SHROPSHIRE GEODIVERSITY ACTION PLAN

CONSULTATION DRAFT – MAY 2007

PREFACE

The Shropshire Geodiversity Action Plan (SGAP) lays out the actions that partner organisations will take to protect, promote, enhance and explain Shropshire's geological heritage. The SGAP covers the administrative area of Shropshire County Council and the adjacent Unitary Borough of Telford and Wrekin.

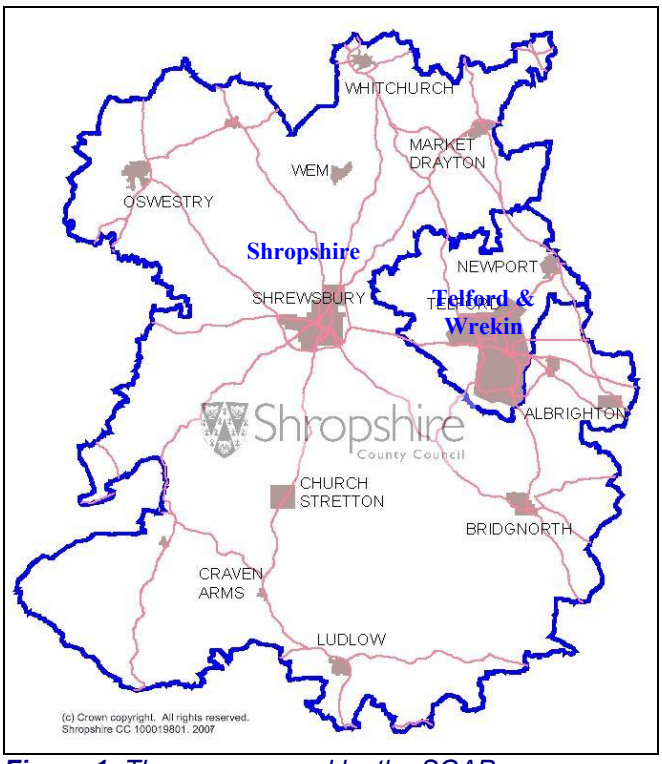

Figure 1: *The area covered by the SGAP*

The SGAP has been produced by a team of editors assisted by a wider group of geological stakeholders from the Shropshire Geological Forum. The editors are:

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Note on geological fieldwork

The identification of geological sites in this plan does not imply any right of access to such sites. Prospective visitors should always seek the permission of the landowner or ensure there is public access before undertaking geological fieldwork.

Disclaimer

Any liabilities regarding the information contained in the SGAP or any uses to which such information is put are excluded to the fullest extent permitted by law.

An electronic copy of the SGAP and Details of the SGAP process can be inspected on: www.shropshire.gov.uk/planning.nsf

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CHAPTER 1

Introduction

What is geodiversity?

Geodiversity is a word used to describe the geological variety of an area. This includes the variety of rocks, fossils, minerals and soils in an area and all aspects of landscape, cultural and economic activity which results from this variety.

Our lives and environment are very much influenced by geodiversity, from the distribution of mineral **Resources** and water supplies to the pattern of settlements, farming and wildlife. Geodiversity can add to our understanding of the natural and historic environment and can tell us fascinating stories about the history of the Earth, its ancient plant and animal inhabitants, climates and environments. Geodiversity also underpins biodiversity, or the variety of life on earth, with the soil forming the link between them.

The government has placed geodiversity at the heart of planning policy in Planning Policy Statement 9 'Biodiversity and Geological Conservation' (2005). PPS9 states that where they have been produced, it would be good practice to use Local Geodiversity Action Plans (LGAPs) as a framework within which to audit, conserve, manage and promote geological **Resources** (see Appendix 1).

Geodiversity in Shropshire

Shropshire is exceptionally rich in geodiversity. There are over 300 regionally important geological sites and rocks representing all but two of the main internationally recognised divisions of geological time. This includes rocks formed in a diverse range of conditions including deserts, tropical jungles, coral seas, volcanoes and glaciers. The county is famous for its fossils, including the Condover Mammoth, the Grinshill Rhynchosaurus (a lizard-like reptile pre-dating the dinosaurs) and the Ludlow Bone Bed (full of fossil fish bones), and has yielded the earliest known evidence of a wildfire.

Some Shropshire fossils

Shropshire is the birth-place of Charles Darwin and was an important focus for pioneering research in the early 19th Century which laid the foundations for modern geology. Rocks of a particular age were first described in the county and place names such as Ludlow and Wenlock are now internationally recognised as divisions of geological time. Shropshire continues to be regarded as a classic training ground for geologists because of the variety of its geology, bringing many educational groups and geotourists to the county each year.

Geological diversity accounts for Shropshire's attractive and varied landscapes, from the glacial meres and mosses around Ellesmere to the Shropshire Hills Area of Outstanding Natural Beauty with its wooded Silurian limestone scarps, Ordovician volcanic hills and Precambrian moorlands.

Geoconservation in Shropshire

A wide range of organisations are involved in geological conservation and interpretation actions in Shropshire, including local interest groups, local authorities and the minerals industry. In addition, part of the Abberley and Malvern Hills European Geopark extends into the county, up the Severn Valley to Bridgnorth.

Geoconservation in action

What is a Local Geodiversity Action Plan?

The SGAP is one of a series of Local Geodiversity Action Plans (LGAPs) published across England by a range of organizations, mainly at the county level. The (LGAP) system launched by English Nature in 1998 aims to provide a co-ordinating framework within which issues related to geological conservation can be assessed within a local area. LGAPs are action-led and rely on stakeholder partnerships to carry out the proposed actions.

The SGAP identifies Shropshire's geological assets in order to promote actions which conserve and enhance them. The overarching aim is to promote knowledge, education, conservation and sustainable management of the county's geodiversity. The processes set in motion by the plan are intended to be self-perpetuating. Future actions will follow from existing ones, taking account of experience gained through implementation.

The SGAP is not an end in itself. The success of this process is dependent on the ability to deliver the proposed actions. We have therefore adopted a number of strategies in order to maximise opportunities for achieving the actions, placing a strong emphasis in particular on partnership and joint working.

Why does Shropshire need a Geodiversity Action Plan?

Shropshire's rich geological heritage needs to be conserved so that it is available for enjoyment and study by current and future generations. Much good work is already being done. However, a number of issues have the potential to impact significantly on geological conservation interests unless appropriate action is taken. This includes potential threats to geodiversity such as natural deterioration of rock exposures and infilling of old quarries. It also includes potential opportunities such as the ability to improve access to suitable exposures and create new geological trails.

The SGAP will facilitate conservation and access to Shropshire's wealth of geological and related cultural and heritage features, ensuring that they are considered at all levels of planning and land use. Other potential benefits include:

- promoting improved understanding of geological processes, evolution / past life forms and the effects of earlier cycles of climate change;
- emphasising the important relationship between the earth sciences and the environment at a time when environmental issues such as climate change are assuming ever increasing prominence;
- promoting the economic / tourism potential of the county's geodiversity assets.

The SGAP has potential significance to a wide range of audiences, including:

- local residents and communities who want to find out more about the geology, landscape and mineral extraction in their area;
- schools and colleges looking for suitable geological exposures / landscape examples for educational use;
- universities and institutes looking to undertake research into Shropshire's geology
- local specialist interest groups such as wildlife and mining enthusiasts and building historians who have need for or interest in specialist geological information to tie in with their principal interest;
- visitors with a general interest in geology;
- local businesses;
- local authorities looking for guidance on how to incorporate geological conservation into their planning decisions and policies;
- developers and landowners looking for guidance on how to conserve geological assets on their land.

