Extractive industries

County Durham has a very long and distinguished history of mineral production. A very wide range of mineral products has been worked within the county. Mining and related industries have had a substantial impact on the character of parts of the Durham landscape and the way it has been perceived. Perhaps the most abiding images of the county are as an industrial landscape of coal mining, lead mining, steel making and railways, at the heart of the industrial revolution. Despite the enormous importance of coal, for which the county is perhaps best known, the significance of other mineral products won from the county's rocks must not be underestimated.

Coal

To many people the county's name is virtually synonymous with coal mining. This industry, more than any other, has been of fundamental importance in shaping the landscape, economic, political and cultural heritage of the central and eastern parts of the county. Underground coal mining has now ended and opencast extraction is today a mere shadow of even a few years ago. Ambitious land reclamation projects have removed the most obvious scars of mining and a visitor to many parts of the county today will find scant evidence that this was once one of the world's greatest sources of coal. However, aspects of the legacy of centuries of coal mining do still pervade large areas of the county, though many of these are comparatively inconspicuous, certainly to a casual observer. Evidence for this once great industry today lies mainly in the pattern of scattered coal mining settlements, often with 'colliery' included within their names. Less apparent are areas affected by continuing surface instability, or the discharges of iron-rich mine waters. The Durham coast, once freely used as a place to dispose of vast quantities of colliery waste, has been largely cleared, though pockets of spoil still remain in a handful of localities.

Not only have some of the most obvious signs of coal mining been obliterated but, as discussed above (see Westphalian Rocks), tangible evidence of the very rocks from which the coal was won are increasingly difficult to see within the county.

Ironstone

The Coal Measures rocks of the county locally contain significant concentrations of sedimentary ironstones, mostly in the form of 'clay ironstone' nodules or as beds of 'black band' ironstone. Many of these are likely to have been worked in early centuries, though they formed the basis for the major iron smelting industries developed during and after the industrial revolution. Such iron ores were worked either alone or as by products of coal mining. It was the availability of such ores, together with the closeness of coal suitable for smelting, which led to the establishment of major iron making centres at Consett, Tow Law, and Spennymoor.

Substantial quantities of iron ores occur in association with the lead-bearing veins of the Northern Pennine Orefield. These too are likely to have been worked at an early date, but attained their greatest importance in the 19th century when large quantities of ores from several mines in Weardale also supplied the furnaces at Consett, Tow Law, and Spennymoor.

The Northern Pennine Orefield

County Durham includes a substantial proportion of the richly mineralised area of Carboniferous rocks, known as the Northern Pennine Orefield (see Mineral Veins). Although the main concentration of deposits within this orefield lies within the Pennine dales of Teesdale, Weardale and the Derwent Valley, related mineralised veins extend into the Durham Coalfield. Although not productive of metal ores in the coalfield, several substantial deposits of barytes and witherite were worked alongside coal.

Some of the earliest documentary records of mineral working within the county, which date back to the 12th century, refer to the mining of minerals such as iron and lead ores in the Pennine dales. Earlier mining for metals is possible, or even probable, though there is no proof of this. It is, however, reasonable to suppose that mineral products have been worked in the county since the earliest days of human occupation.

Most prominent of these ores was lead ore, or galena, mining for which was to impact heavily upon almost every aspect of the natural and human landscape of the Durham dales. During the 18th and 19th centuries the Northern Pennines was one of Britain's main sources of lead, and one of the world's most significant producers of the metal. Many mines, large and small, worked lead ore, often from veins in remote locations in the Pennine hills and dales. Smelting was originally undertaken close to the mines, but in the later years of the industry the ores were taken to smelters outside of the county.

Substantial amounts of silver were recovered as a by-product of lead mining and smelting. Suggestions that silver may have been the chief metal worked in early centuries from now lost silver-rich lead deposits ores cannot be reliably substantiated.

