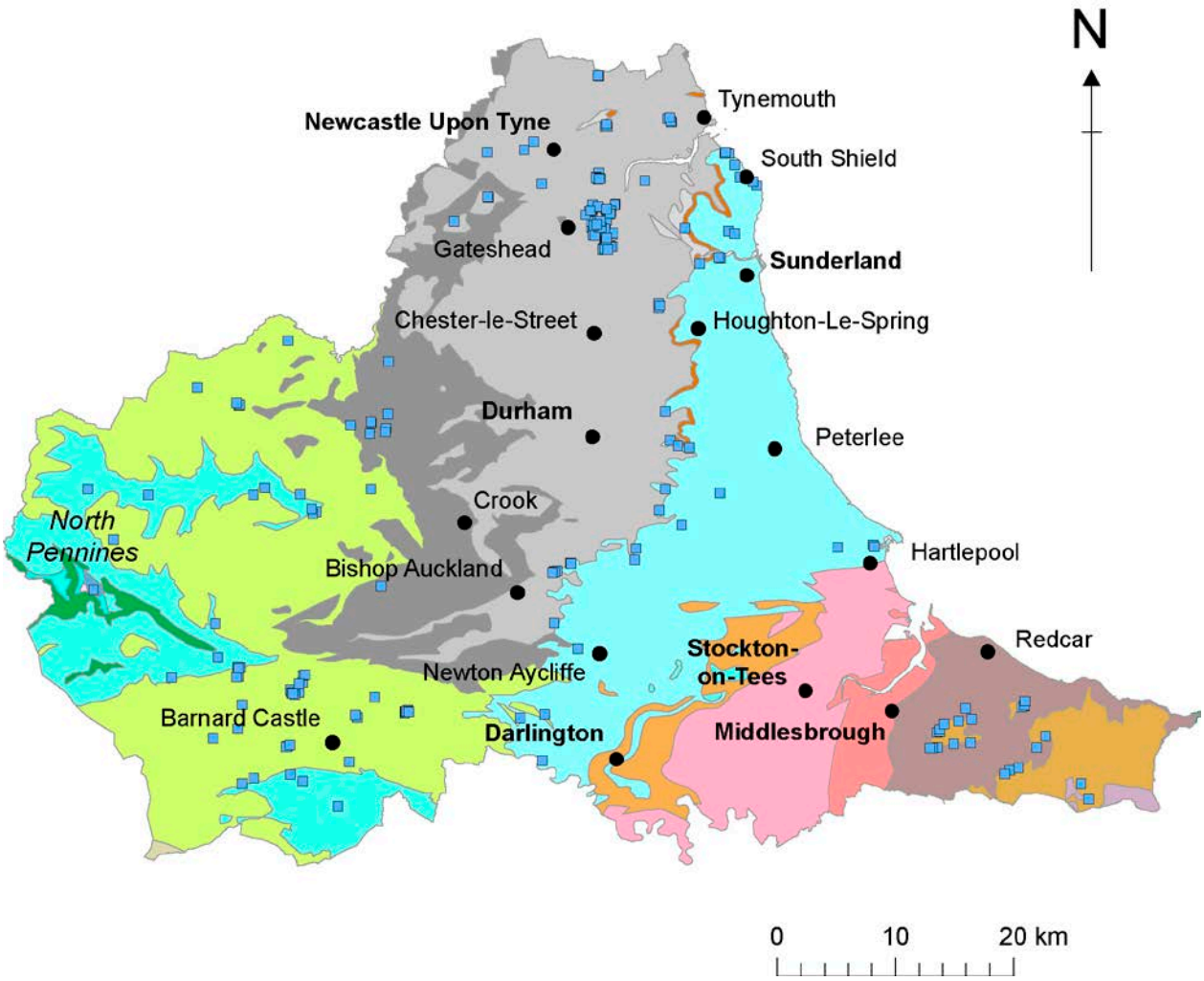
Some sandstones are well cemented with silica, producing a ganister-like rock, and these beds were formerly quarried for use as refractories. The Grindstone Post Sandstone was used in the manufacture of grindstones, with the bulk of the production having come from quarries east of Wrekenton.

Jurassic sandstones in Cleveland, especially Ravenscar Group sandstones, have also been fairly extensively quarried as a source of local building stone. In places, the strata were sufficiently iron rich for a large iron-working and smelting industry to become established.

Magnesian Limestone was quarried for lime burning in Durham from the mid to late 18th century, and in the early 19th century, in response to the increasing demand from agriculture. A number of new quarries in the Raisby Formation were opened. The rocks from these quarries were also used for building purposes, and many of the early settlements along the Permian escarpment (from Hetton-le-Hole to Ferryhill) were built of these dolomitic limestones and dolostones.

In the mid-19th century, a number of additional quarries were opened to provide Magnesian Limestone for the specialist needs brought about by the Industrial Revolution, including flux for iron making, dolomite for fire bricks and magnesia for chemical purposes. Today, a number of large quarries continue to provide sand and aggregate for the construction industry, and both active and disused workings occupy prominent sites on the escarpment.

