
Part 1 Geodiversity

Defining geodiversity

Geodiversity has been defined as “the link between people, landscape and their culture: it is the variety of geological environments, phenomena and processes that make those landscapes, rocks, minerals, fossils and soils which provide the framework for life on earth” (Stanley, 2001), or as “geological diversity or the variety of rocks, fossils and minerals and natural processes” (Prosser, 2002). Highlighting a key element in Stanley's definition, Burek (2001) commented that “Geodiversity underpins biodiversity” and offered a further definition of geodiversity as “the abiotic factors, which together with biodiversity give a holistic view of the landscape” (Burek, 2002). The rapidly evolving subject of geodiversity is reviewed in detail in a book by Gray (2003), published during the final stages of the present study.

Geodiversity is a key component of an area's natural heritage. A vital starting point is an appreciation of the most up to date available understanding of the area's geological deposits and features, together with the processes and phenomena which have formed them and continue to influence them. An area's geodiversity thus encompasses:

- The historical legacy of research within the area
- Sites or features at which representative examples of the area's geological deposits and features may be seen
- Sites or features which are deemed worthy of some form of designation or protection for the quality of earth science features displayed
- The whereabouts and nature of past and present working of mineral products
- Sites and features currently employed in interpreting earth science
- The influence of earth science in shaping the built and man-made environment
- Materials collections and site and other records
- Published literature and maps
- The inter-relationship and inter-dependence between earth science and other interests

Following the UK government's ratification of the UN Convention on Biological Diversity, which resulted from the Rio Earth Summit in 1992, and the production in 1995 of the UK Biodiversity Steering Group's Report “Meeting the Rio Challenge”, subsequent years have seen the preparation and implementation of Biodiversity Action Plans for most parts of the UK. Biodiversity is now accepted as an essential element in sustainable planning and management strategies.

Until recently the parallel concept of geodiversity has attracted little interest, despite its fundamental importance in underpinning biodiversity.

It is a common misconception that geological and landscape features, other than those already afforded some measure of protection as Sites of Special Scientific Interest (SSSIs), are sufficiently robust not to require active management or action planning. All geological features are potentially vulnerable. In addition to obvious threats posed by inappropriate site development and the infilling of quarries, the encroachment of vegetation, natural weathering and general deterioration with time may threaten to damage or obliterate important geological features. This situation would not be tolerated in wildlife or archaeological sites of comparable scientific or educational value.

However, geodiversity is not, or should not be, regarded merely as concerned with conservation of geological sites or features. As an essential part of natural heritage it influences fields as varied as economic development and historical and cultural heritage.

The relevance of geodiversity

Geology is fundamental to almost every aspect of life. Geological resources provide the raw materials for civilisation, be they fuels, water supply, metal ores or bulk and industrial minerals and building materials. A clear understanding of

geology is vital to the design and siting of buildings, roads, railways and airports as well as to the safe control of waste disposal, and the management of a wide range of natural and man-made natural hazards. All are aspects of geodiversity.

The recognition of natural and cultural heritage features and their sustainable management, are today accepted as important functions within a civilised society.

The importance of the range and diversity of earth science features — the 'geodiversity' — of any area is as important a facet of its natural heritage as its wildlife interests. Conservation, sustainable management, educational use and interpretation of geodiversity is thus as important as that of biodiversity or archaeology.

Geodiversity may be one of the most significant areas of heritage interest in areas of high landscape value, or areas previously or currently affected by significant mineral extraction.

Geodiversity interests need to be integrated into management and conservation strategies for related or parallel interests, including wildlife and archaeological features.

Geodiversity issues may contribute significantly to informing a wide range of planning and environmental policies.

An appreciation of geodiversity is important to a full understanding of many aspects of biodiversity.

It also offers very substantial opportunities to enhance the conservation, management, educational use and interpretation of such related features.

Geodiversity is an emerging field, which has hitherto received little serious consideration; it needs to be embraced by all concerned with the county's heritage.

Aims and objectives of this geodiversity audit

The principal aim of this Geodiversity Audit is to review the component elements of the county's geodiversity, and their relevance to other interests, in their local, regional, national and international context. It will serve as a means of informing sustainable management, planning, conservation and interpretation of all aspects of the earth science heritage of County Durham well into the future.

The Audit will also serve as the essential background to the Local Geodiversity Action Plan (LGAP), which will frame recommendations, action points and policies relevant to all aspects of geodiversity within the county.

Such recommendations, action points and policies can only be meaningful if they are based upon a sound modern understanding of the earth science of County Durham. Accordingly, in this document the key elements of the county's geology are outlined in sufficient detail to enable users who may not be trained earth scientists, or who may be unfamiliar with the geology of County Durham, to appreciate the relevance and contribution each element makes to the geodiversity of the county.

Local and regional knowledge in the field of earth sciences is often scarce in local government departments despite the fact that there may be local community interest and concern with issues relating to earth heritage. As the results of the geological audit are intended to serve as an important guide and source of reference well into the future they are presented here as a separate document. Specific recommendations and action points derived from this audit will be published separately and will include the results of consultation with a wide range of interested parties.

Individual objectives within this Geodiversity

Audit may be summarised thus:

- To raise awareness of the fundamental importance of geodiversity in County Durham
- To improve knowledge and understanding of the geodiversity of County Durham

- To identify the main geological formations and features, and to evaluate their contribution to geodiversity within County Durham.
- To place these geological formations and features in their regional, national and, where appropriate, international context.
- To provide non-specialists with an easy to use guide to the geodiversity of County Durham.
- To identify linkages between the county's geodiversity and its landscape character, biodiversity, economic and cultural history.
- To comment on geodiversity issues relevant to planning, development, mineral extraction and environmental monitoring and management.
- To identify threats to geological features.
- To identify opportunities to enhance the value of geological features.
- To evaluate those geological sites within the county which currently enjoy statutory protection as Sites of Special Scientific Interest (SSSIs), and non-statutory protection as Durham County geological sites (DCGS) or Regionally Important Geological and Geomorphological Sites (RIGS), of which there is only one at present in Durham.
- To encourage industry, local communities and voluntary groups and societies to become involved in understanding and celebrating the county's geodiversity.
- To 'embed' geodiversity into future planning, management and interpretation policies.
- To provide a sound expert basis for framing specific recommendations and action points for the county's geodiversity

The influence of geology in County Durham

County Durham comprises approximately 223,106 hectares of North-East England extending from some of the highest ground of the Northern Pennines, eastwards to the North Sea coast (Figure 1).