Although small concentrations of copper ores are known to occur in a few veins in Weardale, there are no records of working of these ores in County Durham, though small amounts of copper ores were worked from veins in the Garrigill area, a short distance west of the county border.

In addition, small amounts of zinc ores are known to have been worked commercially within the county.

The non-metalliferous minerals fluorite, baryte, witherite and quartz, found as 'gangue' minerals in association with metal ores, have been worked commercially in the county.

County Durham played a major role in the development of the world fluorspar industry. Long regarded as a waste product of lead mining, this mineral became a vital raw material for use as a flux in the steel industry in the closing years of the 19th century. Demand for Durham fluorspar grew in the early years of the 20th century, both for steel making and for a developing range of uses in the chemical industry. Mining and exploration for new reserves continued intermittently throughout much of the 20th century, though the availability of cheap fluorspar from sources such as China in the 1980s and 90s dealt a fatal blow to the Durham fluorspar industry. The county's last fluorspar mine, at Frazer's Hush in Rookhope, closed in 1999.

The barium minerals barytes and witherite are common gangue minerals in the outer zones of the Northern Pennine Orefield, which encompasses parts of the Durham Coalfield. Deposits of both minerals have been worked from several Durham collieries. County Durham shares, with Northumberland, the distinction of being one of the few places in the world where witherite was mined commercially as a raw material for the chemical industry.

A few tons of quartz are understood to have been extracted in Weardale for specialised use in the chemical industry.

To some extent mining of fluorspar, barytes and witherite helped offset the catastrophic economic consequences of the collapse in world lead prices which devastated the Durham lead mining economy at the close of the 19th century, though mining for these minerals never replaced the economic importance of lead mining to the communities of the west Durham dales.

Bulk minerals

Rocks currently, or formerly, worked from the county are:

Dolerite ('Whinstone'), Limestone, Dolomite, Sandstone (including ganister), Shale and brickclay, Fireclay, Sand and gravel, Peat, Slate.

Dolerite from the Whin Sill, and from the Cleveland Armathwaite Dyke has been worked at numerous sites for aggregate and roadstone. Working of these rocks today is confined to the Whin Sill at Force Garth Quarry, near High Force.

Most of the individual limestones in the Carboniferous succession of the Pennines have been worked, mainly on a small scale, for making quick-lime and mortar. Large scale extraction in County Durham has been focussed on the Great Limestone. Huge quarries around Stanhope and Frosterley supplied limestone flux to the steel industry, as well as large quantities of crushed limestone aggregate. The same limestone provided the main raw material for cement making at Eastgate until the closure of this works in 2001. Extraction of Great Limestone, for use as aggregate and roadstone continues today at Heights Quarry in Weardale, and at Selsett Quarry in Lunedale.

The county's Carboniferous limestones have been little used as building stones, except for very local use in drystone walls. However, the Frosterley Marble has been much used locally, and outside the county, as an ornamental stone (see Built Environment and Extractive industries).

The Permian Limestones of eastern County Durham have long enjoyed a variety of uses. From early times the pale cream coloured limestones of the Magnesian Limestone have been much used for local building. Indeed, their use as building stone imparts a distinctive character to the built environment of the eastern part of the county. As most of the limestones are in reality either dolomites or dolomitic limestones, they have long been important raw materials for the chemical industry. Large tonnages of Permian limestones and dolomites are still extracted today to supply the chemical industry and also as a major source of aggregates.

Substantial portions of the county's succession of Carboniferous rocks, both in the Pennine dales and the Durham Coalfield, comprise sandstone. Several of these sandstone units have been employed as building stone. Much of the stone is of unremarkable or indifferent quality, appropriate only for local use in vernacular architecture or drystone walling, though it is this use which lends much character to the county's built environment. However, certain beds of sandstone are of more consistent quality and thickness and have been more widely employed for construction. Notable examples include the Low Main Post sandstone from the Coal Measures, from which substantial parts of Durham Cathedral are built. Other sandstones from the Lower Carboniferous succession are still worked on a considerable scale at quarries in the Stainton area for use within the county and beyond.