We will encourage the public and interested groups and organisations to become aware of and involved in geological conservation initiatives in Shropshire, and will seek to identify ways in which this can occur.

The SGAP Steering Group and partner organisations

The editors and stakeholders will form a steering group which will be responsible for:

- co-ordinating the plan's actions;
- identifying the resources necessary in order to progress SGAP actions;
- ensuring that proposed actions are realistic and achievable;
- identifying suitable partner organisations to assist with SGAP actions;
- ensuring that the SGAP is a useable tool for landowners and policy makers;
- monitoring and implementation.

The core of the steering group will comprise the existing membership of the Shropshire Geological Forum (SGF) which has been meeting to promote geological conservation and interpretation work within the county since 2003. Organisations currently represented on Shropshire Geological Forum are:

- Shropshire County Council, Planning Development Control (SGAP editor);
- Shropshire Geological Society (SGAP editor);
- Shropshire Wildlife Trust (SGAP editor);
- Shropshire County Council, Museum Services (SGAP editor).
- Natural England (geological SSSIs);
- SRIGS members;
- British Geological Survey;

- Telford & Wrekin Council;
- Shropshire County Council, Sustainability Group;
- Shropshire Hills Area of Outstanding Natural Beauty (AONB) Partnership;
- Shropshire County Council, Tourism;
- Shrewsbury Museum Service;
- Abberley and Malvern Hills Geopark;
- Adjoining LGAP steering groups;
- Shropshire Caving and Mining Club;
- Shropshire Mines Trust Ltd;
- University of Birmingham;
- Forestry Commission;
- The National Trust;
- Shropshire Hills Discovery Centre.

The roles of some of the SGAP steering group members are outlined in Appendix 2.

Whilst the steering group will coordinate SGAP actions, a priority will be to establish an extended partnership network, engaging local landowners, businesses and the leisure and education sectors. Partners will be encouraged to play an active role in the SGAP. Potential currently identified SGAP partners include:

- The Minerals Industry in Shropshire;
- Borough / District Councils (planning and landscape conservation);
- Shrewsbury Darwin Festival;
- The Bog Mine Visitors Centre;
- Wardens, managers and land agents;
- Other Shropshire Museums and interpretation facilities;
- Interested individuals and landowners (including RIGS owners);
- National Farmers Union;
- Wildlife conservation bodies (i.e. Shropshire Biodiversity Partnership);
- Education, including universities and colleges of further/higher education, including Earth Science Teachers Association, WEA and U3A;
- Relevant Parish Councils and Parish Plan Steering Groups;
- local community groups such as WI;
- local interest groups (heritage, walking);
- The Geologists Association;
- Other local geological societies and trusts.

Become involved with the SGAP

You can apply to join the Steering Group or the partner network by sending details of your organisation to planning.development@shropshire.gov.uk

CHAPTER 2

A summary of Shropshire's geology

Shropshire's geology spans almost 700 million years and charts the movement of England over 110 degrees of latitude and 12,000km from the southern to the northern hemisphere, due to plate tectonics (see figure 3; p11). Throughout this immense timescale the county has remained at a border between different geological regions. Plate collision, faulting and folding of rocks formed in diverse conditions have been major factors accounting for Shropshire's exceptional geodiversity.

Precambrian At 660 million years old the Precambrian volcanic rocks (Uriconian) of the Wrekin, Stretton Hills and Earl's Hill are amongst the oldest rocks in England, and are associated locally with even older metamorphic rocks (schists and gneisses). They represent the remains of an island arc which, like modern Japan, formed on the edge of one of the Earth's major crustal plates. Shropshire was in the southern hemisphere at this time, 60° south of the equator.

Erosion of the island arc led to the accumulation of a massive thickness of sedimentary rocks (the Longmyndian) in a subsiding trough on the edge of the continental crust. At the end of the Precambrian, *ca.*550 million years ago, the volcanic and sedimentary rocks were folded into a huge syncline (U shaped fold) which was bordered by two great tears in the crust: the Church Stretton and the Pontesford-Linley faults.

Precambrian moorland at the Longmynd and gritstones at Bayston Hill Quarry

Cambrian, Ordovician and Silurian (Lower Palaeozoic) During the Lower Palaeozoic Shropshire was located at the edge of an ocean (the Iapetus Ocean) which became progressively smaller during this period, eventually being destroyed. To the west of the Long Mynd the continental shelf plunged into an area of deeper water which was the site of significant volcanic activity in the mid-Ordovician. To the east the shallow marine shelf extended across the West Midlands towards a Precambrian landmass in the area of Leicestershire. During this period southern Britain moved from 70°S to a subtropical position at 25°S. This enabled the coral reefs of Wenlock Edge to form during the Silurian period. The wide range of rocks deposited in the Lower Palaeozoic accounts for the diverse landscapes of the Shropshire Hills Area of Outstanding Natural Beauty.

Devonian Uplift and mountain building ensued in the Devonian period (*ca.*390Ma) as southern and northern Britain collided with the closure of the Iapetus ocean. Shropshire retained a border position. New mountains to the north swept sediment southwards to be

spread across the alluvial plains of the Marches, creating what is popularly known as the Old Red Sandstone.

Shropshire has a diverse range of Palaeozoic rocks with important mineral ***Resources***

Carboniferous Less dramatic earth movements at the end of the Devonian saw uplift of a land mass across central England ('St George's Land') as part of a larger European landmass. This ran west to east across the centre of the county, with extensive shallow tropical seas to the north and south. The Carboniferous Limestone of the Oswestry uplands was deposited to the north of St Georges Land on the southern margin of the Pennine Basin. The thinner deposits around Titterstone Clee were deposited to the south of St Georges Land on the northern margin of the Avon or Mendip Basin.

This marginal position persisted through into the Coal Measures, by which time, Shropshire was very close to the equator and home to extensive tropical rain forests. The resulting great Midlands coal swamps extended westwards until they finally petered out against the Welsh uplands and the northern flank of the Long Mynd. This led to the formation of a number of small coalfields from Oswestry in the north-west, through Shrewsbury to the Wyre Forest in the south east. At Coalbrookdale near Telford coal famously fuelled the birth of the Industrial Revolution, but perhaps few realise just how useful it was for an essentially rural population simply to have access to local sources of coal.

Shropshires Carboniferous rocks are an important source of minerals

Permo-Triassic During the Permian period Shropshire continued its northward journey into desert latitudes around 20°N as part of the supercontinent of Pangaea. Wind-swept desert conditions dominated by sand dunes prevailed, with older dunes being progressively buried and "fossilised" beneath newer ones. This produced the "New Red Sandstone", a relatively weak "dune bedded" sandstone so clearly seen now in the cliffs below Bridgnorth High Town. A major river system flowed north through Shropshire in the early Triassic. The deposits of this river gave rise to a number of prominent sandstone ridges in north and east of the county, yielding fine building stones including the famous Grinshill stone. There followed a return to desert conditions later in the Triassic, but this time a dust desert, producing the red clays seen in the north of the county. Extensive salt deposits formed at this time and are worked in the neighbouring county of Cheshire.

