

Industrial minerals, geology and man, Northern England

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Introduction

Limestone and dolomite-rock

Many of the limestones of northern England have been worked in the past, though often only for small-scale, local use. Those of Carboniferous age account for the bulk of production; most are within the Great Scar Limestone Group (Visean), but one major unit, the Great Limestone, forms the uppermost part of the Alston Formation (Yoredale Group, Namurian).

In the earliest use of limestone, quicklime and slaked lime were produced as a soil dressing or to make lime mortar. Across most of the region's limestone outcrops are numerous small limekilns that operated to meet these demands. With improved transport links, lime burning became centralised at a smaller number of quarries where large reserves with consistent quality could be worked more efficiently. However, the greatest expansion in limestone working resulted from the demand for limestone flux created by the rapid growth in iron smelting during the 19th century. Large quarries in several of the thick Visean limestones of the Furness area supplied the iron works of south Cumbria, Visean and Namurian limestones from west Cumbria were employed in the nearby furnaces, and the Namurian Great Limestone of Weardale was extensively quarried for the iron works of north-east England. The decline of iron making, now restricted in northern England to Teesside, ended the large-scale demand for limestone flux, though burnt lime for use in steel making is still produced at Hardendale Quarry, near Shap.

In south Cumbria, Visean limestones such as the Red Hill, Park and Urswick formations are of high purity (more than 97 per cent CaCO_3), and the Park Limestone is worked at Stainton Quarry for use in the chemical and water treatment industries. Most of the south Cumbrian limestones also provide good quality aggregates. Farther east, in the Shap–Ravenstonedale area, similar though generally rather thinner high-purity sections are found in the Knipe Scar and Potts Beck limestones. The equivalent formations in west Cumbria are commonly more argillaceous than those of south Cumbria and Shap, but limestone suitable for general-purpose aggregate is worked from several quarries.

Thick, Visean limestones (Robinson and Melmerby Scar) are worked for aggregate on the Pennine escarpment; they are generally of high purity. The Namurian, Great Limestone is worked as a source of aggregate in the northern Pennines and central Northumberland, and also in north Cumbria (where it is known as the First Limestone). In the Isle of Man, Carboniferous limestones are worked for agricultural lime and crushed rock aggregate at Turkeyland and Billown.

Carbonate rocks comprise most of the Permian Zechstein Group in eastern County Durham. Much of the sequence is dolomitic and has been traditionally referred to as the Magnesian Limestone; it is the main source of dolomite-rock, $\text{CaMg}(\text{CO}_3)_2$, in Britain. Dolomite-rock has been of great importance to the steel industry. It was used in the manufacture of sea-water magnesia (at Hartlepool), a material used in refractory bricks for convertor linings and in other applications. Sea-water magnesia production ceased in 2005 but dolomitic lime is still in demand as a flux in steel making. Significant quantities of dolomite-rock are also used for agricultural lime. The Magnesian Limestone is generally inferior to Carboniferous limestones as a source of aggregate, because of its variable character, lower strength and higher porosity. However, it is extensively quarried for a range of construction uses, mostly for fill and sub-base roadstone.

Cement raw materials

Portland cement production normally takes place where the two main raw materials, limestone and clay (or in some cases mudstone), are available. Some gypsum or anhydrite is also required. The Weardale Cement Works, at Eastgate in Weardale, worked the Great Limestone with shale being obtained from the overlying clastic sequence. Cement making was a major industry in Weardale, until the closure of the works in 2002. Portland Cement was also formerly a by-product of sulphuric acid production from anhydrite at Billingham and Whitehaven.

Gypsum and anhydrite

Permian gypsum and anhydrite beds occur within the Eden Shales and St Bees Shale formations of the Vale of Eden and the Cumbrian lowlands. Permian anhydrite, locally altered to gypsum near rockhead, also occurs in the Billingham Anhydrite Formation of Teesside and south-east County Durham.

Anhydrite was formerly mined at Hartlepool for the manufacture of cement, and at Billingham on Teesside, Sandwith Mine near Whitehaven, and at Long Meg Mine near Lazonby, as a raw material for the manufacture of sulphuric acid. This industry ceased in the early 1970s. Much smaller amounts of anhydrite, mainly for use in the glass and cement industries, were mined until fairly recently at Newbiggin Mine in the Vale of Eden.

Gypsum has been worked for plaster and plasterboard manufacture near Carlisle, at Whitehaven, near Darlington and in the Vale of Eden; an underground mine in the last area, at Kirkby Thore, now supplies the region's only plaster works. Cheap but high quality synthetic gypsum, or 'desulphogypsum' produced as a by-product during desulphurisation of flue gases at the Drax coal-

fired power station in Yorkshire, has partly replaced natural gypsum as a raw material for plaster making here.