Bedrock Geology Map



Key

Building stone sources

Bedrock geology

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

Ravenscar Group — sandstone, siltstone and mudstone

Lias Group — mudstone, siltstone, limestone and sandstone

Triassic Rocks (undifferentiated) — mudstone, siltstone and sandstone

Triassic Rocks (undifferentiated) — sandstone and conglomerate, interbedded

Permian Rocks (undifferentiated) — sandstone and conglomerate, interbedded

Permian Rocks (undifferentiated) — mudstone, siltstone and sandstone

Zechstein Group — dolomitised limestone and dolomite

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

Pennine Middle Coal Measures Formation and South Wales Middle Coal Measures Formation (undifferentiated) — mudstone, siltstone, sandstone, coal, ironstone and ferricrete

Pennine Lower Coal Measures Formation and South Wales Lower Coal Measures Formation (undifferentiated) — mudstone, siltstone, sandstone, coal, ironstone and ferricrete

Millstone Grit Group — mudstone, siltstone and sandstone

Yoredale Group — limestone with subordinate sandstone and argillaceous rocks

Yoredale Group — limestone, sandstone, siltstone and mudstone

Dinantian Rocks (undifferentiated) — limestone with subordinate sandstone and argillaceous rocks

Unnamed igneous intrusion, Carboniferous to Permian — mafic igneous-rock

Ordovician Rocks (undifferentiated) — mudstone, siltstone and sandstone

Unnamed extrusive rocks, Ordovician — mafic lava and mafic tuff

Stratigraphic Table

Geological timescale	Group	Formation	Building stone	Page
Tertiary (Palaeogene)	North Britain Palaeogene Dyke Suite	Armathwaite-Cleveland Dyke	Cleveland Dyke Rock	26
Jurassic	Ravenscar Group (Estuarine Series)	Scalby Formation	Scalby Sandstone	25
		Scarborough Formation		
		Saltwick and Cloughton Formation	Saltwick and Cloughton Formation Sandstone	25
	unassigned	Dogger Formation	Dogger Sandstone	24
	Lias Group	Whitby Mudstone Formation		
		Cleveland Ironstone Formation	Cleveland Ironstone	25
		Staithes Sandstone Formation	Staithes Formation Sandstone	24
		Redcar Mudstone Formation		
Triassic	Penarth Group	not differentiated		
	Mercia Mudstone Group	not differentiated		
	Sherwood Sandstone Group	not differentiated		
Permian	Zechstein Group	Roxby Formation		
		Seaham Formation	Upper Magnesian Limestone	22
		Roker Formation		
		Ford Formation	Middle Magnesian Limestone	21
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Permo-Carboniferous	Whin Sill Complex	Great Whin Sill	Whinstone	18

Geological timescale	Group	Formation	Building stone	Page
Carboniferous	Pennine Coal Measures Group	Pennine Upper Coal Measures Formation	Upper Coal Measures Sandstone	17
		Pennine Middle Coal Measures Formation	Middle Coal Measures Sandstone (Durham Low Main Post Sandstone, High Main Post Sandstone, Seventy Fathom Post Sandstone, Grindstone Post Sandstone, Clousden Hill Sandstone)	15
		Pennine Lower Coal Measures Formation	Lower Coal Measures Sandstone	13
	Yoredale Group	Stainmore Formation	Stainmore Formation Sandstone (Firestone Sill, Tanhill Grit, Grindstone Sill, High Grit Sill), Stainmore Formation Limestone (Whitehouse Limestone, Crag Limestone, Lower Felltop Limestone)	11
		Alston Formation	Peghorn Limestone, Smiddy Limestone, Jew Limestone, Tynebottom Limestone, Maize Beck Limestone, Cockleshell Limestone, Scar Limestone, Five Yard Limestone, Three Yard Limestone, Four Fathom Limestone, Frosterley Marble, Great Limestone	8
	Great Scar Limestone Group	Melmerby Scar Limestone Formation	Melmerby Scar Limestone	7
Ordovician	Skiddaw Group	various	Skiddaw Slate	7

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

2 Local Building Stones

Ordovician

Skiddaw Group, various formations

Skiddaw Slate

In County Durham, Ordovician rocks crop out in a very restricted area (the Teesdale inlier) beneath Cronkley and Widdybank Fell in Upper Teesdale. The outcrop probably extends to a few square kilometres, but much of this is concealed beneath superficial deposits, and exposures are mainly limited to a handful of small sites along the River Tees. Rocks belonging to the Skiddaw Group consist of fine-grained, pale grey to greenish-grey slates and metamudstones, which locally contain thin gritty laminae.

Slates from the Skiddaw Group have been worked very locally for building (including roofing) purposes at Greenhill Quarry in Forest-in-Teesdale. The softer slates were formerly worked at Pencil Mill for the manufacture of slate pencils.

Carboniferous

Great Scar Limestone Group, Melmerby Scar Limestone Formation

Melmerby Scar Limestone

In County Durham, these rocks are confined to a limited area in Upper Teesdale, between Langdon Common and High Force. They consist of fine-grained, pale grey limestones and grey-brown sandy limestones, with bands of shaly mudstone and sandstone. Some of the limestones are oolitic and weather a distinctive ochreous colour. The lower basement beds rest unconformably on older rocks and comprise conglomerates and breccias (with pebbles of Skiddaw Slate, vein quartz and tuffs), purple-red and green mudstones and siltstones.

The coarser beds are commonly cross-bedded with erosive bases, whereas ripple marks and plant debris characterise the finer beds. Some of the individual limestone beds are up to 6m thick and exhibit a saccharoidal texture.

The Melmerby Scar Limestone Formation was worked locally in small quarries and used either as building stone or for making lime, for both agricultural and building purposes.

Yoredale Group, Alston Formation

Peghorn Limestone, Smiddy Limestone, Jew Limestone, Tynebottom Limestone, Maize Beck Limestone, Cockleshell Limestone, Scar Limestone, Five Yard Limestone, Three Yard Limestone, Four Fathom Limestone, Frosterley Marble, Great Limestone

The Alston Formation of Asbian to Pendleian age crops out in two areas of western County Durham. The larger area extends from Frosterley via Stanhope, Rookhope, Westgate and St John's Chapel through Teesdale (Newbiggin, Middleton-in-Teesdale) and into the Romaldkirk area. To the west, the formation continues as far as the county border. A smaller area of Alston Formation strata is also present in southern County Durham, to the south of Bowes and extending to the border with North Yorkshire and the eastern Pennines.