Jurassic Subsidence of the New Red Sandstone or Triassic basins associated with the break-up of Pangaea heralded in broader warm seas of the Jurassic. Initially conditions were muddy resulting in the build up of Liassic mudstones which occur around Prees in north east Shropshire where they were the basis of a flourishing 18th and 19th century brick making industry. This is where the history of Shropshire as recorded in the bedrock ceases. We have none of the famous Jurassic Limestones of the south Midlands, nor any of the Cretaceous chalk, though the clear warm sea of the time probably spread right across a Britain worn down to its rocky foundations.

Tertiary (Palaeogene and Neogene) America began to split away from Europe in the Tertiary period (from 65Ma), creating the Atlantic Ocean. Britain, on the north western edge of the European Continent began to tilt significantly to the south east as the ocean formed. Younger rocks were stripped off newly elevated uplands of north-west Britain to reveal the ancient landscapes of the Palaeozoic beneath. Meanwhile, south east England warped steadily downward, with thick Tertiary deposits accumulating in the London-Paris Basin. And where was the axis of tilting? Yes, through Shropshire!

Pleistocene The penultimate refinement of this process came about during the Ice Age, when glaciers swept southwards across the Shropshire-Cheshire Plain and eastwards out of upland Wales. There were two major glacial advances peaking around 450 000 and 20 000 years ago which left the north of the county plastered with till (boulder clay), sands and gravels. Thicker glacial deposits (moraines) formed at the edges of glaciers, giving rise to sandy hillocks. The hollows between them filled with water to give us the landscape of 'meres and mosses' so characteristic of the country around Ellesmere. The broad spreads of sand and gravel gave poor soil for cultivation and survived for a long period as heaths - many now remembered in place names only.

Meanwhile glaciers moving out of Wales deepened their valleys to a characteristic U shape, leaving the gently rounded and fairly flat-topped hills of the Clun Forest between them. Yet again Shropshire was on a margin of geological activity. The last glacial advance from the north stopped up against the Shropshire Hills. The Welsh glaciers gave out around Ludlow, providing a South Shropshire landscape which is influenced by both glacial erosion and glacial deposition.

Holocene or Recent Since the end of the last ice age about 10 000 years ago, our landscape has been gradually shaped into the form we see today. Initially this was by vast outpourings of water from the retreating ice sheet. Later landscape processes were dominated by natural (temperate) weathering and fluvial action aided by man-made deforestation. This has given rise to the modern river valleys with their flat flood plains and gravel terraces representing former river levels. At this time, rising post-glacial sea levels broke through the chalk ridges linking Britain to the continent, forming the English Channel and leaving us as an island.

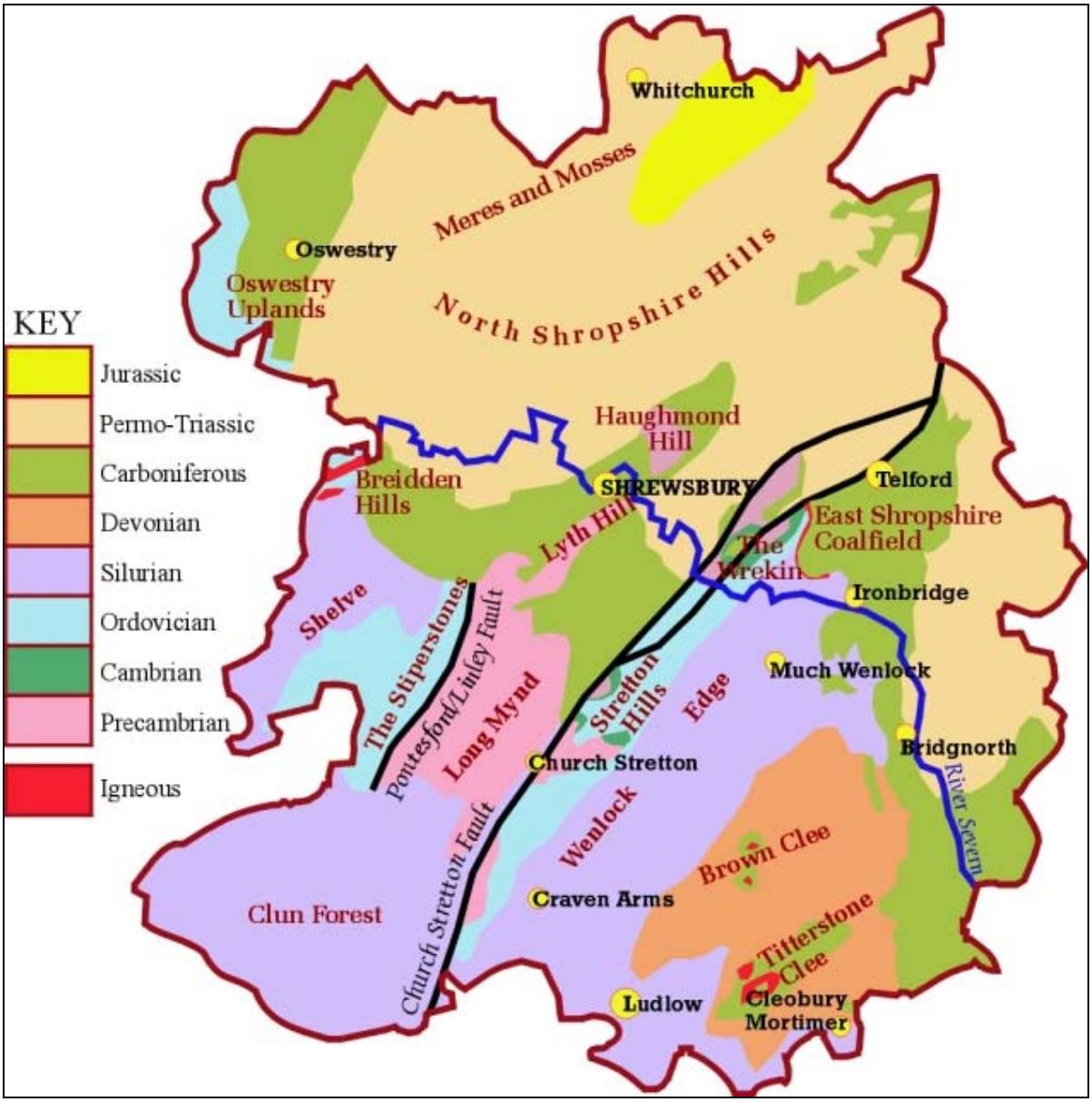

Figure 2. The geology of Shropshire
Relatively younger deposits (mainly Permo-Triassic with thick glacial cover) in the north and east are separated from older rocks (Precambrian to Devonian) in the south and west by an intermittent band of Carboniferous strata containing a series of small coalfields.

Shropshire's landscape has been carved out of the incredibly varied sequence of rocks which underlie the county, the resistant ones forming the upstanding hills, the less resistant being eroded away down valleys. Few other regions of the world can demonstrate such a vast degree of geodiversity in such a small area, hence our need for a comprehensive plan to do justice to all the issues and challenges which this raises.