In the mid 1990's the then Countryside Commission and English Nature developed a joint project to map variations in the landscape and ecological characteristics of the English Countryside. The result of this collaboration was a joint map, called 'The Character of England: landscape, wildlife and natural features', which identifies 181 Countryside Character Areas and 120 Natural Areas. Natural areas are broad bio- geographic zones. Countryside Character Areas are broad regional landscapes. Together they form a national framework for decision making about landscape and biodiversity.

It is a reflection of the great scenic diversity of County Durham that it includes six Countryside Character Areas and five Natural Areas (Figure 3). The Northumbria Coal Measures Natural area is subdivided into two Character Areas; the remaining four Natural areas correspond to the four Character areas and are known as 'Joint Character Areas'. The structure of these broad landscapes strongly reflects the underlying geology (Figure 2).

The Pennine uplands which attain 746 metres at the county's highest point, Burnhope Seat, and which include the headwaters of the rivers Derwent, Wear and Tees, lie within the North Pennines character area. Within the county, much of this coincides with the North Pennines Area of Outstanding Natural Beauty, now designated as Great Britain's first European Geopark (see page 9).

Together with the county's great biological, economic and cultural diversity, these varied landscapes closely reflect the underlying geodiversity. In few areas of Great Britain can the inter-relationships, inter-dependence and relevance of geology with all of these other factors be more clearly demonstrated than in County Durham.

The fundamental importance of geology is perhaps most obvious in its role in shaping the physical landscape. The scenic landscapes of the valleys of the River Wear and its tributaries are now designated as Areas of High Landscape Value in development plans. The form, pattern and character of the hills, valleys and coast are profoundly influenced by the geological materials of which they are composed, and by the complex interplay of earth processes which have shaped them over millions of years of geological time.

The essential part played by geology in shaping this landscape extends far beyond the creation of landforms. Ecology is directly dependent upon soils and climate. Soils derive many of their most fundamental characteristics from their parent materials — the underlying rocks or other geological deposits. The close, often intimate, relationship between vegetation and the underlying geology is everywhere an important factor in understanding the ecology of the county. These same ecological considerations direct and constrain land use practices, be they hill pastures, grouse moors, forestry or agriculture. The crucial link between geodiversity and biodiversity are thus both obvious and inescapable: an appreciation of one is essential to the true understanding of the other.

The diversity of geological materials within the county has long offered a wealth of raw materials. An abundance of rocks suitable for building have, through their individual and distinctive properties, helped create the characteristic local vernacular architecture. Farm buildings, hamlets and villages and, in the upland parts of the county, countless miles of drystone walls, clearly reflect the local geology.

Even in towns the traditional use of stone and locally made brick impose a distinctive character on architecture and hence the urban landscape. County Durham's most famous building and World Heritage Site, Durham Cathedral, stands as an eloquent testimony to the use of locally won Coal Measures sandstone.

The same diverse geology provided the raw materials for the extractive industries, which for centuries formed the basis of much of the county's economy. County Durham is inextricably linked to coal mining, an industry which, until the second part of the 20th century, was the county's largest employer. Over the centuries, millions of tons of Durham coal fuelled industries, railways and shipping locally and across the world. Underground coal mining in the county has now ended. Opencast extraction continues, currently at one site.

County Durham also has a long and distinguished history as a major source of lead and iron ores, mined from the Pennine hills and dales in the west of the county. Small, but significant, amounts of silver were recovered as a by-product of lead mining and smelting. The demise of lead mining in the late 19th century was accompanied by the emergence of ready markets for the spar minerals fluorspar, barytes and witherite. County Durham led the world in production of fluorspar and shared with its neighbour Northumberland the distinction of being the world's chief commercial source of witherite. Although mining of these minerals has ended within the county, further reserves, particularly of fluorspar, may exist but must await a more favourable economic climate to attract commercial interest.

The county has long been a major source of sandstone, limestone, dolomite, dolerite ('whinstone'), sand and gravel, brick and refractory clays. All are still produced within the county.

Centuries of exploitation have left an almost universal and indelible imprint on the county's landscape. Although mineral extraction is today a shadow of its past, it remains an essential element in the human and economic profile of the area. The past, present and future use of geological materials, and the interdependence of economic and cultural factors with the exploitation of these natural resources, are essential elements in the county's geodiversity.

Through its long history of mineral extraction, the county has been at the forefront of developing ideas and concepts in the understanding of geological materials and processes. Research on County Durham's geology has made major contributions to many avenues of earth science. Of particular note are those relating to the understanding of coal and coal-bearing rocks, the marine Permian rocks of eastern County Durham, the nature and origins of the Whin Sill and the range of geological, geophysical and mineralogical studies of the nature and formation of the Pennine ore deposits. All have made significant impacts upon similar rocks and features worldwide. This historical legacy is another factor in the rich geodiversity of the area. The county remains, and will long continue to be, an important educational and research resource in a varied range of earth science fields.

Conserving earth science within County Durham

The word 'geology' can trace its origins back to Durham in the 14th century, although as originally coined the word had a much wider meaning than that understood today.

The word 'geologia' was first used by Richard de Bury, Bishop of Durham between 1333 and 1345. In his book 'The Philobiblion' he discusses laws, arts and sciences and in so doing introduces the new term geologia or earthly science.