A number of Lower Carboniferous sandstones exhibit closely-spaced bedding or lamination making them eminently suitable as roofing stone. Many dales cottages are roofed with such sandstone flags, though no sources of this material are worked within the county at present.

Certain silica-rich sandstones possess refractory properties which attracted their use in the making of furnace linings. The term 'ganister' is commonly applied to such rocks. 'Ganisters' commonly, though not invariably, occur as 'seatearths' beneath coal seams, or the horizon of former coal seams. Such sandstones were formerly worked from numerous quarries within the Carboniferous rocks of the Pennine dales and Coalfield.

Some poorly-cemented sandstones are friable rocks suitable for use as moulding sands in the foundry industry. They have been worked from several quarries within the Carboniferous rocks of the Pennine dales and Coalfield.

A wide variety of shales and siltstones are suitable for the production of ordinary bricks. Several beds of such rocks within the Coal Measures have been employed in this way and brick production continues today at Ambion Brickworks using Coal Measures shale. Brick works were operated by some collieries, using waste shale of suitable composition.

Mudstone seatearths suitable for the making of refractory wares are normally termed 'fireclays'. They were often worked as by-products in coal mining, both during underground mining, and in more recent years during some opencast operations.

Uncemented, or very weakly cemented, sands at the base of the Durham Permian succession, known as the Yellow Sands, have long been valued as building sands. They are worked today from several large quarries along the escarpment of the Permian rocks.

Glacial deposits and some alluvial deposits, locally contain reserves of sands and gravels suitable for construction use.

Peat forms a widespread mantle, in places several metres thick, over substantial areas of the higher Pennine hills. Although no longer of economic interest, these peat deposits provided an important local source of fuel for lead smelting.

The county's sole exposure of Ordovician slates, at Pencil Mill, near Cronkley in Upper Teesdale, is an old quarry formerly worked for the making of slate pencils.

Not only have these extremely varied mineral resources played a key role in the county's economic development, but they are clearly important elements in the area's geodiversity. Past and present workings offer a variety of opportunities to appreciate these.

The vital role played by mineral extraction in the geodiversity of the county is considered under the following headings:

- Abandoned quarries
- Active quarries
- Abandoned underground mines
- Active underground mines
- Spoil heaps.

Abandoned quarries

Whereas the county's long and distinguished history of mineral extraction has left a legacy of many hundreds of abandoned quarries, there is no comprehensive register of their whereabouts and it is not currently possible to depict them on a map. However, certain geological units or formations have attracted particular economic interest. Numerous substantial quarries mark the outcrops of the Great Limestone, the Whin Sill and Palaeogene dykes, several of the Carboniferous sandstones, the Permian 'Yellow Sands' and Magnesian Limestone, and glacial sands and gravels. Smaller pits, often worked only for very local use, are also common. In building dry-stone walls and farm buildings it was common practice to obtain stone from as close as possible to the construction site. Thus, small pits are common alongside many lengths of wall, or close to farms or hamlets. Some of the county's mineral veins and related flat deposits were worked by quarrying. Peat is known to have been extracted on a substantial scale in the past, though none of these workings can be reliably identified today. Abandoned quarries may be regarded as essential and distinguishing features of the present day landscape in many parts of the county.

As disused quarries provide some of the most important, and several unique, sites at which certain rock units may be seen, they contribute greatly to the area's geodiversity.

Abandoned quarries may also be extremely important biodiversity sites. In some instances their biodiversity interest may be significantly greater than their geodiversity interest. Quarries can provide an opportunity to study the natural revegetation of an area. Abandoned quarry floors and faces offer a variety of substrates for rare or specialised plant communities, including sites for lichens and other lower plants. Whilst disused quarries can provide a refuge for many grassland plant species, it takes many years for the vegetation to develop. Under these circumstances unless there is a seed source reasonably close by from which plants can invade, then some species will be unable to take advantage of the new habitat and could become lost from the area altogether. Old quarries frequently offer excellent nest and roost sites for a variety of bird species, and may provide important bat roosts. Flooded quarry workings may offer important water bodies for aquatic life and a variety of bird species, including migrants.