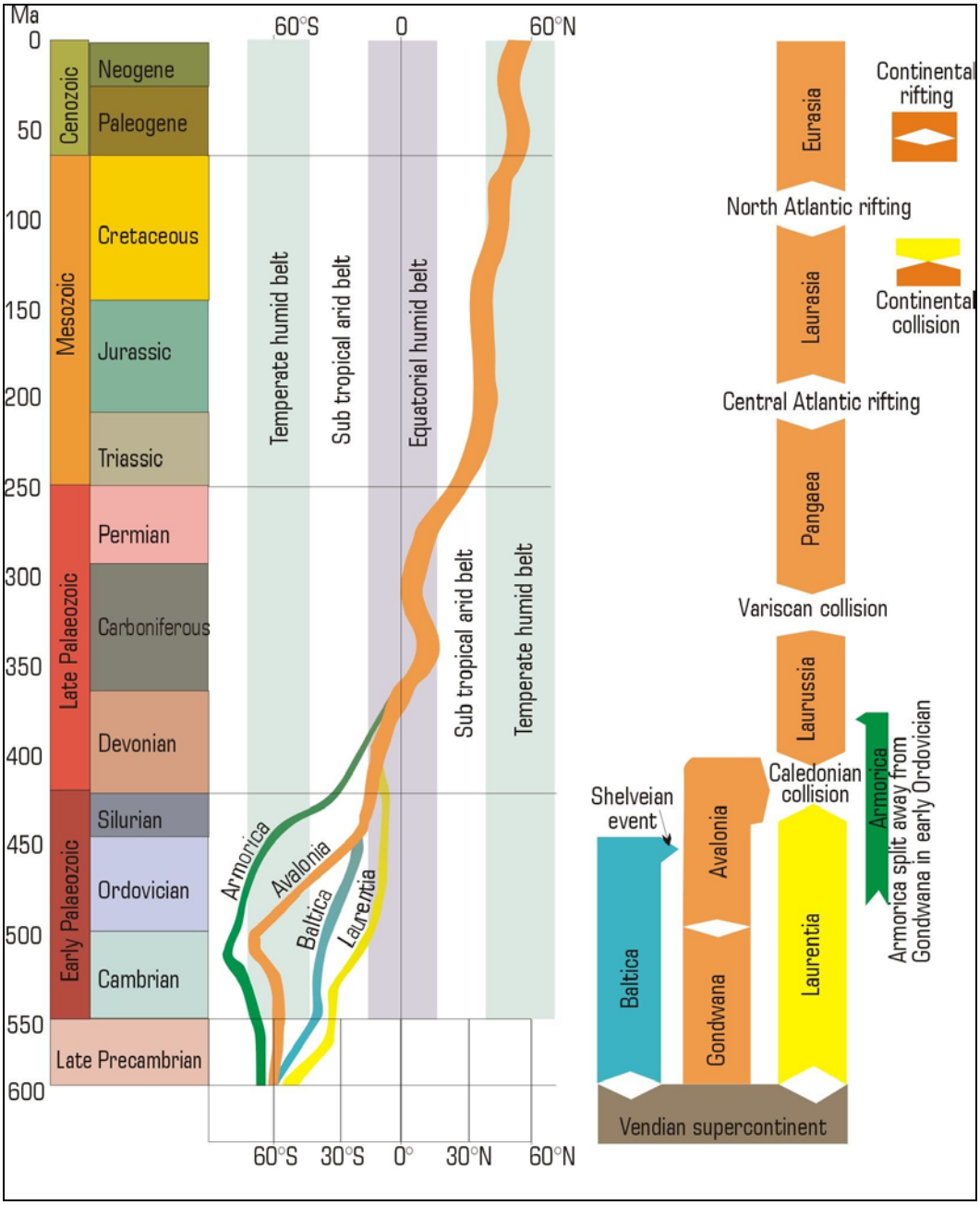

Figure 3. Shropshire through geological time (from P.Toghill, The Geology of Shropshire)
Shropshire's rocks chart the movement of England over 110 degrees of latitude and 600 million years. Ocean closure, continental collision and mountain building in the Palaeozoic gave way to more stable tectonic conditions, initially as part of the desert continent of Pangaea and then at the edge of a widening North Atlantic Ocean. The county's rocks faithfully record these changes.

Economic Geology Geodiversity has played a significant part in the prosperity and development of the county (Table 2.1). The county's coalfields have all been extensively mined in the past. More recently, extensive areas of land were worked for coal by opencast methods in south-west Telford up to the early 1990's. At Ironbridge near Telford, local sources of coal, limestone and ironstone provided the raw materials necessary to start the industrial revolution. The county was also formerly a major supplier of lead and barytes (barium ore) in the 19th and early 20th centuries.

Galena (lead ore)

A diverse range of local building stones add character to the county's historic towns and villages. This includes the famous cream-coloured Triassic Grinshill stone which continues to be quarried today, and has been used both locally and nationally on many prestigious buildings. The Carboniferous and Silurian limestones occurring within the county were also the basis for an extensive 19th century lime industry, for agriculture and in earlier years for building. Shropshire remains an important mineral producer. The county supplies around 4 million tonnes of aggregate annually and is the largest supplier of crushed rock in the West Midlands region. Water too is a valuable geological resource which is exploited within the ground, especially in the relatively porous and permeable Permo-Triassic strata of the North Shropshire Plain.

Table 2.1 A summary of Shropshire's rocks and mineral deposits

SYSTEM & AGE (million years: Ma)	MINERAL RESOURCE AND OCCURRENCE
HOLOCENE (0.01 Ma to present)	Alluvium and river terrace deposits have been worked until recently in the Severn Valley south of Bridgnorth. Peat was also formerly dug at Whixall Moss near Wem.
PLEISTOCENE (2 Ma to 0.01 Ma)	Widespread glacial sands, gravels and clays especially in North Shropshire. Sand and gravel worked near Ellesmere and at Condover south of Shrewsbury. Raised fluvioglaciall terrace deposits worked at Bromfield near Ludlow.
TERTIARY (65-2 Ma)	Sediments of this age are thought to be absent in Shropshire, although Tertiary dykes are intruded into Triassic sandstones in North Shropshire and deep Tertiary weathering has affected the dolerite 'Dhu Stone' of Clee Hill.
CRETACEOUS (135-65 Ma)	Sediments of this age are absent in Shropshire.
JURASSIC (206-135 Ma)	Outcrops around Prees in North Shropshire. Historical use as brick clay.
PERMO-TRIASSIC (206-290 Ma)	Extensive outcrop of sandstones, conglomerates and mudstones in North & East Shropshire. Conglomerates yield sand & gravel. Sandstones are an important source of building stone which is still worked near Wem. Also a major groundwater aquifer. Historical use of upper Triassic Mercia Mudstone as a brick clay.
CARBONIFEROUS (362-290 Ma)	Extensive outcrop from East to North West in discontinuous arc. Coal Measures yield coal and associated fireclay. Formerly mined in 5 small coalfields and the subject of recent open casting near Telford and at Clee Hill. Overlying strata yield brickclays worked at Hadley (Telford) and south of Bridgnorth. Formerly mined for iron ore and clay in Telford. Underlying limestones worked previously for lime at Ironbridge, near Oswestry and south and east of Clee Hill. Dolomitic limestones currently worked for roadstone (e.g. at Llynclys nr Oswestry). Dolerite (an igneous rock, locally known as "Dhu Stone") is also worked for roadstone at Clee Hill near Ludlow. Sandstones formerly important for building stone.
DEVONIAN (416-362 Ma)	Extensive outcrop of 'Old Red Sandstone' in South East Shropshire. Formerly worked for building stone (sandstone), brickclay and lime ("cornstones").
SILURIAN (443-416 Ma)	Wide outcrop of limestone, siltstone and mudstone in South Shropshire. Limestones yield roadstone (Wenlock Edge), building stone (Corvedale) and lime.
ORDOVICIAN (495-443 Ma)	Varied sequence of sedimentary and volcanic rocks outcropping in West Shropshire and also to the east of the Church Stretton Fault. Yielding roadstones near Minsterley (hardened grit/siltstone) & Llanyblodwel (volcanic) nr Oswestry. Contains important metalliferous ore deposits west of Long Mynd which were worked extensively in 19th to early 20th Centuries (e.g. Snailbeach mine). Flags formerly worked for roofing stone and grits for building stone.
CAMBRIAN (545-495 Ma)	Very restricted occurrence of sandstones (building stone), mudstones and quartzites around Comley and the Wrekin. Quartzites formerly yielded roadstone at the Wrekin.
PRECAMBRIAN (+ 545 Ma)	Divided in Shropshire into a thick sequence of sedimentary rocks (Longmyndian) and a generally older sequence of volcanic and metamorphic rocks (Uriconian). Main Longmyndian outcrop at the Long Mynd near Church Stretton (grits, siltstones and mudstones). Grits worked for roadstone at Bayston Hill and Haughmond, Shrewsbury. Uriconian rocks have restricted outcrop around the Wrekin and at the Stretton Hills. Volcanics are worked for roadstone at Leaton near Wellington.