"...From which it is seen clearly enough, that as laws are neither arts nor sciences, so books of law cannot properly be called books of art or science. Nor is this faculty which we may call by a special term geologia or the earthly science, to be properly numbered among the sciences. Now the books of the liberal arts are so useful to the divine writings, that without their aid the intellect would vainly aspire to understand them..." (Translation from the Latin of The Philobiblion.)

Following on from this early recognition of the importance of 'earthly science', County Durham has a long and distinguished record in addressing those aspects of management and conservation of geological features which are today included within the term geodiversity. An understanding of the nature and scope of existing conservation measures is an essential basis for informing proposals and recommendations for future sustainable management, conservation and interpretation of the county's geodiversity.

The extremely varied natural and cultural landscape of County Durham includes a wealth of earth science features and sites which not only contribute to the distinctive character of the county, but which also have an interest and importance which extends beyond its boundaries. Such features may be recognised in a number of ways. This may take the form of legal protection through statutory scheduling as National Nature Reserves (NNRs) or as Sites of Scientific Interest (SSSIs), through non-statutory designation as Durham County geological sites, or as most recently, by the recognition of the entire North Pennines Area of Outstanding Natural Beauty (AONB) as a European Geopark.

The North Pennines AONB European Geopark

The North Pennines AONB covers much of the west of County Durham together with parts of Northumberland and Cumbria see (Figure 4). The primary purpose of AONB designation is to conserve and enhance natural beauty. 'Natural Beauty' in this context "...is acknowledged to refer to a meeting of scenic, ecological, physiographical, geological and cultural interests, which help to define the special characteristics of a particular place" (North Pennines AONB Management Plan, 2004).

The important role played by geology in shaping the physical and human character of the North Pennines, and its potential for interpretation, education and research, was recognised in June 2003 by the designation of the North Pennines AONB as a European Geopark, the first on the UK mainland. A European Geopark is a defined territory with a specific geological heritage, where there is considerable local effort to conserve this heritage and encourage its enjoyment and understanding by a wide public. UNESCO is soon to establish a 'Global Geopark' network, with the 17 existing European Geoparks, including the North Pennines AONB, and thus a substantial portion of County Durham, at the forefront of this new world-wide designation.

Statutory designations protecting the earth science interest of County Durham

National Nature Reserves (NNRs)

National Nature Reserves represent some of the best wildlife and earth heritage sites in the country, many of which are important in an international context. There are six National Nature Reserves in County Durham including part of the extensive Moorhouse — Upper Teesdale NNR, which is designated as an International Biosphere Reserve by UNESCO (United Nations Educational, Scientific and Cultural Organisation), the first to be established in the United Kingdom.

The Moorhouse — Upper Teesdale NNR incorporates numerous features of earth science significance, including classic outcrops of the Whin Sill, its contact metamorphic rocks including the 'Sugar Limestone', significant occurrences of mineralisation, and extensive and internationally important expanses of blanket bog. It is also internationally celebrated for a range of extremely important and rare biological habitats. It offers superb opportunities to demonstrate the vital and intimate relationship between the area's geodiversity and its biodiversity.

Derwent Gorge and Muggleswick Woods NNR is a ravine woodland which is one of the finest and largest remaining oakwoods in North-East England. It occupies a spectacular meander of the River Derwent deeply incised into Namurian

rocks with remnants of former lead mining operations.

Castle Eden Dene NNR comprises the largest, and perhaps finest, of the Durham denes. These are deeply incised valleys cut through Quaternary deposits into the underlying Magnesian Limestone. Although Castle Eden is designated as an NNR primarily for its woodland ecology, it is an important geological feature and contains numerous important individual sites of geological interest.

Thrislington NNR is an outstanding example of Magnesian Limestone grassland which here supports a variety of scarce plant species. The reserve includes areas of grassland successfully transplanted as giant turves in advance of limestone extraction at the adjoining Thrislington Quarry.

Cassop Vale NNR is designated for its fine examples of Magnesian Limestone grassland, scrub and woodland. In addition, the reserve includes good examples of valley bottom fen and swamp vegetation as well as re-colonised spoil heaps of a long-abandoned coal mine.

The Durham Coast NNR includes striking examples of Magnesian Limestone cliffs, headlands and beaches, together with the seaward ends of the deeply incised denes carved by glacial meltwaters. In addition to important sections through the Magnesian Limestone, there are good sections through the overlying Quaternary deposits. The reserve also features notable Magnesian Limestone grassland plant communities.

Sites of Special Scientific Interest (SSSIs)

The very best of the country's wildlife and geological sites enjoy legal protection through their designation as SSSIs. This designation was introduced as one of the provisions of the 1949 National Parks & Access to the Countryside Act and has been maintained through subsequent conservation legislation. The network of SSSIs in England is the responsibility of English Nature.

County Durham contains a number of SSSIs notified primarily for their geological importance. In addition, many of the SSSIs notified for other interest include features of geological significance.

Geological Conservation Review (GCR) Sites

The Geological Conservation Review (GCR) was initiated by the Nature Conservancy Council in 1977 to identify, assess, document and eventually publish accounts of the most important parts of Great Britain's rich and varied geological heritage. GCR sites are those of national or international importance which have either been notified as SSSIs or are being considered for such notification. Publication of descriptions of GCR sites is being undertaken in a series of 42 thematic volumes. Since 1991, publication of descriptions of GCR sites has been undertaken by the Joint Nature Conservation Committee on behalf of the three country agencies, English Nature, Scottish Natural Heritage, and the Countryside Council for Wales.

County Durham includes a number of GCR sites.

Non-statutory designations protecting the earth science interest of County Durham

Regionally Important Geological and Geomorphological Sites (RIGS)

Regionally Important Geological and Geomorphological Sites are "any geological or geomorphological sites, excluding SSSIs, in a county ...that are considered worthy of protection for their educational, research, historical or aesthetic importance". RIGS are broadly analogous to non-statutory wildlife sites and are often referred to locally by the same name. They can include important teaching sites, wildlife trust reserves, Local Nature Reserves and a wide variety of other sites. RIGS are not regarded as 'understudy' SSSIs, but as sites of regional importance in their own right. Although these are non-statutory designations, the sites are recognised by the local planning authorities.