Halite

Brine pumping from beds of halite (salt) within the Triassic Mercia Mudstone Group supported small-scale salt industries at Point of Ayre on the Isle of Man, and on Walney Island, south Cumbria, during the early 20th century. Salt deposits in both of these areas are continuous with more extensive deposits offshore beneath the east Irish Sea; those at Walney Island continue southwards and were formerly also worked at Preesall in west Lancashire. The deposits beneath Point of Ayre and Walney Island are unlikely to be of future economic interest, either as a source of salt or for the development of storage cavities, because of the thinness of the individual halite beds and the presence of wet rockhead.

Beneath Teesside, halite up to 43 m thick occurs within the Permian Boulby Halite Formation. Following the accidental discovery of this salt bed in 1859, it has been extensively worked in the Greatham area by solution mining and formed the basis of the local chemical industry. Brine extraction for chemical use ceased in 2002 but salt solution cavities are still used for storage purposes.

Sand and gravel

The main use of sand is as a fine aggregate in concrete, mortar and asphalt; gravel is mainly employed as a coarse aggregate in concrete. Appreciable quantities of both are also used as constructional fill material. Within northern England, the sand and gravel resources may be grouped into two broad categories: unconsolidated Quaternary deposits and weakly cemented sands of Permian age.

Extensive deposits of Quaternary, glaciofluvial outwash and postglacial river terrace and alluvial sand and gravel have been worked throughout the region, in places on a considerable scale. Holocene coastal deposits of sand and gravel, including blown sand deposits, are also locally important in southern County Durham and the northern part of the Isle of Man. Some marine sand and gravel is dredged from deposits on the floor of the North Sea.

The commercial potential of any body of sand and gravel depends upon a variety of interrelated factors and the depiction of sand and gravel deposits on geological maps cannot be taken as an indication of a workable deposit. Only in the Brampton, Tyne Valley and Millfield Plain areas are systematic evaluations available. In general, glaciofluvial deposits are more variable in composition and particle size than river gravels. Where Coal Measures rocks comprise a major source of the included particles, for example in parts of County Durham, substantial amounts of coal and mudstone fragments within the deposit will reduce its quality.

Because of the regular grain size and weak cement, the Permian Yellow Sands Formation of County Durham comprises an important resource of good quality building sand, with some also being used for asphaltting. Large quarries currently work the Yellow Sands, usually in association with the overlying Magnesian Limestone, at Eppleton, in the Sherburn and Coxhoe areas and at Thrislington, near Ferryhill.

Igneous rock

Many of the region's igneous rocks have been worked for roadstone and aggregate, but whilst these remain important products, they are now derived from a more restricted number of rock types than hitherto.

The region's largest outcrop of igneous rock, the Ordovician Borrowdale Volcanic Group in the central Lake District, includes a wide range of rock types but very few of these have been worked other than on a small scale for local use. Andesite and volcanoclastic rocks in the Furness Inlier in south Cumbria were formerly quarried on a large scale at Greenscoe, and silicic lapilli-tuff within the Waberthwaite Formation is still worked at Ghyll Scaur Quarry, near Millom, for road surfacing. This rock has a very high polished stone value and abrasion resistance, making it suitable for anti-skid surfaces. Similar silicic lapilli-tuff was formerly worked for roadstone in a large quarry at Knock Pike in the Cross Fell Inlier. Metamorphosed andesite within the aureole of the Shap Granite has a particularly high abrasion resistance and high relative density, making it well suited for use as roadstone and railway track ballast. This rock is today worked at the Blue Quarry, Shap, where some of the crushed rock is additionally employed in the making of concrete products.

Until several years ago, the Shap Granite was itself worked for crushed rock and roadstone at the Pink Quarry, Shap. Other Lake District intrusions formerly worked for crushed rock and roadstone include the Threlkeld Microgranite, the Eskdale Granite, the Broad Oak Granodiorite and the Embleton Diorite. On the Isle of Man, crushed rock aggregate and roadstone are produced from the Foxdale Granite at Stoney Mountain, and from the dolerite intrusion at Poortown, near Peel.

In the region's other large volcanic complex, Cheviot, only a small intrusion of microgranite at Alwinton has been substantially worked, at Harden Quarry, for crushed rock and roadstone. Its bright red colour makes it sought after for specialised uses.

Known locally as 'whinstone', the dolerite of the Whin Sill-swarm has a high polished stone value, making it ideal for use as a roadstone. It has long been quarried at numerous sites in Northumberland and County Durham and large tonnages are today extracted from quarries at Belford, Longhoughton, Barrasford, Swinburne and Divethill in Northumberland, and from one large quarry near High Force in County Durham. Roadstone and crushed rock aggregate are the main products, with larger blocks occasionally employed as rip-rap or as armour stone for coastal defences.