Abandoned quarries are commonly seen as eyesores or convenient sites for waste disposal. Overgrowth of vegetation may spoil, or eventually totally obliterate, useful or important geological features. Reclamation schemes aimed at remediation of land affected by mineral extraction may destroy important or unique material.

Restrictions associated with the scheduling of abandoned quarries as historical monuments may seriously compromise the geodiversity value of the quarry.

Abandoned quarries commonly offer significant opportunities to demonstrate and interpret key features of the area's geology though, in the long term, some form of planned management, e.g. periodic clearing of vegetation, may be appropriate.

The educational and interpretational value of many abandoned quarries may be greatly enhanced by integrating their other interests, e.g. wildlife or archaeological significance, into educational or interpretational initiatives.

Active quarries

These comprise quarries at which mineral products are being produced, or at which planning permissions exist to allow such extraction.

Carboniferous Limestone is extracted at several quarries. The bulk of this is used as crushed rock aggregate or roadstone. Large blocks are recovered for use as armour-stone. Some finely crushed limestone is used for agricultural purposes. A small amount of coral-rich limestone from the Frosterley Band within the Great Limestone is recovered from Broadwood Quarry in Weardale for use as ornamental stone.

Magnesian Limestones are worked from several large quarries in the east of the county. By far the greatest proportion is employed as crushed rock aggregate or as fill and sub-base material in road making. Substantial amounts of dolomitic limestone were formerly employed in the chemical industry, particularly in the making of refractory products, though this use has declined markedly in recent years.

Dolerite ('whinstone') from the Whin Sill is worked as an important source of roadstone from Force Garth Quarry in Teesdale. Large blocks are recovered for use as armour-stone.

Sandstone is worked as a building, paving and walling stone from several quarries.

Sand for use in the building and construction industries is worked on a large scale from the Permian 'Yellow Sands', often within the same quarries worked for Magnesian Limestone.

Brick clay is produced from Quaternary clays near Birtley. Coal Measures shales are currently worked for brickmaking at quarries in the Bishop Auckland area.

Active quarries provide fresh, and constantly changing, sections through the deposits worked. They thus provide some of the finest opportunities to further understanding and appreciation of the area's geodiversity.

Quarries inevitably make an impact upon the landscape, though modern operations are subject to planning and environmental conditions and requirements to mitigate this impact.

Active quarries may present significant opportunities for wildlife. For example, some quarry faces, particularly those not currently being actively worked, may offer roosting and nesting sites for a variety of bird species. The associated spoil heaps may provide substantially undisturbed habitats for a wide range of plant and animal life. Flooded portions of workings may offer important water bodies for aquatic life and a variety of bird species, including migrants.

Active quarries offer opportunities to demonstrate the working techniques, and relevance of these industries within their local and regional communities.

Significant opportunities exist at many active sites to plan after-uses which may be sympathetic to the preservation and exploitation of important geological features. With appropriate planning for after-use many quarries can become considerable assets to the county's landscape and natural heritage.

Abandoned underground mines

Abandoned underground mines, which remain accessible, enable examination of numerous geological features associated with the mineral deposits formerly worked there, many of which may be rarely exposed clearly at the surface. Underground sites often give unique opportunities to examine geological successions and structures in three dimensions and may offer the chance to study the mechanical and engineering properties of geological structures and materials. Many underground sites preserve geological features or materials in a comparatively unweathered condition, enabling comparison with surface exposures and therefore aiding understanding of a number of geological processes. Underground sites may also provide unique insights into the working practices adopted in mineral extraction. Abandoned underground mines thus contribute greatly to the area's geodiversity.