Historical geological research in Shropshire Shropshire and adjoining areas were an important focus for geological research in the first half of the 19th Century which determined the relationships of Lower Palaeozoic strata. The early story is dominated by three pioneering geologists: Roderick Murchison, Adam Sedgwick and Charles Lapworth. Sedgwick, working in North Wales identified a series of ancient rocks which he named the Cambrian system after Wales's Cambrian mountains. Meanwhile Murchison, working in

South Wales and the Marches also identified an ancient system of rocks which he named the Silurian system after the Silures, an ancient British tribe. Problems arose as the respective research areas met in Shropshire and Mid-Wales. It became apparent that the lower part of Murchison's Silurian system overlapped with the upper part of Sedgwick's Cambrian! A lengthy dispute ensued. This was finally settled by Lapworth, president of the Geological Society who proposed that the disputed strata should be placed instead in a new system of intermediate age which he named the Ordovician, also after an ancient British tribe.

Historical geological research. Lapworth at Comley Quarry

Much of the subsequent work determining the relationships between the three systems was undertaken in Shropshire by Gertrude Elles and Ethel Wood under Lapworth's direction at Birmingham University.

Shrewsbury and Charles Darwin Shropshire's county town of Shrewsbury is the birthplace of Charles Darwin whose book 'The Origins of Species' introduced the concept of natural selection which is a cornerstone of modern evolutionary theory. Darwin postulated that species adapt to their environments through a process of incremental changes which mounts over time, ultimately giving rise to new species. Species more able to adapt will survive whilst those less able to will become extinct.

Natural selection provided a mechanism to explain extinction in the fossil record. This in turn allowed fossils to be used with confidence for dating the relative age of rocks. It is an interesting coincidence that some of the most important early work establishing the relationship between older 'Lower Palaeozoic' rocks was undertaken in and around Darwin's birth county of Shropshire.

CHAPTER 3

Themes, objectives and actions

This chapter lists the objectives and actions of the SGAP. These are grouped into three main themes and a fourth section dealing with monitoring and implementation:

Theme 1 – Geoconservation and access
Theme 2 – knowledge and understanding
Theme 3 – Interpretation and geotourism
Section 4 – Delivering SGAP actions

Each objective contains a short statement about the issue we are seeking to address. The organisations identified as likely to take the lead role are listed, as are the intended timescales and resource implications of the action (see table 3.1). Many actions will require additional resources in order to be progressed. Section 4 sets out amongst other matters how we propose to secure the necessary resources.

We have highlighted in bold those actions which we consider to be priorities for the current plan. These may need to be undertaken first before other actions can be implemented.

Table 3.1

Organisations responsible for leading an action are summarised as follows:

SGS = Shropshire Geological Society;
SWT = Shropshire Wildlife Trust;
SCC = Shropshire County Council, Planning Development Control;
LMRC = Shropshire County Council, Museum Services;
BGS = British Geological Survey;
AONB = Shropshire Hills AONB Team;
SCMT = Shropshire Caving and Mining Club;
SMT = Shropshire Mining Trust;
GO = Geodiversity Officer (objective 4.3 – subject to funding).

The resource implications of an action are scored on a resources scale of 1 to 3 as follows:

1 – likely to be achievable with existing steering group / partner resources;
2 – may require limited additional staff or voluntary resources;
3 – likely to require significant additional resources.

Carboniferous Limestone at Llynclys Quarry near Oswestry. The quarry is interesting both for its geology and biodiversity and has won a recent national award for the quality of its restoration.

Theme 1 - Geoconservation and access

Strategic aims:

- To identify site-based actions in response to threats and opportunities, including by promoting geological management plans and selecting key sites for improvements;
- To provide opportunities to become involved with geology and geological conservation issues;
- To provide targeted information and advice to audiences including local communities, visitors, landowners, businesses, local authorities, developers, schools and colleges.

Geoconservation and access: Objective 1.1 – Conservation and enhancement of geological sites

Issue: It is important to establish management plans at key sites to keep them accessible and prevent deterioration. Many sites with geological value are owned by the minerals industry or other major landowners such as the National Trust who can be well placed to protect and promote geodiversity.

SGAP response: We will identify and monitor those sites where geology is under the greatest threat and promote appropriate remedial actions, having regard to geological significance of the site, the nature of the threat and other relevant interests such as biodiversity. We will also identify opportunities for enhancing the county's most significant geological and geomorphological sites where appropriate, by promoting improved access and management agreements. In doing so we will work with owners of geological sites to promote appropriate land management techniques to conserve and, where possible, enhance geological interest. This will ensure that suitable sites are available for education, geological interpretation and study.

Actions:

1.1a **Carry out ongoing review of current geological sites (including historical mining features) and potential new sites and undertake regular site survey work to identify sites under threat (e.g. badly overgrown or used for dumping) and potential opportunities for geological conservation and interpretation.** (**Responsibility:** SGS, SWT; **Timescale:** Ongoing; **Resources:** 1-2)

1.1b **Develop full management plans for key sites.** (**Responsibility:** SWT, SGS; **Timescale:** 4 new management plans by Dec 2008; **Resources:** 3)

1.1c **Establish a system for regular monitoring of the condition of all RIGS, possibly on the basis of allocating lists to local volunteers as "wardens".** (**Responsibility:** SGS (RIGS group), AONB; **Timescale:** Dec 07; **Resources:** 3)

1.1d Establish outline management plan for all RIGSs and Liaise with all RIGS owners to promote individual site management plans (**Responsibility:** SCCP, AONB, SWT; **Timescale:** Outline management plan by Dec 2009. Promotion ongoing; **Resources:** 2-3; See objective 2.3)

1.1e Re-survey key mining sites and features where necessary to ensure accurate records. Gauge the rate of decay and degree of risk to such features, then make recommendations for conservation action. (**Responsibility:** SCMT/SMT; **Timescale:** Subject to funding; **Resources:** 3)

1.1f Carry out conservation actions, working closely with landowners, local councils, businesses and other relevant stakeholders such as ecologists. (**Responsibility:** SGS, SWT; **Timescale:** Ongoing; **Resources:** 2)

1.1g Seek access agreements for privately owned sites. Liaise with Natural England to use potential of Environmental Stewardship scheme to secure access. (**Responsibility:** SWT, AONB; **Timescale:** Ongoing; **Resources:** 2-3)

1.1h Seek to increase the number of corporately owned sites promoting geodiversity. (**Responsibility:** SGS, SWT; **Timescale:** Ongoing; **Resources:** 2)

Geoconservation and access: Objective 1.2 – Geological trails.