The Alston Formation consists of a succession of regular, well-developed Yoredale-type cyclothems, comprising bioclastic (biomicritic) limestones, sandstones, mudstones, siltstones and rare coals. Limestones are the most widespread and consistent of the lithologies, and they are often bituminous and generally dark grey to almost black in colour. They show an overall upward change from massive, fine-grained wackestones with a notable algal component, to current-bedded crinoidal packstones and grainstones. Most of the limestones are less than 5m thick (with the exception of the Great Limestone) and they are laterally persistent over many kilometres, enabling reliable correlations to be made with equivalent limestones in adjoining counties. Some exhibit current-bedded structures.

Clastic horizons within the Alston Formation are highly variable, ranging from calcareous and silty mudstones with ironstone nodules, to silty, flaggy sandstones and medium-grained sandstones. The latter are composed of sub-angular quartz grains, commonly contain abundant rootlet traces and have a strong siliceous cement. They are often ripple marked or cross-bedded and exhibit erosive bases.

Historically, the Alston Formation in County Durham has been much exploited and worked locally in many small quarries, either for building stone or for lime making, for both agriculture and building. It has been worked as a building and dimension stone at Brignall Banks Quarry and Lunedale Quarry, and also at Laithkirk. There are also numerous quarries within the formation at Barningham, Boldron, Cowshill, Eastgate, Forest-in-Teesdale, Gilmonby, Grains o'th' Beck, Ireshopeburn, Middleton-in-Teesdale, Scargill, St John's Chapel, Stanhope and Westgate.

Barningham village school and Barningham Park provide typical examples of the use of Alston Formation lithologies for building purposes, and they are likely to have used Great Limestone in at least part of their construction. A quarry was opened in the grounds of Barningham Park to provide a convenient source of building stone for the main house and stables.

The Great Limestone crops out in the western half of County Durham, and it is well exposed on the sides of many of the valleys and along the Pennine escarpment. The limestone consistently fringes the outcrop of the overlying Stainmore Formation, and extends more or less continuously from the northern edge of the county (west of St John's Chapel and Westgate), via Stanhope and Middleton-in-Teesdale, to the southern boundary, south of Barnard Castle, and east and south of Bower.

The Great Limestone is typically 20 to 22m thick and comprises bluish-grey, slightly bituminous, bioclastic limestones (packstones), in which small fragments of fossil crinoids are usually abundant. Complete or fragmentary shells of brachiopods and bivalves are locally conspicuous, and, in places, solitary and colonial corals are common. The member is typically developed as thick limestone beds known to local quarrymen and miners as 'posts',

Figure 1: Village Hall (former school), Barningham. Great Limestone.

Figure 2: Barningham Park. Great Limestone.

which vary from a few centimetres to almost 2m in thickness. The uppermost 4.5m of the member comprise well-marked posts of limestone separated by persistent dark grey shales or mudstone interbeds of up to 0.6m in thickness. Shelly sandstone units also occur and are useful as correlative horizons.

The Great Limestone is the thickest and most extensive limestone within the Carboniferous succession in County Durham, and it has been quarried extensively for building stone and crushed aggregate. Abandoned quarries are conspicuous features in the landscape of Weardale around Stanhope and Frosterley. One particular horizon – the Frosterley Marble – is a very dark grey, almost black colour, and it contains abundant fossil corals and brachiopods. It takes a high polish and is used in interior ornamental work. The Great Limestone is also of economic importance as a host for mineral deposits.

The Great Limestone has been quarried as a building and dimension stone at numerous quarries, including at Boldron, Egglestone, Frosterley, Gateshead, Stanhope, Lunedale, Mickleton, Middleton-in-Teesdale and Wearhead. It was also worked at Barningham, Bowes, Cowshill, Eastgate, Gilmonby, Grains o'th' Beck, Hutton Magna, Ireshopeburn, Lanehead, Newbiggin, Rokeby Park, Rookhope, Scargill, St John's Chapel, Westgate, White Kirkley and Whorlton.