RIGS groups are organised locally, most commonly with a predominantly amateur membership. As the RIGS scheme is mainly dependent on volunteer effort its coverage tends to reflect local enthusiasm and is thus rather patchy.

Moking Hurth, or Teesdale, Cave is the only locality within County Durham designated as a RIGS. Attempts to establish an active RIGS Group for County Durham have so far been unsuccessful.

Durham County Conservation Trust sites

The draft National Scheme for Geological Site Documentation, prepared originally in 1975 by the Nature Conservancy Council and the Geological Curators' Group, further developed by the latter group and the Information Retrieval Group of the Museums Association, was devised to encourage recording of geological sites as an important tool to inform and facilitate geological conservation. In responding to this initiative, between 1977–78, Durham County Conservation Trust (the precursor to Durham Wildlife Trust) undertook one of the first comprehensive surveys of geological sites to be undertaken by a County Trust. The project aimed to provide the information necessary to further the effective conservation of geological sites, to facilitate monitoring of those sites and, where appropriate, to recommend sites for notification as SSSIs. The study culminated in the publication of the document "Significant geological exposures in the Tyne to Tees area" (Durham County Conservation Trust 1978). This identified and listed sites at which significant, or representative, exposures of named geological units or formations known within the county could be seen.

For each of the sites identified, details including geological features exposed and condition of the site at the time of the field visit were recorded. In addition, each site was assigned a rating to reflect such factors as its geological merits, accessibility, and vulnerability. The information collected during the study is today held at the Hancock Museum, Newcastle upon Tyne.

Although the sites so identified were accorded no protection, the exercise marked an extremely important first step in assessing the scope of the geological resources of County Durham.

Durham County geological sites (DCGS) The Geological Conservation Strategy, published by Durham County Council in 1994, was devised to be a natural sequel to the Durham County Conservation Strategy. This involved a major review of the most significant sites representative of the county's geology and geomorphology. The work was undertaken with the advice and assistance of local geological experts who identified a network of candidate

Durham County geological sites (DCGS)

It may be seen as building upon, and updating, the principles that lay behind the 1978 report. Like this report, the County Geological Strategy broke new ground. It was the first geological strategy produced by a local authority and is believed to remain one of the few such exercises undertaken.

The first County Geological Sites were approved by the Environmental Committee of the County Council in April 1993. Although these are non- statutory designations, the sites are recognised by the local planning authorities who consult Durham County Council over proposals which may affect them.

The County Durham Geological Conservation Strategy includes the following three non- development plan policies:

CGS 1 Maintenance of List of County Geological/Geomorphological Sites "The County Council, aided by expert opinion, will prepare a list of important geological and geomorphological sites in County Durham.

The list will be maintained by the County Council and reviewed periodically in consultation with local experts".

CGS 2 Site Creation "The County Council will promote the creation of new geological sites at scientifically important horizons during the construction of major developments such as road building and improvements".

CGS 3 Education "The County Council will assist in identifying and promoting suitable geological and geomorphological sites for teaching purposes".

(Table 1) Details of Durham County geological sites shown on (Figure 5) (A number of originally designated sites lie outside the current county administrative area)

- 1 Black Cleugh, Burnhope — (Dinantian + Structure)
- 2 Wynch Bridge — (Minerals + Igneous)
- 3 Widdybank Fell — (Igneous + Metamorphic)
- 4 Teesdale Cave (Moking Hurth Cave) — (Karst)
- 5 Stanhope Burn — (Dinantian, Namurian + Minerals)
- 6 Stable Edge Quarry — (Namurian)
- 7 Sedling Burn, Cowshill, Weardale — (Dinantian, Namurian + Minerals)
- 8 Scoberry Bridge to Dine Holm Scar (River Tees) — (Igneous, Metamorphic + Landform)
- 9 St. Johns Chapel Drumlins — (Landforms)
- 10 Pencil Mill — (Ordovician)
- 11 Noah's Ark Quarry — (Minerals)
- 12 Killhope Wheel Lead Mining Centre — (Minerals + Namurian)
- 13 Hunters Vein — (Minerals)
- 14 Middlehope Burn — (Minerals + Dinantian)
- 15 Holwick Drumlins, Romaldkirk — (Landforms)
- 16 Harthope Quarry — (Namurian + Palaeontology)
- 17 Harthope Head Quarries — (Namurian)
- 18 Grove Rake Mine and Opencast — (Minerals)
- 19 Greenhurth Mine — (Minerals)
- 20 Greenlaws Mine — (Minerals, Dinantian + Palaeontology)
- 21 Green Gates Quarry — (Dinantian + Metamorphic)
- 22 Greenfield Quarry, Cowshill — (Palaeontology)
- 23 Dirt Pit Mine — (Minerals)
- 24 Cow Green Mine — (Minerals + Metamorphic)
- 25 Copthill Quarry, Killhope Burn and Wear River at Burtreeford Bridge — (Structure, Igneous + Dinantian)
- 26 Coldberry Gutter — (Minerals, Igneous + Namurian)
- 27 Chestergarth Quarry, Rookhope — (Namurian + Palaeontology)