Centuries of coal mining have left many square miles of the county undermined, in places in several seams. In the Durham dales, an equally lengthy history of working of lead ore and associated minerals has resulted in many miles of underground driveages and stopes. Whereas very few old coal workings are accessible today, access to some of the North Pennine mines remains possible, though in most instances only to experienced underground explorers.

It is tempting to suggest that as these sites lie underground, concealed from all except a comparatively small number of underground explorers, that they are not relevant in considering the area's landscape. This argument cannot be sustained. In an area with such a long and distinguished history of underground working, underground workings comprise an element of the landscape as essential as any surface feature.

Like abandoned quarries, it is quite impractical to depict all abandoned underground workings on a map.

In addition to their contribution to the area's geodiversity, underground workings commonly exhibit substantial biodiversity importance. Many mine entrances and shafts are well-known and well-used bat roosts, and some such workings provide specialised habitats for a variety of invertebrates, especially in their near surface parts. Timber, used within the mines, may today host a range of fungal species.

Several of the county's accessible abandoned underground workings exhibit significant features of industrial archaeological or historical interest.

Abandoned underground workings attract the attentions of mine explorers, many of whom have no particular interest in the exposed geological features, as well as mineral collectors. Clearly, access to such potentially unstable workings raises important safety considerations.

By their very nature, underground workings are especially vulnerable to deterioration and progressive dilapidation of the workings and the access routes to them. It is many years since most of the currently accessible workings were actively worked. Their stability and security is therefore almost entirely dependent upon the physical properties of the rocks through which the workings are excavated, and the condition of any supporting structures placed by the original miners. It is common for mine explorers, and mineral collectors to attempt to regain access to long-inaccessible areas of workings by excavating through blockages etc. Such work is generally of an ad hoc type and may not be based on expert civil engineering practices and may threaten the long-term stability of the workings.

Collecting of mineral specimens constitutes one of the most serious threats to both the accessibility and scientific value of many underground geological sites (see page 167).

Two underground sites, Park Level Mine, Killhope, and the abandoned coal drift at Beamish Museum, are currently operated for public access and interpretation of mining and geological features.

Mine exploration groups may offer opportunities to monitor the condition of workings and to recommend necessary remedial work.

Active underground mines

Apart from one very small underground mine, currently worked seasonally to produce fluorite specimens for the collectors' market, mainly in the USA, from a small vein and associated flat deposits at Rogerley Quarry, Weardale, there is no active underground mining today in County Durham.

Like active quarries, active underground mines provide constantly changing sections through the deposits being worked. County Durham's sole active underground mine provides a unique opportunity to study a fluorite-rich deposit typical of several known in the Northern Pennines. The mine makes no significant impact upon either the landscape or biodiversity of the county.

Two underground sites, Park Level Mine, Killhope, and the abandoned coal drift at Beamish Museum, are currently operated for public access and interpretation of mining and geological features.

Spoil heaps

Centuries of mineral extraction have left a varied legacy of mineral wastes in the form of spoil heaps from quarries, mines or mineral processing plants, including former metal smelting operations.

Spoil heaps typically comprise the geological materials discarded as waste from the deposits worked and also contain examples of the materials worked. When derived from underground workings which are no longer accessible for study, these spoil heaps provide a unique source of evidence for the materials worked, or penetrated, in the workings. In some instances these may include important, in some instances unique, sources of certain minerals. Exposure to weathering in spoil heaps may enhance the value of the included materials. For example, many fossils which may be extremely difficult to see in an unweathered exposure or quarry face, may be clearly exposed in weathered blocks in a spoil heap. A number of supergene mineral species may be forming within spoil heaps, particularly in those from some collieries and former smelting operations.

Whereas a considerable variety of spoil heaps associated with mineral extraction may be recognised in County Durham, the following are particularly significant when considering geodiversity.

Colliery spoil heaps. Centuries of coal mining brought millions of tonnes of waste rock to the surface for disposal. Until comparatively recently large heaps of coal mine waste, mainly grey shale, were conspicuous features in the landscape of the coalfield. It was common practice at several coastal collieries to dispose of waste by dumping on the beach. Huge volumes of such waste accumulated on the Durham coast, overwhelming the natural beaches and disfiguring the coastline.