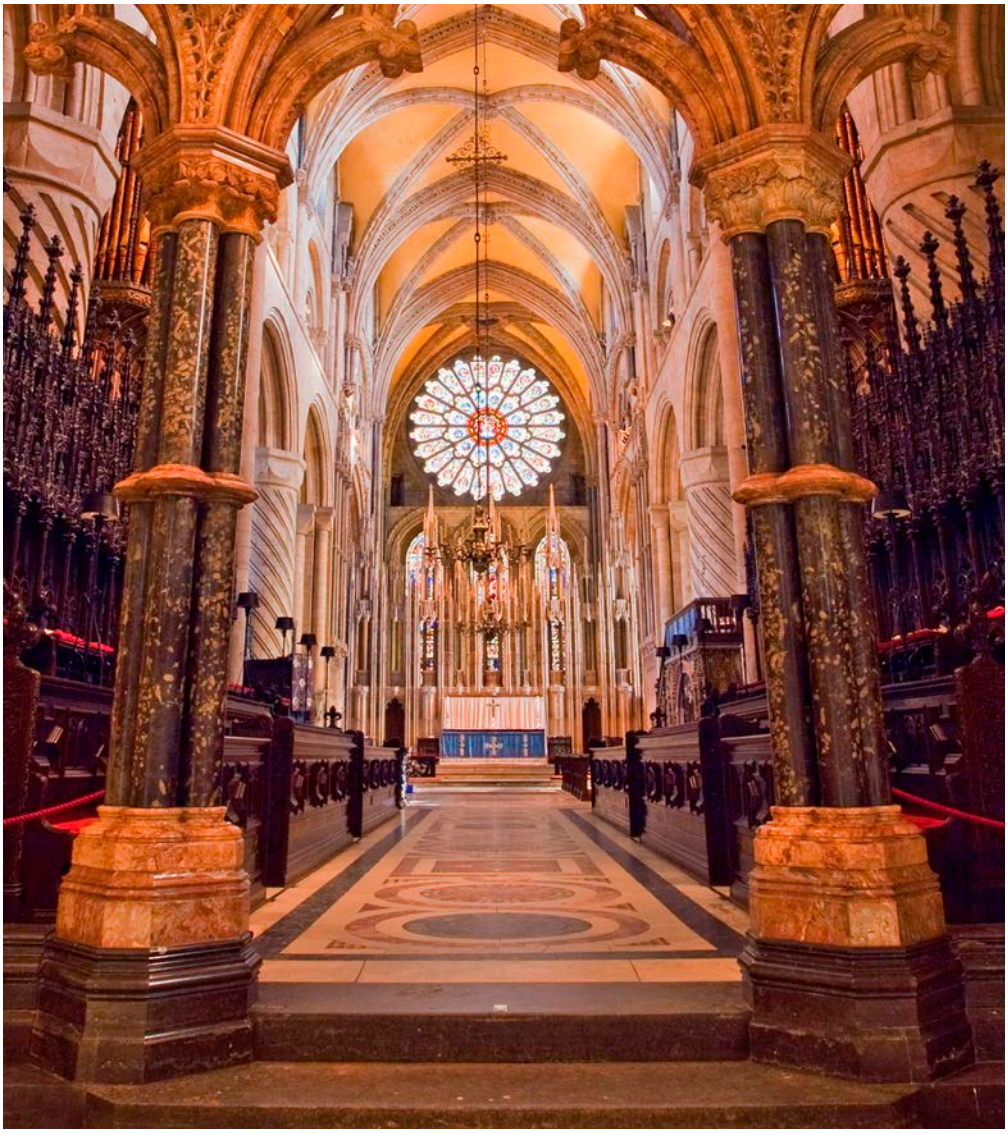

Figure 3: St Peter's Chapel, Durham Cathedral. Frosterley Marble columns.

Yoredale Group, Stainmore Formation

Stainmore Formation Sandstone (Firestone Sill, Tanhill Grit, Grindstone Sill, High Grit Sill)
Stainmore Formation Limestone (Whitehouse Limestone, Crag Limestone, Lower Felltop Limestone)

The Stainmore Formation accounts for approximately 40 per cent of the bedrock geology of County Durham. It crops out extensively in the central and western parts of the county, where it underlies a significant proportion of the open moorland fell country that typifies much of the northern Pennines.

It extends from the northern to southern borders of the county, west of a line marked approximately by Castleside, Wolsingham, Hamsterley, Eggleston, Staindrop and Gainford.

The formation comprises a cyclical succession of thin limestones, sandstones, siltstones, mudstones and thin coals, which shares similarities with the lithologies of the underlying Alston Formation. Like the Alston Formation limestones, the Stainmore Formation limestones are medium-grey biomicrites and biosparites, in which scattered shell and crinoid fragments are locally common and often visible on weathered surfaces. The Stainmore Formation limestones, however, typically contain a greater proportion of clay and silt than those from the Alston Formation.

A significant amount of the Stainmore Formation is made up of sandstones. Most are fine to medium grained and micaceous, and often carbonaceous. At some levels, there are intervals of coarser grained sandstones (locally termed ‘grits’), which are up to 20m thick. Basal beds overlying the Great Limestone (Alston Formation) are often chert rich.

Figure 4: Westend cottages, Wolsingham. Stainmore Formation Sandstone.

Figure 5: Church of St Mary and St Stephen, Wolsingham. Stainmore Formation Sandstone.

A number of individual limestone and sandstone beds within the Stainmore Formation have been named by quarrymen and miners (for example, Whitehouse Limestone and Grindstone Sill).

Stainmore Formation sandstones have been quarried extensively across their outcrop. In many places, the formation has been worked from small pits that were opened as a source of local building stone and for constructing the many miles of drystone walls that are such a distinctive element of the Dales landscape. The chert-rich beds in the area around Bowes also provided local building stone, but they were mainly quarried as a source of chippings for road surfaces.

The formation has been quarried for building and dimension stone at Barnard Castle (Stainton Quarry), Bishop Auckland (Dunhouse Quarry), Bowes, Edmundbyers, Eggleston, Frosterley, Kinninvie (including Howe Gill Quarry and Shipley Banks Quarry), Lartington, Marwood, Mickleton, Staindrop (Dunn House Quarries), Stainton, Stanhope (Dead Friars Quarries), Startforth (Cat Castle Quarry) and Wolsingham. Other quarries within the Stainmore Formation were located at Eastgate, Middleton Common, Newbiggin, Romaldkirk, Waskerley and White Kirkley.

Figure 6: Demesnes Mill, Barnard Castle. Stainmore Formation Sandstone.

Thick sandstone units (notably the High Grit, Low Grit, Grindstone and Firestone Sills) were quarried at Bollihope, Cowshill, Hunstanworth, Middleton-in-Teesdale, Rookhope, St John's Chapel and Westgate. Limestone units (such as the Crag and Lower Felltop Limestones) were worked at Crawleyside, Startforth, Whorlton and Wolsingham.