Issue: A geological trail is a collection of accessible, high quality geological sites such as RIGS which are linked by paths and together exhibit a coherent geological theme. The SGS has already identified and published interpretation leaflets on a number of geological trails in Shropshire including Titterstone Clee, North Stiperstones, Wrekin & Ercall, and Wenlock Edge. Such trails represent a valuable interpretation and teaching resource and can often display the characteristics of an area's geology far better than any individual site. (See also 2.2)

SGAP response: We will identify options for establishing new geological trails and will promote the management of existing trails in order to maintain access to suitable sites.

Actions:

1.2a Identify opportunities to enhance and provide improved access to geo-trail sites including seeking site management agreements and consider the potential for new themed geological trails. For example:

i) A trail through the whole of the geological succession in Shropshire
ii) A trail through all the different rock types in Shropshire.
iii) A trail through the past and present mining and quarrying in Shropshire.
iv) use of satellite navigation handsets in support of geological trails.

(**Responsibility:** SGS, SWT, AONB; **Timescale:** establish three new geological trails by 2009 including access and interpretation materials **Resources:** 3)

Geoconservation and access: Objective 1.3 – Incorporating geological conservation into quarry working and restoration

Issue: Quarry restoration schemes can provide excellent opportunities to retain and provide access to geological exposures. This can be achieved for example through careful consideration of face and bench configurations, formation of access ramps and creation of viewing platforms. Temporary exposures created by mineral extraction can also provide important geological information which can be lost as extraction proceeds. (See also 1.4)

SGAP Response: We will liaise with quarry owners to promote opportunities for geological study by organised groups at appropriate quarries and will promote the incorporation of geological conservation into quarry working and restoration schemes.

Actions:

1.3a **Set up a programme to visit all working quarries on a regular basis to discover and record potential new important exposures. Use RIGS database format to record new quarry outcrops.** (**Responsibility:** SCCP; **Timescale:** Ongoing; **Resources:** 2-3).

1.3b **Prepare a guidance note on geological conservation and quarrying.** (**Responsibility:** SCCP; **Timescale:** Dec 07; **Resources:** 1)

1.3c Review current mineral workings restoration programmes for sensitivity to geological conservation and exposure enhancement and liaise with current mineral operators to promote SGAP objectives in quarry restoration plans. (**Responsibility:** SCCP, SGS; **Timescale:** Aug 08; **Resources**: 2)

Geoconservation and access: Objective 1.4 – Promoting geological conservation at disused quarries and mining sites in association with other uses

Issue: Many former quarries and mining sites in Shropshire have been developed for other uses such as business, nature reserves and outdoor recreation venues. There may be scope to incorporate geological conservation in association with such other uses at suitable sites. (See also 1.3)

SGAP response: We will promote geological conservation and interpretation in association with other post-quarrying uses at appropriate disused quarries and mining sites. This is provided such uses are consistent with the relevant health and safety, access environmental and amenity considerations.

Action:

1.4a **Highlight geological conservation and interpretation opportunities in association with other uses for former quarries and provide guidance on incorporating geolocical conservation into such uses.** (**Responsibility:** SCCP, SGS; **Timescale:** Ongoing; **Resources:** 2-3)

Geoconservation and access: Objective 1.5 – Identifying and recording new exposures

Issue: New excavations such as for buildings, services and road cuttings can add to our knowledge of the county's geology. However, whilst geologists may be aware of excavations at active quarries, other excavations and the geological information they contain may go unnoticed. It may be possible to design some road cuttings and other engineering features from the outset so that valuable geological outcrops can be safely retained. This may lead to other benefits such as enhanced visual and biodiversity interest. There are also many disused stretches of railway line and road cuttings in Shropshire with potentially valuable rock exposures, but such outcrops can be threatened by factors including erosion and re-vegetation.

SGAP response: We will seek to identify and record valuable temporary geological exposures, including through engagement with the planning system. We will promote the incorporation of geological conservation principles in the design of appropriate new engineering schemes where geological exposures are likely to be created. We will also seek to record where valuable non-quarry exposures remain and will promote options for conserving them.

Actions:

1.5a **Set up monitoring system to allow significant new geological exposures to be identified with link to land use planning system and RIGS process.** (**Responsibility:** SCCP; **Timescale:** Aug 07; **Resources:** 1-2).

1.5b **Screen planning applications and policies to identify where significant new engineering exposures are likely to occur.** (**Responsibility**: SCCP; **Timescale**: Ongoing; **Resources**: 2-3)

1.5c Record and photograph significant new permanent outcrops as part of the geological audit process. (**Responsibility**: SGS; **Timescale**: Ongoing; **Resources**: 3)

1.5d Undertake a desktop GIS based review to identify and record potentially significant exposures and back this up with field work where appropriate. (**Responsibility**: SCCP, SGS; **Timescale**: Dec 08; **Resources**: 3)

1.5e Set up a programme to review all disused railway cuttings where the exposures have been lost to vegetation cover, to look into what was formerly exposed and the possibilities of re-exposing the rocks. (**Responsibility**: SGS; **Timescale**: Dec 09 - Aug 10; **Resources**: 3)

Geoconservation and access: Objective 1.6 – Promoting conservation and use of local building stone

Issue: Shropshire's geological diversity has yielded a wide range of building stones to enhance the appearance and distinctiveness of the county's historic buildings and places (see table 2.1, p12). However, most of the stone types quarried historically in the county are no longer worked. As a consequence, large numbers of historic stone buildings lack suitable sources of stone for repair. The problem of finding suitable stone for conservation of historic buildings has been highlighted by recent research by English Heritage. Government advice in Annex 3 of Minerals Policy Statement 1 (November 2006) recognises that there may be a need for Mineral Planning Authorities to safeguard important sources of stone. This is particularly the case where (1) the quarry was the original source of stone for an historic building, or (2) is technically compatible with the structure to be repaired, and (3) is required for restoration or conservation purposes in the absence of viable alternatives.

SGAP response: We will support the need to make appropriate supplies of local building stone available in association with specific conservation proposals for historic buildings, including, where necessary, through temporarily re-opening of suitable disused quarries.

Actions:

1.6a **Identify sources of stone which have been used in historic buildings, creating links between the distribution of historic stone quarries and the buildings which use these materials.** (**Responsibility**: SCCP, AONB, SGS; **Timescale**: Dec 08 **Resources**: 3)

1.6b Create a register indicating priorities for stone availability, having regard to the number of local vernacular and listed buildings of a specific stone type in a given area. (**Responsibility**: SCCP, SGS; **Timescale**: Dec 08; **Resources**: 3; See also 2.2c – GIS record of building stones)

1.6c Undertake desktop study of environmental / planning constraints to identify potentially suitable small-scale quarry sites to supply specific local conservation requirements. (**Responsibility**: SCCP; **Timescale**: Dec 09; **Resources**: 3)

Geoconservation and access: Objective 1.7 – Promoting conservation and appreciation of our metal mining heritage

Issue: Shropshire has a significant mining heritage. Metal mining continued until the 1960's and coal into the 1970s. The Shropshire systems of longwall and ironstone mining were of international significance. The county has excellent surviving examples of coal and ironstone mining and also quarrying in the form of shafts, buildings and spoil tips which can sometimes yield interesting mineral specimens. However, processes such as re-vegetation and deterioration of old mining buildings mean that such features are becoming increasingly rare. Many shafts, adits and buildings have collapsed and been lost forever. Others are in imminent danger of collapse. It is important to preserve these existing features and memories before they are lost.