With the demise of coal mining, and a widespread programme of environmental improvements, most inland colliery spoil heaps have been subject to reclamation works. Many have been landscaped, covered in topsoil and either developed into amenity open spaces or planted with trees. Others have been largely backfilled into adjacent opencast coal workings. In comparatively few inland localities can significant amounts of colliery spoil be seen today.

The 'Turning the Tide' programme, administered by Durham County Council between 1996 and 2001, resulted in the clearance of vast quantities of colliery spoil from the Durham coast, though some areas of such spoil remain on the coast, for example at Dawdon and Easington.

Coal Measures shales are typically rich in pyrite and marcasite. In the presence of water these are unstable, leading to the formation of extremely acidic iron-rich groundwaters. This process of decomposition is accelerated in the presence of sea water. In consequence, significant amounts of acidic iron-rich water are today being leached from the accumulations of colliery spoil at Dawdon and Easington. In places, notably around Hawthorn Hive, partial evaporation during dry weather produces ephemeral encrustations of a range of rare iron sulphate minerals (see Minerals and Mineralogy) on the spoil and adjoining Magnesian Limestone cliffs.

Metalliferous mine spoil heaps. A long history of mining for lead, iron and associated minerals from the deposits of the Northern Pennine Orefield have produced numerous spoil heaps in the west of the county. Although substantial volumes of spoil have accumulated adjacent to some of the county's larger metalliferous mines and processing plants, such spoil heaps are generally very much smaller than those associated with the collieries of central and eastern Durham. These heaps typically contain a high proportion of waste wall-rock, though many contain an abundance of vein minerals discarded as uneconomic during mining. The rock and mineral fragments contained in spoil heaps from many of the county's former metalliferous mines offer the sole remaining evidence of the deposits worked and the constituent minerals. Metalliferous mine spoil heaps include accumulations of spoil from mineral processing operations. Typically these comprise concentrations of gravel or sand sized particles, mainly of vein minerals. Accumulations of slags and other smelter wastes are present at former smelting sites. Spoil heaps may be regarded as crucial resources in the county's geodiversity.

Spoil heaps are locally important elements in the county's landscape. Indeed, many of the spoil heaps associated with metalliferous mines may be viewed as essential elements which help to characterise and define those landscapes. In some places spoil heaps may give the only remaining clues to the presence of former workings.

Some spoil heaps provide an important habitat for a number of plant communities. These include limestone flora on the heaps adjoining some limestone quarries and metallophyte flora on numerous spoil heaps from metal mines and processing and smelting plants.

Spoil heaps may be rather vulnerable elements in the landscape. Removal of rubble for earthworks or track-making, or reclamation of spoil heaps may destroy or obliterate them. Such reclamation activities may include tree planting or top-soiling of the heaps, both of which effectively render the materials contained within the heap inaccessible for geological study. Natural erosion threatens a small number of scientifically significant spoil heaps. Collection of mineral specimens may seriously deplete the resource.

Several spoil heaps, particularly some associated with former metalliferous mines are included in the archaeological features scheduled at those sites. Scheduled Ancient Monument (SAM) designation normally precludes any form of disturbance, however minor, including the collecting of geological specimens. Where applied to spoil heaps this designation may effectively limit severely the geodiversity value of that spoil heap.

Fresh material added to spoil heaps associated with active mineral workings potentially increases the resource value of that heap. Potential exists for mineral operators to make portions of spoil heaps accessible for educational or recreational use by groups or individuals. Such activities may include setting aside concentra-tions of waste material of particular geological interest.

Excavation of a spoil heap offers important opportunities for recovery of significant material and associated recording of finds.

Spoil heaps may offer important potential for sustainable educational and recreational collecting.