- 28 Bow Lees Beck — (Dinantian, Palaeontology + Karst)
- 29 Bollihope and Snowhope Carrs (Snowhope Carrs) — (Landforms + Quaternary)
- 30 Bollihope and Snowhope Carrs (Bollihope Carrs) — (Landforms + Quaternary)
- 31 Boltsburn Mine and Rookhope Borehole — (Minerals + Igneous)
- 32 Spurliswood Beck and Quarter Burn, Eggleston — (Namurian-Westphalian contact + Palaeontology)
- 33 Sharnberry Meltwater Channel — (Landform)
- 34 Knott's Hole Meltwater Channel (associated with Sharnberry MC) — (Landform)
- 35 Roundhill Quarry, Stanhope — (Namurian)
- 36 Knotty Hills and Hoppyland Kames (Hoppyland Kames) — (Landforms)
- 37 Knotty Hills and Hoppyland Kames (Knotty Hills) — (Landforms)
- 38 Harehope Quarry, Frosterley — (Namurian, Palaeontology, Buildings + Minerals)
- 39 Folly House Glacial Drainage Channels, Eggleston — (Landforms)
- 40 Fine Burn, Bollihope — (Namurian)
- 41 Dene Holme — (Permian)
- 42 Craghead Craggs, Lintzford — (Westphalian)
- 43 Cement Works Quarry, Eastgate — (Namurian + Karst)
- 46 Beacon Hill Rail Cutting — (Permian + Palaeontology)
- 47 Binchester Craggs — (Westphalian)
- 48 Bishop Middleham Quarry — (Permian)
- 49 Castle Eden Dene — (Permian + Landforms)
- 50 Causey Burn — (Westphalian)
- 51 Chilton Quarry — (Minerals + Permian)
- 52 Derwent River Gorge — (Namurian)
- 53 Dropswell Farm, NNE Hillside — (Permian + Tufa)
- 54 Underground tunnels at Easington Colliery — (Westphalian + Mining)
- 56 Ferryhill Gap — (Permian + Landforms)
- 57 Gaunless River — (Westphalian)
- 58 Hesleden Dene and downstream continuation (HD) — (Permian + Landforms)
- 59 Middridge railway cutting — (Westphalian)

61 Old Quarrington Quarry — (Permian)

62 Raisby Railway Cutting — (Permian + Minerals)

63 Rough Furze Quarry — (Permian + Minerals)

64 Sacriston Subglacial Channels — (Landforms + Quaternary Deposits)

65 Part of Sheraton Kame moraine — (Landforms + Quaternary Deposits)

67 Thrislington Quarry — (Permian + Palaeontology)

69 Wear River Gorge at Durham City — (Landforms, Westphalian + Buildings)

County Wildlife Sites

The network of County Wildlife Sites within County Durham does not have any sites designated primarily for their earth science interest, although features of earth science importance may be present.

Although these are non-statutory designations, the sites are recognised by the local planning authorities who consult the County Council over proposals which may affect them.

Some of these sites offer excellent opportunities for an integrated approach to conservation and interpretation of natural heritage.

Do protected sites adequately represent the geodiversity of County Durham?

As SSSIs and GCR sites within County Durham have been selected to reflect the national or regional importance of the features exposed they do not necessarily provide a representative coverage of the county's geology.

The network of Durham County geological sites was devised to provide that representative coverage. This audit of the county's geology has demonstrated that the existing Durham County geological sites are still relevant. However, in the light of this detailed evaluation of the county's geology, and the need to make provision for future conservation, management and interpretation of the key elements of this geology, some additional sites are desirable.

Recommendations for these will be included in the Geodiversity Action Plan.

Opportunities to enhance understanding of geological features in County Durham

Many types of groundworks and civil engineering, particularly road building and improvement works may involve significant excavation. Such operations offer opportunities to reveal hitherto unexposed geological sections, either temporarily during construction, or as permanent features. Geological features exposed in cuttings may be viewed as assets which contribute to the county's natural heritage. It is common practice in road construction to cover rock exposures in excavations, particularly cuttings, thus permanently obliterating potentially important geological exposures. With careful and imaginative planning such exposures could be retained as interesting and instructive landscape features with considerable educational value.

Quarries, both working and abandoned, offer prime opportunities to see exposures of rocks and geological features. Restoration or reclamation of abandoned quarries, landfilling, or landscaping of spoil heaps, may threaten to damage or destroy important geological features. Careful and imaginative planning, involving liaison with owners and quarry operators, may not only allow preservation of these features, but also may offer opportunities to create interesting and valuable landscape features or educational resources. This may include provision for various forms of access.

Crucial to safeguarding any such features is the knowledge of what is present and an understanding of the local, regional or national, significance of those features. One of the key purposes of this Geodiversity Audit is to inform this process of understanding and to heighten awareness of the importance of taking geological interests into account in a wide range of

planning and development issues.

Earth science interest of sites protected for other reasons

Sites of Special Scientific Interest (SSSIs) Most of the SSSIs within the county are designated for their wildlife interest. Some parallel earth science interest may be identified at a number of these, for example, where distinctive plant communities are related to particular rock types. Such sites offer excellent opportunities for an integrated approach to conservation and interpretation of natural heritage.

Scheduled Ancient Monuments (SAMs)

A number of sites of former extractive industries within the county are designated as Scheduled Ancient Monuments for their industrial archaeological interest. SAM status is a statutory designation that imposes certain legal restrictions on activities which may be permitted at a site.

Focussing upon archaeological considerations, the scheduling does not normally take into account the often intimately associated nature conservation, including earth science, interests. As may be expected of former mines or quarries, a number of these sites encompass features of some earth science importance.

Lead mining sites

The report "The North Pennines Lead Industry; Key sites and proposals for action" (North Pennines AONB Partnership — 2001), reviews the remains of the North Pennines lead industry and its impact upon the landscape. Several of the sites listed lie within County Durham. As with SAMs (above), no account is taken of the earth science interest, though many lead mining sites within the county include features of earth science importance.

Amongst the report's recommendations are lists of sites of former mineral working identified as meriting conservation and public access. As it is likely that the conservation, enhancement, public access or interpretation measures proposed for many of these sites may require some on-site groundworks, it is important to identify and make appropriate provision to safeguard the features of key earth science interest.

Can other conservation interests threaten earth science features?