Access to all mine sites needs to take into account not only potential hazards to visitors but also wildlife considerations. Many of Shropshire's mine sites are of national importance as hibernation, breeding and nursery sites for bats.

SGAP response: We will promote understanding of Shropshire's metal mining heritage and the need to conserve surface and underground mining remains.

Actions:

1.7a **Identify mining features with greatest potential for interpretation and establish a strategy to promote and prioritise interpretation of historic mining features.** (**Responsibility**: SCCP, SGS, AONB, SCMC; **Timescale**: Dec 08; **Resources**: 3; See also 1.3a - GIS record)

1.7b Promote recording of historical mining features and prioritise those areas / features under greatest threat. (**Responsibility**: SGS, SCMC; **Timescale**: Ongoing; **Resources**: 3; See also 1.3a - GIS based geodiversity record)

1.7c Promote mine open days. (**Responsibility**: SCMT/SMT, SGS, LMRC; **Timescale**: Ongoing; **Resources**: 2)

1.7d Review current mine interpretation and recommend improvements where appropriate. (**Responsibility**: SGS, LMRC, SCMT/SMT; **Timescale**: Ongoing; **Resources**: 2)

Geoconservation and access: Objective 1.8 – Planning guidance on development and geodiversity

Issue: Planning Policy Statement 9 requires that identified sites of geological value should be protected from adverse impact. A number of adopted and emerging planning policies in Shropshire reflect this requirement. However, there is a need for clearer guidance for landowners and developers in order to identify where sites of geological interest are located and how they should be protected. Without such guidance it may sometimes be difficult to identify when geological conservation policies should apply and what mitigation procedures should be adopted in a given case.

Stone and vernacular brick buildings/structures and signs of past mining activity can provide an important sense of history and local distinctiveness. New development can sometimes undermine this evidence of geology, for example by obscuring stone features or removing kerbing or cobbles. It also has the potential however to enhance the evidence of geological diversity in the county's townscapes, for instance by highlighting or complimenting the vernacular style of existing stone buildings. This can help to provide a 'sense of place' for new development, 'embedding' such development more fully into its natural and cultural setting. (See also objective 4.4)

SGAP response: We will seek to influence the design of new development in areas of geological significance, in order to protect significant geological features and landscapes. Where appropriate, we will also encourage design principles for new development which reinforce the significance of important geological features in the landscape. We will seek to achieve this through engagement with developers and planners, provision of guidance on good practice for geological conservation and provision of accessible information on the location of geologically significant sites and landforms.

Actions:

1.8a **Prepare guidance notes to developers and land managers on geological conservation and promote these wherever appropriate.** (**Responsibility**: SCCP, AONB; **Timescale**: Dec 08; **Resources**: 2)

1.8b Promote references to the SGAP in all relevant new planning policy documents. (**Responsibility**: SCCP; **Timescale**: Ongoing; **Resources**: 1; See also 4.8 – promoting the SGAP)

Theme 2 - Knowledge and Understanding

Strategic aims:

- To carry out a geological audit;
- To promote knowledge and understanding of geology / geodiversity, by developing an information strategy, making recommendations for further study;
- To increase access to the geological learning resources available to schools, colleges and researchers, in particular by using the internet, identifying suitable fieldwork sites and providing interpretation resources.

knowledge and Understanding: Objective 2.1 – Geological audit

Issue: Whilst much information is available on Shropshire's geology it is held in many different formats and locations including some with restricted access. In addition, much important Shropshire material is held in museum collections outside the county.

SGAP response: We will undertake a geological audit, bringing all available information together in a single database, identifying gaps in knowledge and promoting work as necessary in order to validate recorded geological information. This will include amongst other matters an audit of exposures, relevant geological collections (local and national), other geological material such as maps, borehole records and photographs and a database of geological expertise. We will aim to make this information available to a wider audience subject to copyright, including by establishing an online database.

Actions:

2.1a **Identify all existing sources of information relating to Shropshire's geology, including literature, research papers, photos and museum collections, including outside the county.** (**Responsibility**: SGS, BGS, LMRC, SCCP; **Timescale**: Dec 2008; **Resources**: 2-3)

2.1b **Undertake desk-based study to identify all known important geological sites, including geological trails, SSSIs, RIGS and record sites on a database linked to SCC's Environmental Record.** (**Responsibility**: SCC, SGS; **Timescale**: Dec 09; **Resources**: 2-3; See also action 2.3e)

2.1c **Work with SCC Minerals section and minerals industry to audit all working quarries for features of geological interest. Use RIGS database format to record new outcrops.** (**Responsibility**: SGS, SCC; **Timescale**: Dec 09; **Resources**: 3; See also actions 1.3a-e and 1.4 a,b)

2.1d **Carry out an audit of Shropshire museum and other relevant collections and record information on a database.** (**Responsibility**: LMRC; **Timescale**: Dec 2008; **Resources**: 3; See also 2.5 – access to geological information)

2.1e **Review all current records of sites to assess suitability, use of up to date terminology etc. and instigate a programme of assessment using the UKRIGS site assessment forms where this information is lacking.** (**Responsibility**: LMRC; **Timescale**: Dec 2008; **Resources**: 3)

2.1f **Collate available information on past mining activity.** (**Responsibility**: SCMT/SMT; **Timescale**: Dec 2010; **Resources**: 3; See also actions 1.7a-d, 2.2b,c and 4.4m)

2.1g Ensure all survey work for RIGS etc is accompanied with photographic record and add these to database. (**Responsibility**: SGS; **Timescale**: Ongoing; **Resources**: 3)

knowledge and Understanding: Objective 2.2 – GIS database of geodiversity, including past mineral workings

Issue: RIGS and geological SSSIs have been recorded on Shropshire County Council's Geographic Information System (GIS). However, there are many other features of geological significance which have not yet been recorded. Hundreds of disused quarries have been worked in Shropshire up to the beginning of the last century at a time when demand was high for local mineral resources such as building stone. This created valuable geological exposures, many of which have been designated as RIGS. Now workings have ceased these exposures are potentially at risk. Many have already been lost or made inaccessible for study. Recording their location and condition is an essential pre-requisite to any conservation action.

SGAP response: As part of the geological audit we will establish a GIS database of geodiversity. This will record the location, geology and condition of all features of geological significance, including quarries, natural outcrops, historic workings, geological trails and interpretation facilities. It will also aim to identify spatial links with other leisure and environmental assets.