Pennine Coal Measures Group, Pennine Lower Coal Measures Formation

Lower Coal Measures Sandstone

The Pennine Lower Coal Measures Formation occupies a broad north to south trending band in west-central County Durham, extending from Ebchester and Consett in the north, via Satley, Tow Law and Crook, to Woodland and Cockfield in the south. The formation also crops out along the western edge of Tyne and Wear, where the strata (much concealed beneath Quaternary sediments) extend via Blaydon and Whickham towards Newcastle-upon-Tyne.

The sequence includes grey to yellow-brown-coloured sandstones, siltstones, mudstones and coals (the last become thicker in the upper parts of the sequence). The sandstones vary from massive or thick bedded to flaggy, but they are typically medium to coarse grained and cross-bedded. They are often micaceous and carbonaceous, and occasionally contain elongate ferruginous concretions or mudstone clasts. The basal parts of sandstone units are sometimes conglomeratic or feldspathic. Many of the sandstones are tough and durable and they make excellent building stones; some are extremely hard and quartzitic and ganister-like in nature.

Lower Coal Measures sandstones were quarried extensively, albeit on a relatively small scale, for building stone and roof flags across the outcrop. They have been worked for building and dimension stone at several quarries in the Rowlands Gill, Satley and Salters Gate areas (including the Butsfield, Drovers Roadside, Quickburn and Woodburn quarries).

Figure 7: Cutlers' Hall, Consett. Lower Coal Measures Sandstone.

Lower Coal Measures were also worked at Castleside, Cockfield, Consett (Hown's Quarry), Hamsterley (Rackwood Hill), High Stoop, Lanchester, North Bitchburn, Staindrop, Stanhope, Sunniside, Tow Law, Waskerley, West Auckland, Witton-le-Wear, Wolsingham and Woodland.

Figure 8: St Aidan's Vicarage, Consett. Lower Coal Measures Sandstone.

Figure 9: Church of St Philip and St James, Tow Law. Lower Coal Measures Sandstone.

Pennine Middle Coal Measures Formation, Pennine Middle Coal Measures Formation

Middle Coal Measures Sandstone (Durham Low Main Post Sandstone, High Main Post Sandstone, Seventy Fathom Post Sandstone, Grindstone Post Sandstone, Clousden Hill Sandstone)

The Pennine Middle Coal Measures Formation occupies a broad north to south trending band in east-central County Durham, extending from Stanley and Chester-le-Street in the north, via Waterhouses, Durham, Brandon and Willington, to Bishop Auckland and West Auckland in the south. Durham Cathedral is one of the finest examples of the use of Pennine Middle Coal Measures sandstones in the county. The stone was sourced mainly from the stratigraphic level of the Low Main Post, from quarries in the city of Durham itself (although these have long been abandoned). In Tyne and Wear, the formation has an extensive outcrop, but much of it is concealed beneath Quaternary sediments. The Middle Coal Measures strata extend westwards from the coastal exposures between Whitley Bay and South Shields to Wallsend, Gosforth and Newcastle-upon-Tyne, and then southwards to Birtley, Washington and east of Chester-le-Street.

The formation consists of pale grey, brownish-grey to pinkish or yellowish-grey subarkosic sandstones, with mudstones, siltstones and coal seams. Beds of mudstone containing marine fossils also occur at intervals. The sandstones occur as relatively thin (<5m thick), laterally extensive, sheet sandstones or as thicker (10 to 50m thick) channel sandstones. Often, these channel sandstones exhibit variable grain size, in places becoming coarse grained or even pebbly. Virtually all the sandstones are cross-bedded and they are commonly ripple marked.

Figure 10: Durham Cathedral. Pennine Middle Coal Measures Formation Sandstone.

The channel sandstones often occupy washout structures, which may cut down several metres into underlying strata and contain mudstone, ironstone or coalified pebbles (locally called ‘scars’ or ‘scares’).

Local quarrymen or miners have named a number of distinct sandstone units within the Pennine Middle Coal Measures Formation. These include (from the lower part of the sequence upwards) Durham Low Main Post Sandstone and Seaton Sluice Sandstone, High Main Post Sandstone, Seventy Fathom Post Sandstone, Grindstone Post Sandstone and Clousden Hill Sandstone.

Middle Coal Measures sandstones are generally tough, durable and quartzitic. They have been quarried extensively for building purposes, and sometimes for roofing and aggregate, across their outcrop in County Durham and Tyne and Wear. Nonetheless, substantial reserves of stone remain.

The sandstones have been worked as building and dimension stone from quarries at Billy Mill, Blakelaw, Blaydon, Burradon, Byker, Felling, Gateshead, Heworth, High Fell, Longbenton, Middlestone, Newcastle-upon-Tyne, North Walbottle, South Shields and Westerton. There are also sandstone quarries at numerous locations across the whole area, including Annfield Plain, Billy Row, Bishop Auckland, Brandon, Chester-le-Street, Consett, Crook, Dinnington, Durham, Ebchester, Gosforth, Great Lumley, Hetton-le-Hole, Houghton-le-Spring, Lanchester, Leadgate, Longbenton, Rowlands Gill, Ryton, Sacriston, Stanley, Sunderland, Throckley, Westerton, Whickham and Witton Gilbert.

In addition to the quarry locations listed above, the Seventy Fathom Post Sandstone has been worked at Penshaw, Springwell and Wrekenton; the Grindstone Post Sandstone at Heworth and New Penshaw; and the High Main Post Sandstone at Birtley, Elswick and Newcastle-upon-Tyne (including the Elswick and Benwell quarries).

Examples of the use of Middle Coal Measures sandstones include the Chapel of St Peter at Auckland Castle, Bishop Auckland, the former Subscription Library in Howard Street, Tynemouth, and Emerson Chambers in Newcastle-upon-Tyne.

Figure 11: St Peter's Chapel, Auckland Castle, Bishop Auckland. Pennine Middle Coal Measures Formation Sandstone.