Palaeogene dolerite dykes have been worked locally for roadstone: the Acklington Dyke at Acklington; the Cleveland Dyke at Barrock Fell near Armathwaite, at Cockfield Fell and at Bolam in County Durham.

Clay and shale

Small brickworks utilising a great variety of clays were formerly common in many parts of the region. Raw materials included Quaternary glacial till, laminated lacustrine clays, alluvial and marine clays and silts; Carboniferous mudrocks have also been used. Until recently, large brickworks at Birtley, near Gateshead, worked substantial deposits of laminated clay within the Team valley. Glacial clays are still worked today for brick-making on a small scale at Thrunton, near Alnwick. Many Coal Measures mudstones are suitable for making 'common' bricks and it was usual in the 19th and early 20th centuries for brick works to be attached to collieries.

The brick industry is now based on a small number of plants producing high-quality facing bricks,

engineering bricks and related products such as clay pavers. Modern brick-making technology requires raw materials with predictable properties and consistent firing characteristics, with blending of different clays, including fireclays (see below) employed to achieve improved durability and a range of fired colours and textures. Lower and Middle Coal Measures mudstones, quarried in the Bishop Auckland and Gateshead areas, together with mudstone recovered as a by-product of opencast coal extraction, supply large modern brickworks at Bishop Auckland and Throckley. Skiddaw Group mudstones in the Furness area supply a brickworks near Askham.

Fireclay

Fireclay, known in northern England as 'seggar', is a palaeosol, a non-marine mudstone upon which grew coal-forming vegetation. It generally occurs as comparatively thin (less than 1 m), homogeneous beds with abundant rootlet traces. Fireclays exhibit a wide range of mineralogical compositions and properties that determine their vitrification characteristics and colour after firing. Consisting essentially of kaolinite, hydrous mica and fine-grained quartz, fireclays have high alumina and low alkali contents, hence the refractory properties.

Historically, fireclays were mainly used in the manufacture of refractory products for use in the iron and steel industries. The fireclay was commonly extracted as a by-product of coal mining but there were also many dedicated fireclay workings. The distinctive, pale buff-coloured firebricks, produced at numerous collieries, remain a conspicuous feature of vernacular architecture in parts of the Northumberland and Durham coalfield. Fireclays were also much used in the manufacture of salt-glazed pipes and sanitary ware.

Demand for refractory products declined sharply after the late 1950s, as a result of changing technology in the iron and steel industry. Today, only very small amounts of fireclay are used for refractory purposes. Significant amounts are still recovered as a by-product of opencast coal extraction and are in demand as raw materials for brick-making, either to produce pale buff-coloured bricks or to blend with other clays.

Sandstone

Although the principal use of sandstone within the region is as a building material, a variety of sandstones have been employed for other purposes.

Hard wacke sandstone within the Silurian Kirkby Moor Formation has very high polished stone values and is quarried for roadstone at Holmscales and Roan Edge, near Kendal. The quartz arenite-dominated Creg Agneash Formation in the Ordovician Manx Group is today worked for crushed rock aggregate at Dreemskerry on the Isle of Man.

Several of the region's 'gritty' Carboniferous sandstones proved ideal as grindstones. Particularly well known were the so-called Newcastle Grindstones obtained from prominent sandstone beds (the 'Grindstone posts') in the Middle Coal Measures of the Wrekenton and Springwell areas, near Gateshead.

Siliceous sandstone, including the seatearths found beneath some coal seams, is commonly termed ganister. It was well-suited to the manufacture of silica refractories. Ganisters were formerly worked from the Namurian sequence around Castleside and Healeyfield, near Consett, from Harthope Quarries and elsewhere in Weardale, and at Distington and Branthwaite in west Cumbria.

Deeply weathered, coarse-grained feldspathic sandstones are common in the Carboniferous

sequences of north-west County Durham and adjoining parts of Northumberland. They formerly provided excellent sources of natural moulding sand at several localities including Castleside and near Blanchland.

Diatomite

Diatoms are a form of siliceous algae, and substantial accumulations of their fossilised remains occur in some postglacial lake deposits in the Lake District. The only economically workable deposit of diatomite in England was exploited there, between 1924 and 1975 at Kentmere, near Kendal, and was used in the manufacture of insulation. The diatomite bed was between 4.5 m and 11.5 m thick over an area of approximately 30 hectares beneath the alluvium of the River Kent.

Graphite

One of the region's most famous mineral deposits is the graphite deposit at Seathwaite in Borrowdale. Mining here dates back to at least the 16th century and continued intermittently until 1891. Originally worked for making crucibles and moulds for casting weaponry, the remarkably pure graphite eventually became the basis for the pencil industry which survives today in Keswick, though now using imported raw materials.

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