Sites or features selected for any form of protection can rarely, if ever, be satisfactorily regarded as 'single interest' sites. Statutory designations, for example as SSSIs or SAMs, offer powerful means of protecting the most important sites and features, though even here failure to take account of other interests can lead to misunderstandings and potential conflict. In some instances scheduling without adequate multi-disciplinary consultation may even result in these related interests being put at risk. Non-statutory designations, whilst offering no legal protection may, nevertheless, be extremely useful in highlighting a site's importance. However, here again, the 'claiming' of such a site by one interest group, without an awareness of other likely interests, may act against the best conservation of that site.

In some instances the legal restrictions associated with SAMs may be detrimental to the conservation and use of the site's earth science interest. For example, a mine site selected for conservation and restoration of its archaeological interest may also include extremely important geological features. Failure to take these into account may result in them being compromised or even destroyed. There is thus a need wherever possible to eliminate the potential for any conflict between different conservation interests.

Opportunities to enhance the value or interest of other protected sites

The incorporation of some explanation of relevant geological information could greatly enhance the understanding of the archaeological or wildlife features visible at abandoned limestone quarries and limekilns or lead mine sites. Comment on the nature and use of building materials can greatly enhance the appreciation of the built heritage.

A multi-disciplinary approach to conservation of all features, is not only highly desirable, but offers enormous potential to enhance the value and interest of many individual sites. Whereas this may seem obvious, the underlying principle seems often to have been overlooked, or even ignored, in many previous conservation initiatives.

Figures, photos and tables

(Figure 1) The Topography of County Durham.

(Figure 2) Simplified geological map of County Durham.

(Figure 3) English Nature 'Character Areas' within County Durham.

(Figure 4) County Durham and the North Pennines Area of Outstanding Natural Beauty.

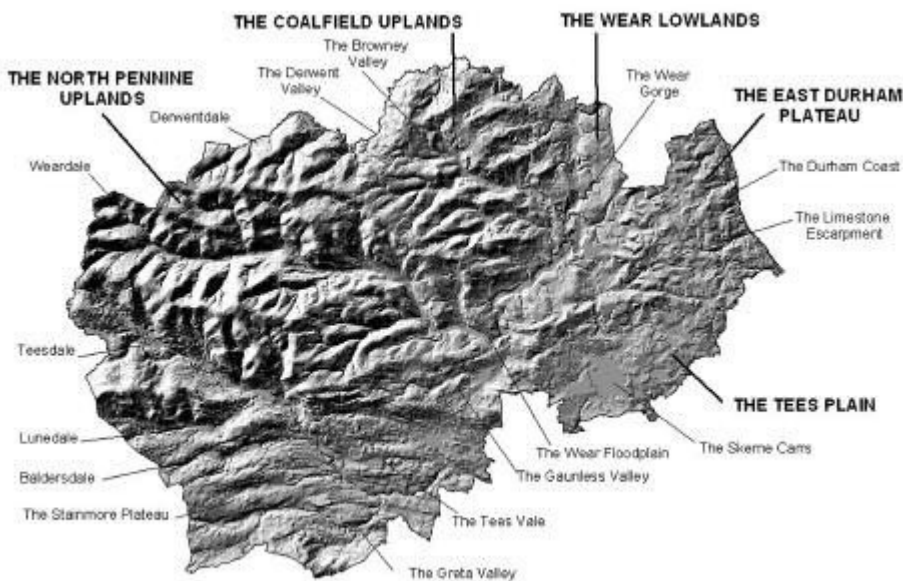
(Figure 5) Location of Durham County Geological sites (April 2004).

(Table 1) Details of County Durham County geological sites 13 shown in (Figure 5).

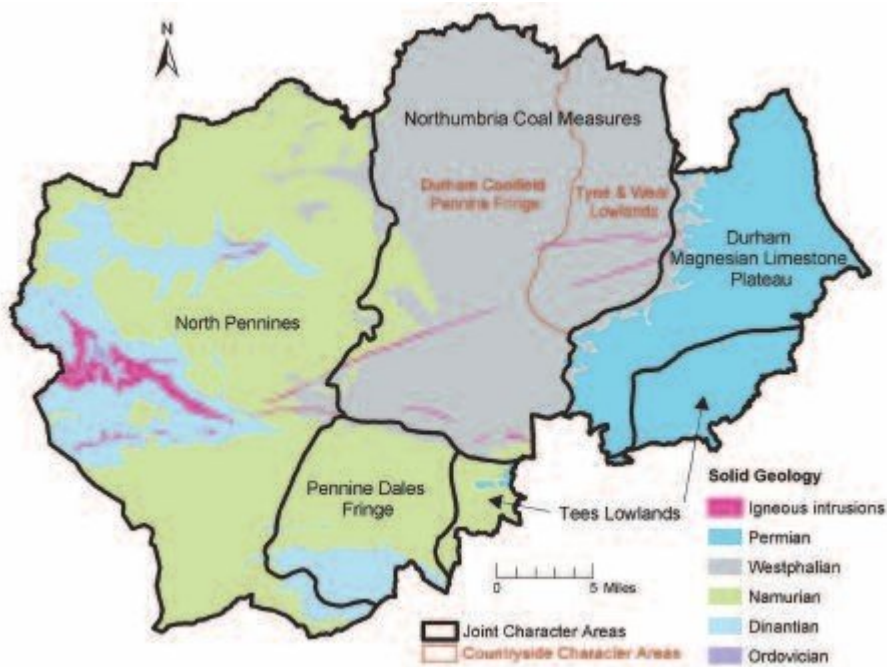
Selected references

Burek, 2001; Burek and Potter, 2002; Durham County Conservation Trust, 1978; Durham County Council, 1994; Ellis, 1996; English Nature et al. 2003; English Nature, 1991, 2000, 2002, 2003; Gray, 2003; Nature Conservancy Council, 1990; North Pennines AONB Partnership, 2004a, 2004b; Prosser, 2002; Stanley, 2001.