Figure 12: Emerson Chambers, Blackett Street, Newcastle upon Tyne. Middle Coal Measures Sandstone.

Pennine Coal Measures Group, Upper Coal Measures Formation

Upper Coal Measures Sandstone

Pennine Upper Coal Measures strata are restricted to a few outcrops in Tyne and Wear, mainly small fault-bounded outliers east of Gateshead and west of Sunderland, close to the boundary between Carboniferous Coal Measures deposits and Permian sediments. Pennine Coal Measures strata also occur near Killingworth, approximately 10km north-east of Newcastle-upon-Tyne.

Relatively little is known about this higher part of the Pennine Coal Measures sequence, which is largely obscured by overlying Permian strata. The succession as a whole comprises interbedded grey mudstones, siltstones and pale grey, fine-grained sandstones, with common coal seams. Argillaceous sediments tend to dominate, and apart from one 9m-thick sandstone unit (occurring beneath the Hylton Castle coal seam), sandstone units are generally thin. The sandstones are utilised very locally for building purposes, often in conjunction with other (specifically Middle) Coal Measures sandstones. The Upper Coal Measures sandstones have been worked at Boldon (West Boldon Quarry), Hebburn (Simonside Quarry and Brockley Whins Quarry) and Sunderland (Hylton Place Quarry).

Pemo-Carboniferous

Whin Sill Complex, Great Whin Sill

Whinstone

This intrusive igneous complex underlies much of north-east England, but within County Durham it is only exposed in the Middleton-in-Teesdale area. The sill rocks (Whinstone) comprise dark grey-black to black, fine to medium-grained, weakly porphyritic, quartz-dolerites, with crystals of up to 2mm in diameter.

The rock contains small phenocrysts of plagioclase feldspar, with pyroxene (mainly augite, hypersthene and pigeonite) set in a dark grey, fine-grained groundmass. Significant amounts of opaque iron oxides and pyrite are also present. Many rocks have interstitial quartz-alkali feldspar intergrowths. There is a marked decrease in grain size at the margins of the sill, where the rock comprises a very fine-grained tachylite.

In the upper half of the sill, the dolerite is locally cut by flat-lying sheets, veins and segregations of coarse-grained pegmatitic dolerite, with crystals up to 20mm in length.

Whinstone has been employed only occasionally as a local building stone and walling near accessible outcrops. However, its hardness and resistance to erosion make it an excellent roadstone and crushed rock aggregate. Larger blocks are used occasionally as rip-rap or as armourstone for coastal defences.

Whinstone has long been quarried at numerous sites in Teesdale, including Forest-in-Teesdale, Holwick, Laithkirk, Middleton-in-Teesdale (Force Garth Quarry and Greengates Quarry), Newbiggin and Stanhope. The large abandoned dolerite quarries in Teesdale and Lunedale indicate that this has been an important industry in the past. Today, large tonnages are extracted from a quarry near High Force.

Permian

Zechstein Group, Raisby Formation

Lower Magnesian Limestone

The Raisby Formation lies along the narrow western edge of the Magnesian Limestone outcrop in County Durham. It extends from Pittington in the north, via Cornforth, to areas just east of Bishop Auckland and Gainford. The formation also crops out in eastern Tyne and Wear, extending southwards as an irregular, 1 to 4km-wide belt from South Shields to Hetton-le-Hole.

The formation comprises pale grey, creamy or pale brown, fine-grained dolostones; grey, fine-grained limestones occur rarely. The lower units are mainly evenly bedded dolomitic limestones; the middle unit (most commonly seen at outcrop) comprises thinly bedded, fine-grained dolostones and calcitic dolostones; the upper unit is represented by buff to brown dolostones, developed as irregular lenticular beds of up to 0.5m in thickness. Brecciated horizons are widespread in the middle unit (and to a lesser extent within the upper unit), and they are often interbedded with gypsum. Stylolitic bedding laminae occur throughout most of the formation, but they are particularly abundant in the middle unit. Soft sediment deformation features produced by minor submarine avalanches and slides are locally present in the Raisby Formation, especially in the coastal cliffs south of South Shields.

Many quarries have been opened across the outcrop area of this formation, and these provided stone for a variety of purposes. The strata were quarried

Figure 13: Jackson's Mill, Easington. Lower or Middle Magnesian Limestone.

for building and dimension stone at Bowburn, Cornforth, Coxhoe, Darlington (Walworth Quarry), Mainsforth, Pittington, Raisby Hill, Shadforth (Crime Rigg Quarry), Sherburn and Summerhouse.

The Raisby Formation has also been quarried extensively from numerous quarries at Aycliffe Village, Bishop Middleham, Boldon, Cassop, Cornforth, Coundon, Ferryhill, Haswell, Herrington, Hetton-le-hole, Houghton-le-Spring, Kelloe, Killerby, Middlestone, Penshaw, Redworth, Sunderland (Claxheugh Quarry and Ford Quarry), Thornley and Wheatley Hill.

Figure 14: Whitburn Mill, Boldon. Lower or Middle Magnesian Limestone.

Figure 15: St Andrew's Church, Sunderland. Lower Magnesian Limestone.

Zechstein Group, Ford Formation

Middle Magnesian Limestone

The Ford Formation represents the central portion of the Magnesian Limestone outcrop in County Durham. It encompasses an area bordered approximately by South Hetton, Thornley, Wingate, Bishop Middleham and Sedgefield, and then extends south through Aycliffe to Darlington. The Ford Formation also crops out in eastern Tyne and Wear, extending southwards in a belt from Boldon, New Silksworth and Houghton-le-Spring to Hetton-le-Hole.