Selected references

Atkinson, 1968; Burgess and Holliday, 1979; Dunham, 1990; Dunham and Wilson, 1985; English Nature et al. 2003; Fairbairn, 2003; Forbes et al. 2003; Galloway, 1882; Jevons, 1915; Mills and Holliday, 1998; Mills and Hull, 1976; North Pennines Partnership, 2001; Say and Whitton, 1981; Smith, 1994; Smith and Francis, 1967; Sopwith, 1833; Taylor et al. 1971; Wallace, 1861.

Photographs

(Photo 74) Area of Knitsley Opencast site, before working. ex-Opencast Executive Collection now deposited with BGS. BGS, ©NERC, 2004.

(Photo 75) Knitsley Opencast site, during working. ex-Opencast Executive Collection now deposited with BGS. BGS, ©NERC, 2004.

(Photo 76) Bollihope, Weardale. Abandoned quarries in Great Limestone. CL Vye, BGS, ©NERC, 2004.

(Photo 77) Dun House Quarry, Stainton. Namurian sandstone worked as building stone. BGS, ©NERC, 2004.

(Photo 78) Cambokeels Mine, Weardale. The original stone- arched horse level. B Young, BGS, ©NERC, 2004.

(Photo 79) Groverake Mine, Rookhope. Loading fluorspar ore in the 60 Fathom Level. Photographed 1982. BGS, ©NERC, 2004.

(Photo 80) Lodge Sike Mine, Teesdale. Extensive spoil heaps from old lead workings. B Young, BGS, ©NERC, 2004.

(Photo 81) Hawthorn Hive, Easington. Colliery spoil accumulated on beach. The vivid yellow areas are crusts of iron sulphate minerals forming by weathering of the pyrite-rich spoil. B Young, BGS, ©NERC, 2004.

Full references

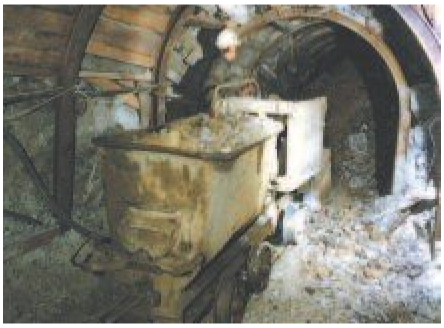
(Photo 74) Area of Knitsley Opencast site, before working. ex-Opencast Executive Collection now deposited with BGS. BGS, ©NERC, 2004.

(Photo 75) Knitsley Opencast site, during working. ex-Opencast Executive Collection now deposited with BGS. BGS, ©NERC, 2004.

(Photo 76) Bollihope, Weardale. Abandoned quarries in Great Limestone. CL Vye, BGS, ©NERC, 2004.

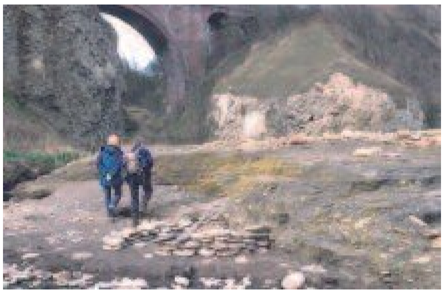
(Photo 77) Dun House Quarry, Stainton. Namurian sandstone worked as building stone. BGS, ©NERC, 2004.

(Photo 78) Cambokeels Mine, Weardale. The original stone- arched horse level. B Young, BGS, ©NERC, 2004.



(Photo 79) Groverake Mine, Rookhope. Loading fluorspar ore in the 60 Fathom Level. Photographed 1982. BGS, ©NERC, 2004.

(Photo 80) Lodge Sike Mine, Teesdale. Extensive spoil heaps from old lead workings. B Young, BGS, ©NERC, 2004.



(Photo 81) Hawthorn Hive, Easington. Colliery spoil accumulated on beach. The vivid yellow areas are crusts of iron sulphate minerals forming by weathering of the pyrite-rich spoil. B Young, BGS, ©NERC, 2004.