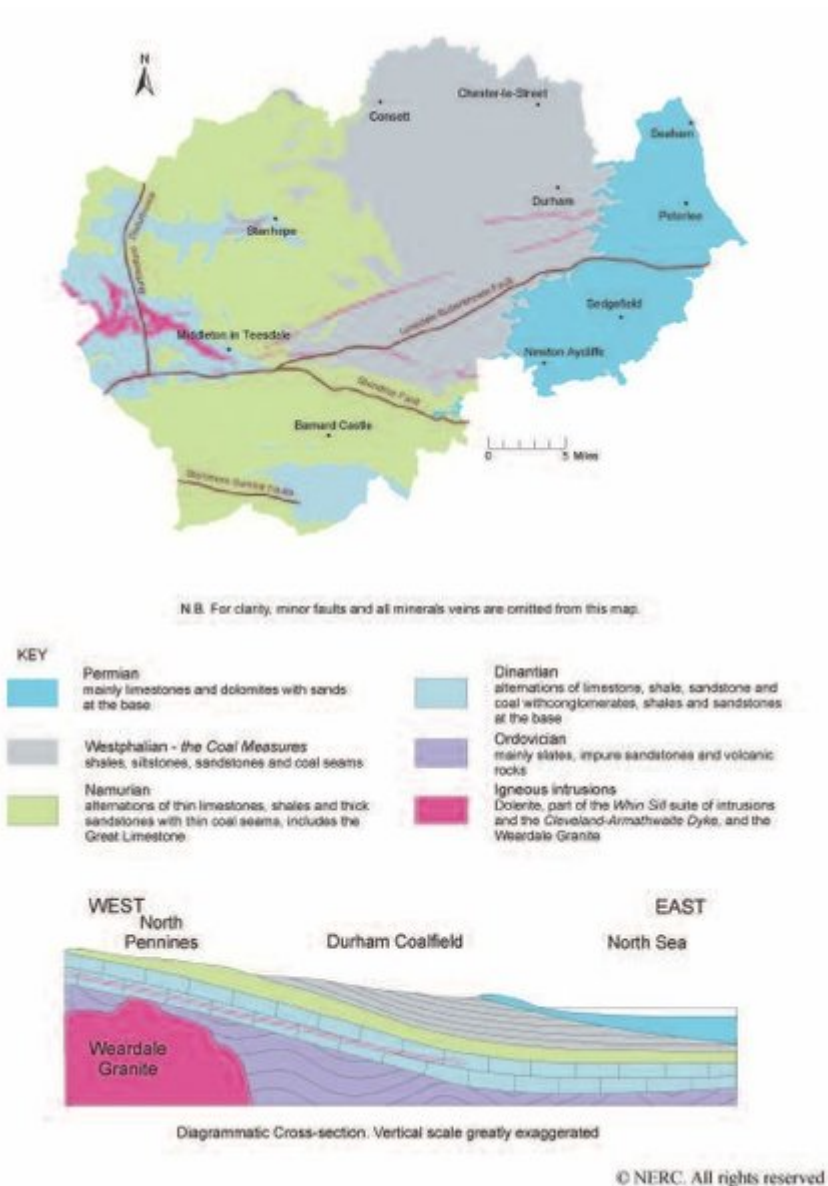
Full references



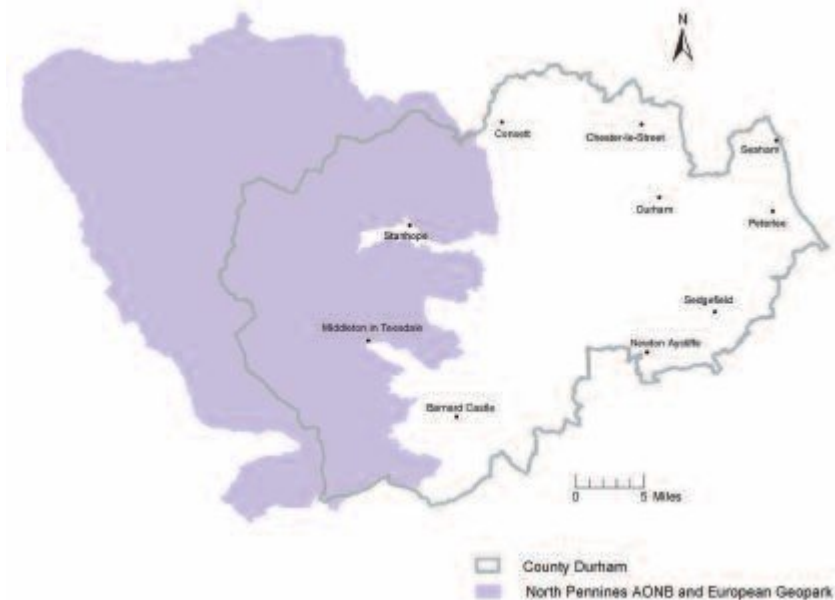
(Figure 1) The Topography of County Durham.



(Figure 3) English Nature 'Character Areas' within County Durham.



(Figure 2) Simplified geological map of County Durham.