The lower part of the Ford Formation is represented by a thin sequence of buff-coloured, fine-grained, clastic dolostones, which are transitional to the underlying Raisby Formation. Above these transitional beds are distinctive reef facies sediments, comprising massive dolomitic limestones and dolostones. Shelf-edge, back-reef and lagoonal beds, fore-reef talus aprons and off-reef facies are all present. On the landward (western) side of the reef, a varied sequence of granular ooidal and pisolitic carbonates accumulated, and these are almost universally dolomitised. The recrystallised platy dolomite crystals, which are up to 5mm in size, give the rock a characteristic ‘felted’ texture.

The reef lithologies are resistant to erosion and form one of the most striking topographical features of the Permian succession in north-east England. Lower parts of the reef contain a prolific fossil fauna, with brachiopods, bivalves and polyzoa. The upper parts are largely of algal origin and contain stromatolitic growth forms.

With the exception of the reef rock facies, which has been used on a small scale in buildings at several locations, including Hawthorn, Easington, Peterlee and Hesleden, the dolostones of the Ford Formation are generally too soft and variable for building purposes.

The harder magnesian limestone, above the dolostone layer, has been been worked as a building stone at High Coniscliffe Quarry near Darlington and Whelly Hill House Quarry, Hartlepool. The strata have also been quarried at several other locations, including Aycliffe, Boldon, Bishop Middleham, Dalton-le-Dale, Easington, Fishburn, Ford, Haswell, Houghton-le-Spring, Humbledon, Kelloe, Murton, New Silksworth, Old Wingate, Ryhope colliery, Seaham, Thornley, Trimdon, Tunstall (Nettles Lane), the Sunderland area (Quarry Heads, Hylton Castle, and Moory Nook quarries) and Wheatley Hill.

Zechstein Group, Roker Formation, Seaham Formation

Upper Magnesian Limestone (Cannonball Rock)

The Roker Formation crops out along the eastern coastal section of County Durham, extending from Seaham in the north, via Easington, Horden, Hart and Elwick, to Hartlepool in the south. The formation also occurs along the coastal section of Tyne and Wear, extending from near South Shields to Roker.

The formation comprises cream to pale grey-coloured, fine-grained, granular and oolitic dolostones, with subordinate thin beds of fine-grained dolomite. However, overall, there is relatively minor variation in lithology. Cross-bedded and ripple-bedded dolostones occur, with associated rip-up clasts and minor erosion surfaces. The lower parts of the formation consist of thinly bedded dolostones, with very distinctive beds containing rounded, calcitic concretions of up to 50mm in diameter. These distinctive concretions are termed ‘cannonballs’ and their presence has led to this unit being informally named the ‘Cannonball Rock’. The evenly bedded and fine-grained dolostones are typically harder and more resistant than the other facies.

Figure 16: St Oswald's Church, Hartlepool. Upper Magnesian Limestone.

The Roker Formation was used locally as a building stone wherever it crops out. It was formerly much worked in quarries at Hartlepool, including Hart Quarry, Craggy Bank Quarry and Raisby Quarry, and it was employed in the construction of nearby churches, harbour works and private houses.

The formation has been quarried as a dimension stone at Hartlepool, and also at Marsden, South Shields, Sunderland (Fulwell Quarry) and Whitburn. It was also worked at several quarries in Boldon, Cleadon, Dalton-le-Dale, Easington, Grangetown, Seaham and Whitley Bay.

Outcrops of the Seaham Formation are restricted to the coastal cliffs and area immediately inland of Seaham, in north-eastern County Durham.

The Seaham Formation consists predominantly of pale grey, fine-grained, thin-bedded limestones (calcite mudstones/wackestones with some interbedded coquinas, packstones, grainstones, mudstones and concretionary limestones), with some dolostones. Cut-and-fill structures, low-angle cross-lamination and low-amplitude, long wavelength ripples increase in abundance upwards through the formation. The strata are relatively soft, with the whole formation having been severely disrupted and locally brecciated. Some beds are used very locally for construction purposes within the Seaham area; the sea wall is one example.

Figure 17: Sea wall, Hartlepool. Upper Magnesian Limestone.

Jurassic

All of the Jurassic sedimentary rocks described in this guide occur within the Redcar and Cleveland unitary authority area. They crop out as a belt of Lower and Middle Jurassic strata that extends from Upsall (south-east of Middlesbrough) in a roughly east–west direction through central Redcar and Cleveland, lying to the north of Skelton and to the south of Saltburn-by-the-Sea.

They also occur within a north-east to south-west trending belt that extends from near Guisborough towards the south-west corner of the unitary authority area.

Lias Group, Staithes Sandstone Formation

Staithes Formation Sandstone

The Staithes Sandstone Formation comprises ferruginous, fine-grained, yellowish-grey sandstones, interbedded with softer, silty, argillaceous sandstones and siltstones. Some individual sandstone beds are calcareous and up to 0.3m thick. The sediments typically contain a rich marine fauna dominated by bivalves (especially oysters and scallops).

The Staithes Formation sandstones are relatively soft compared to other Jurassic sandstone units, but some of the calcareous sandstones are better cemented and more resistant. The less argillaceous sandstones have been employed as a local building stone, especially in and around Staithes, where they may be used in combination with Middle Jurassic sandstones of the Ravenscar Group.

Lias Group, Cleveland Ironstone Formation

Cleveland Ironstone

The Cleveland Ironstone was mined and quarried extensively along its outcrop, especially in the Tees Valley (north Cleveland). It is a grey to yellow-brown sideritic and berthiernitic ironstone and iron-rich sandstone with abundant ooids and shelly fossils. The stone was not commonly used as a building stone but ironstone extracted from nearby Skelton mine was used in the 19th century construction of Rushpool Hall, near Saltburn.