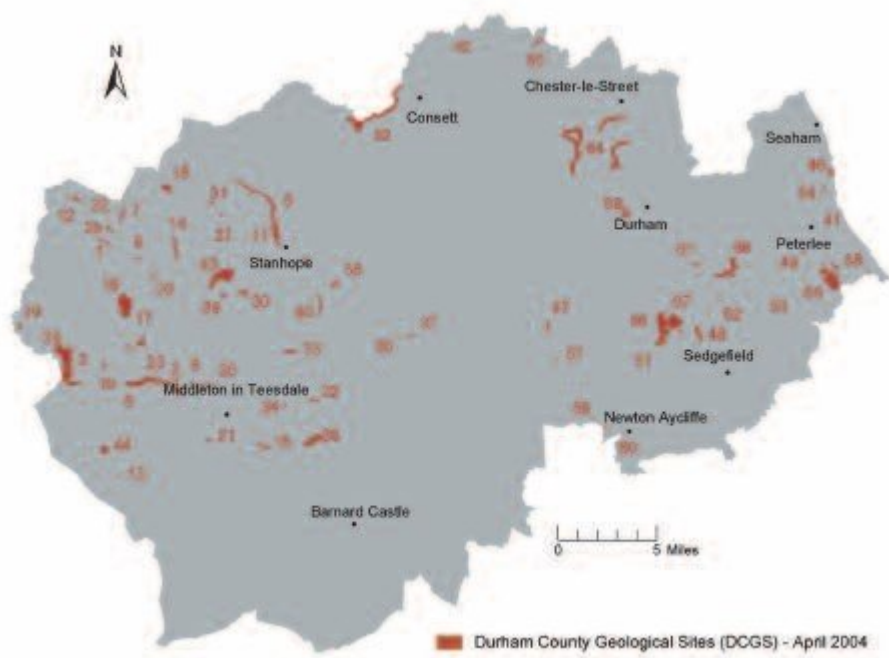


(Figure 4) County Durham and the North Pennines Area of Outstanding Natural Beauty.

Table 1. Details of County Durham County Geological Sites shown in Figure 5.

Details of Durham County Geological Sites shown on Figure 5 (A number of originally designated sites lie outside the current county administrative area)	
1 Black Cleugh, Burnhope - (Dinantian + Structure)	12 Killhope Wheel Lead Mining Centre - (Minerals + Namurian)
2 Wynch Bridge - (Minerals + Igneous)	13 Hunters Vein - (Minerals)
3 Widdybank Fell - (Igneous + Metamorphic)	14 Middlehope Burn - (Minerals + Dinantian)
4 Teesdale Cave (Moking Hurth Cave) - (Karst)	15 Holwick Drumlins, Romalldkirk - (Landforms)
5 Stanhope Burn - (Dinantian, Namurian + Minerals)	16 Harthope Quarry - (Namurian + Palaeontology)
6 Stable Edge Quarry - (Namurian)	17 Harthope Head Quarries - (Namurian)
7 Sedling Burn, Cowshill, Weardale - (Dinantian, Namurian + Minerals)	18 Grove Rake Mine and Opencast - (Minerals)
8 Scoberry Bridge to Dine Holm Scar (River Tees) - (Igneous, Metamorphic + Landform)	19 Greenhurth Mine - (Minerals)
9 St. Johns Chapel Drumlins - (Landforms)	20 Greenlaws Mine - (Minerals, Dinantian + Palaeontology)
10 Pencil Mill - (Ordovician)	21 Green Gates Quarry - (Dinantian + Metamorphic)
11 Noah's Ark Quarry - (Minerals)	22 Greenfield Quarry, Cowshill - (Palaeontology)
26 Coldberry Gutter - (Minerals, Igneous + Namurian)	23 Dirt Pit Mine - (Minerals)
27 Chestergarth Quarry, Rookhope - (Namurian + Palaeontology)	24 Cow Green Mine - (Minerals + Metamorphic)
28 Bow Lees Beck - (Dinantian, Palaeontology + Karst)	25 Copthill Quarry, Killhope Burn and Wear River at Burtreeford Bridge - (Structure, Igneous + Dinantian)
29 Bollihope and Snowhope Carrs (Snowhope Carrs) - (Landforms + Quaternary)	
30 Bollihope and Snowhope Carrs (Bollihope Carrs) - (Landforms + Quaternary)	43 Cement Works Quarry, Eastgate - (Namurian + Karst)
31 Boltsburn Mine and Rookhope Borehole - (Minerals + Igneous)	46 Beacon Hill Rail Cutting - (Permian + Palaeontology)
32 Spurlswood Beck and Quarter Burn, Eggleston - (Namurian-Westphalian contact + Palaeontology)	47 Binchester Crags - (Westphalian)
33 Sharnberry Meltwater Channel - (Landform)	48 Bishop Middleham Quarry - (Permian)
34 Knott's Hole Meltwater Channel (associated with Sharnberry MC) - (Landform)	49 Castle Eden Dene - (Permian + Landforms)
35 Roundhill Quarry, Stanhope - (Namurian)	50 Causey Burn - (Westphalian)
36 Knotty Hills and Hoppyland Kames (Hoppyland Kames) - (Landforms)	51 Chilton Quarry - (Minerals + Permian)
37 Knotty Hills and Hoppyland Kames (Knotty Hills) - (Landforms)	52 Derwent River Gorge - (Namurian)
38 Harehope Quarry, Frosterley - (Namurian, Palaeontology, Buildings + Minerals)	53 Dropswell Farm, NNE Hillside - (Permian + Tufa)
39 Folly House Glacial Drainage Channels, Eggleston - (Landforms)	54 Underground tunnels at Easington Colliery - (Westphalian + Mining)
40 Fine Burn, Bollihope - (Namurian)	56 Ferryhill Gap - (Permian + Landforms)
41 Dene Holme - (Permian)	57 Gaunless River - (Westphalian)
42 Craghead Crags, Lintzford - (Westphalian)	58 Hesleden Dene and downstream continuation (HD) - (Permian + Landforms)
	59 Middridge railway cutting - (Westphalian)
	61 Old Quarrington Quarry - (Permian)
	62 Raisby Railway Cutting - (Permian + Minerals)
	63 Rough Furze Quarry - (Permian + Minerals)
	64 Sacriston Subglacial Channels - (Landforms + Quaternary Deposits)
	65 Part of Sheraton Kame moraine - (Landforms + Quaternary Deposits)
	67 Thrislington Quarry - (Permian + Palaeontology)
	69 Wear River Gorge at Durham City - (Landforms, Westphalian + Buildings)

(Table 1) Details of County Durham County geological sites 13 shown in (Figure 5).



(Figure 5) Location of Durham County Geological sites (April 2004).