Group unassigned, Dogger Formation

Dogger Sandstone

The Dogger Formation shows considerable lateral and vertical lithological variation. In central, northern and western Cleveland, there is a mix of grey, chamositic, ooidal ironstones (with siderite mudstone matrix) and ferruginous sideritic sandstones. Pale grey, medium-grained, sandy limestones (mainly bioclastic wackestones and packstones with peloids and ooids) and partings, lenses and beds of grey, fossiliferous, fissile mudstones are also present. Iron-rich sandstones often develop a yellow-brown, ochreous crust upon weathering.

In some places, the formation may be absent due to erosion prior to deposition of the overlying Saltwick Formation and Cloughton Formation. Where present, however, the Dogger Formation yields marine fossils, including bivalves and scattered ammonites. Corals, bryozoans, crinoids and brachiopods are locally found in the more calcareous facies.

Dogger Sandstones are used occasionally as a local building stone and tend to be roughly dressed into squared blocks. They were worked from Normanby Moor Quarry, near Ormesby.

Ravenscar Group, Saltwick and Cloughton Formation

Saltwick and Cloughton Formation Sandstone

The Saltwick and Cloughton Formation comprises of fine to medium-grained, yellowish-grey sandstones, with grey mudstones, siltstones and rare thin coals. Plant remains and rootlets are common throughout. Ferruginous sandstones, mudstones and ooidal limestones (containing a marine macrofossil and trace fossil assemblage) also occur. Cross-stratification is present in the sandstone units, and finer grained lithologies often exhibit planar lamination.

The thicker sandstones (freestones) from these formations are much used as a local building stone, either as rubblestone or as roughly squared and dressed blocks. However, they are not suitable for higher structures or for bearing great pressure because they contain fairly high percentages of decomposed feldspathic minerals.

Sandstones belonging to the Saltwick and Cloughton Formation have been worked as building and dimension stone at several locations, including Upleatham (Marske Quarry), Boosbeck, Eston Moor, Slapewath and Wilton (Court Green Quarry and Lazenby Bank Quarry). There are also many workings at Brotton, Skelton, Skinningrove, and Loftus.

Figure 18: Tocketts Mill and Mill House, Guisborough. Saltwick and Cloughton Formations Sandstone.

Ravenscar Group, Scalby Formation

Scalby Sandstone

The Scalby Formation is dominated by pale grey to grey, medium to coarse-grained, sporadically pebbly, trough cross-bedded sandstones, with lenses and more extensive units of pale, highly siliceous, orthoquartzitic sandstones. Thin siltstone and mudstone beds also occur. Trough cross-bedding and low-angle cross-stratification are common features of the lower

sandstones, whereas the upper sandstones are typically planar bedded. The orthoquartzitic sandstones (Moor Grit) tend to be homogeneous and relatively hard compared to other lithologies. Fossil plant fragments and rootlets are common throughout the formation, with wood casts occurring in the lower part.

The Scalby Sandstone has commonly seen use as a local general purpose building stone, either in the form of rubblestone or as roughly dressed blocks. The more homogeneous units are usually treated as a freestone and dressed for use as ashlar.

The lower orthoquartzitic sandstones were formerly widely quarried as a valued building stone over moorland and coastal areas. For example, the formation has been worked as a building and dimension stone at Smeathorns Hill Quarry on Moorsholm Moor and at Lingdale (Wygrave Quarry and Little Moorsholm Quarry). The Moor Grit facies has been quarried at Ormesby (Upsall Moor) and Skelton.

Tertiary

North Britain Palaeogene Dyke Suite, Armathwaite-Cleveland Dyke

Cleveland Dyke Rock

In the southern area covered by this guide, these Palaeogene dolerite dykes only occur south of Stainton, and they extend in a roughly west–east direction close to (and extending over) the Yorkshire border at Great Ayton. In Tyne and Wear, dykes of a similar trend occur in the central and north-eastern areas. Noteworthy locations include Walbottle, Cowgate and Hebburn, as well as further north, near Tynemouth and Whitley Bay. In County Durham, the dykes only occur near Middleton-in-Teesdale and Eggleston. In all locations, the dolerite dykes are exposed intermittently at the surface, often being concealed by glacial drift or other sediments. One example of the use of dolerite as a building stone is the memorial Town Clock in Redcar, where the plinth and lower courses are composed of the dyke rock, possibly in combination with Whinstone sourced from Teesdale.

These dyke rocks are dark, bluish-grey to nearly black, basaltic rocks, and they are typically finely crystalline. They contain evenly scattered, small, glassy, lath-shaped crystals of plagioclase feldspar in a glassy matrix. Other minerals, such as pyrite, calcite, quartz and pectolite, are rarely encountered. These dolerite dyke rocks may be distinguished from those of the Whin Sill by their more porphyritic character.

These Palaeogene igneous rocks have not really been used for building purposes because of their very hard, intractable nature and restricted occurrence. However, they have been employed locally as stone walling near accessible outcrops. They are also used as small paving setts. Their primary use is roadstone and aggregate.

Cleveland Dyke Rock has been worked at Cockfield, Eaglescliffe (Witham Hall Quarry and Barwick Quarry), Eggleston, Longnewton, and Middlesbrough. In County Durham, these dolerites have been worked at Hamsterley, Hett, North Bitchburn and Witton-le-Wear. Several of the formerly accessible reserves of dyke rock, for example at Hett, Wackerfield and Bolam, are now worked out or built over. The Cleveland Dyke at Bucks Head Farm and Woodland (in the Barnard Castle area), was extensively worked from 1780, but all accessible rock has been extracted.

Figure 19: Memorial Town Clock, Redcar. Cleveland Dyke Rock plinth and lower courses.

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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