Actions:

2.2a **Establish a GIS layer showing all geodiversity data including SSSI's, RIGS, LIGS, geological trails and geological museum collections and make relevant information available on Shropmap (SCC's web based mapping system).** (**Responsibility**: SCCP; **Timescale**: Aug 2009; **Resources**: 2-3)

2.2b **Plot historical mining and quarrying features on a GIS layer and investigate making information available online subject to copyright. Use SCC's environmental record to help identify mining buildings and structures with historical / archaeological interest.** (**Responsibility**: SCCP; **Timescale**: Dec 2010; **Resources**: 3)

2.2c Develop a GIS layer for recording the use of building and roofing stone and identification of potential sources of the stone. (**Responsibility**: SCCP, SGS; **Timescale**: Dec 2011; **Resources**: 3)

Knowledge and Understanding: Objective 2.3 – Promoting the coverage of Regionally Important Geological Sites (RIGS)

Issue: There are currently over 300 designated RIGS in Shropshire (see figure 3, p25). In addition, it is estimated that a further 100 sites worthy of RIGS status are still to be formally designated. RIGS coverage within the county is stronger for some geological systems and arguably does not fully reflect the whole extent of the county's geodiversity. There are potentially an even greater number of Locally Important Geological Sites (LIGS) and further study may indicate that some LIGS are worthy of RIGS designation. The relationship between geology and landscape is particularly clear in Shropshire. Features such as Wenlock Edge, the Church-Stretton Valley and the Ironbridge Gorge are text-book examples of geomorphological landforms. However, few geomorphological RIGS have so far been designated within the county. Designating wider landscape features for their geomorphological significance will help us to promote land management regimes and planning decisions which take this geodiversity value more fully into account.

SGAP response: We will review the coverage of RIGS and will implement a strategy to address any gaps in existing coverage / knowledge.

Actions:

2.3a **Review the coverage of Shropshire RIGS and highlight areas that are underrepresented or unsurveyed.** (**Responsibility**: SGS; **Timescale**: Dec 2010; **Resources**: 3)

2.3b Seek funding for additional surveying of RIGS where review under 2.3a indicates a need for this. (**Responsibility**: SCCP, SWT; **Timescale**: From Dec 07; **Resources**: 3)

2.3c Publicise the RIGS more widely within the County including by the use of Shropmap, through the (future) Geological Records Centre, stakeholder websites and fact sheets for schools and colleges. (**Responsibility**: LMRC, SWT, SCCP, SGS; **Timescale**: Ongoing (RIGS placed on Shropmap in

December 2006); **Resources**: 2)

2.3d Systematically, from literature search where necessary, assess all scientifically or academically important sites (stratotypes, historic localities etc) with a presumption of RIGS designation unless condition and/or access is poor. (**Responsibility**: SGS; **Timescale**: Dec 2008; **Resources**: 3; see also action 2.1e)

Knowledge and Understanding: Objective 2.4 – Establish a Geological Records Centre

Issue: It would be beneficial if all public geological records could be collated and stored in a single location. This would assist in identifying and protecting geological sites and could act as a catalyst for further geological study in Shropshire.

SGAP response: We will promote the establishment of a geological records centre for Shropshire and will seek to identify ways in which such a centre could be secured and funded in a sustainable way (see also objective 4.9).

Actions:

2.4a **List key criteria for a geological record centre and investigate potential locations and ways of staffing and funding a centre, including potentially as part of a wider environmental record centre.** (**Responsibility**: SGS, LMRC; **Timescale**: May 08; **Resources**: 2)

2.4b Agree a strategy to progress a bid to establish a geological record centre, including identification of potential sources of funding. (**Responsibility**: SGS, LMRC; **Timescale**: May 08; **Resources**: 2 for strategy, 3 for centre)

knowledge and Understanding: Objective 2.5 – Promoting increased access to academic geological information

Issue: A wide range of academic geological records are held at various locations in Shropshire and outside the county. This includes geological journals, books, maps and papers relating to the geology of Shropshire held at the museum resource centre at Ludlow.

SGAP response: We will aim to make records of Shropshire's geology more accessible to a wider range of potential users, identifying measures to allow the storage, management and dissemination of geological information. In particular, we will aim to bring geological records together in one place, to make appropriate material available in 'moving museums' and to place appropriate material online.

Actions:

2.5a **List the academic holdings currently held and make this list publicly accessible.** (**Responsibility**: LMRC; **Timescale**: Ongoing; **Resources**: 2; See also 2.1d – audit of museum collections)

2.5b Digitise records and investigate making appropriate records available online subject to copyright. (**Responsibility**: LMRC; **Timescale**: Ongoing; **Resources**: 3)

2.5c Identify opportunities for further improving the availability of research assets such as museum collections and literature held by archives, museums, societies and the BGS. (**Responsibility**: LMRC, SGS; **Timescale**: Dec 08; **Resources**: 1-2)

knowledge and Understanding: Objective 2.6 – Promoting geological research in Shropshire

Issue: Whilst Shropshire has been a major focus of historical geological research, this does not mean that we know everything there is to know. Indeed, the international significance of the county's geology as the type location for many older rocks means that it is even more important to ensure that geological

knowledge is kept up to date and previous work is revisited with the benefit of modern knowledge. For instance, advances in seismology (the study of earthquakes) can add to our understanding of the deep structure of Shropshire, including the county's recent earthquakes.

SGAP response: We will aim to carry out additional survey work or encourage new research to advance our knowledge and understanding of Shropshire's diverse geology, linking different research projects where appropriate and identifying new research opportunities. These surveys will encompass new quarry exposures, landscape scale features, mine sites, geological collections and archives.

Actions:

2.6a **Identify and enhance links with individuals and institutions involved with geological research.** (**Responsibility**: SGS, LMRC; **Timescale**: Ongoing; **Resources**: 1-2)

2.6b Review information and identify what gaps exist in our knowledge of Shropshire's geology. Publicly list these and notify relevant research links. (**Responsibility**: SGS, LMRC; **Timescale**: By May 08; **Resources**: 2-3)

2.6c Make recommendations for further study including fieldwork where necessary, using the RIGS database format to record all sites. (**Responsibility**: SGS, LMRC; **Timescale**: By May 09; **Resources**: 2-3)

2.6c Maintain a research opportunities database, taking account of existing and proposed research in Shropshire and nationally. (**Responsibility**: SGS, LMRC; **Timescale**: Ongoing from June 07; **Resources**: 2)

2.6d Investigate ways of making geological information more readily available for research purposes, including through establishment of online **Resources** (**Responsibility**: LMRC, SGS; **Timescale**: Dec 09; **Resources**: 2)

2.6e Identify resident specialists or groups able to assist with research in terms of providing advice. (**Responsibility**: SGS, LMRC; **Timescale**: Dec 07; **Resources**: 1)

Knowledge and Understanding: Objective 2.7 – Promoting knowledge of historical geology in Shropshire

Issue: Shropshire has strong historical connections with geology. Much early pioneering work was undertaken in and around Shropshire and place names such as Ludlow and Wenlock are now internationally recognised as divisions of geological time. Charles Darwin was born in Shrewsbury in 1807.

SGAP response: We will seek to increase public knowledge of the pioneering geological work undertaken in and around Shropshire and Darwin's contribution to geology, including through creation of interpretation materials such as a Darwin geological trail (see also objective 1.2).

Actions:

2.7a Seek funding for preparation of museum exhibits and interpretation materials explaining Shropshire's historical contribution to geology and the reason why some Shropshire place names are now internationally recognised by scientists. (**Responsibility**: LMRC; **Timescale**: Ongoing; **Resources**: 2)

2.7b A member of the SGAP Steering Group to represent geology in the Darwin Festival committee meetings. (**Responsibility**: SWT; **Timescale**: Ongoing; **Resources**: 2)

Theme 3 – Interpretation and geotourism

Strategic aims:

- To facilitate education and awareness of geological resources across the board and promote these resources.
- To increase awareness of existing earth science resources including museums, visitor centres and accessible geological exposures.
- To provide interpretation for key sites and resources important in the story of Shropshire's geology.

Interpretation and geotourism: Objective 3.1 – Promoting geological education and tourism in Shropshire

Issue: Shropshire is well known amongst the geological community but is less well known as a destination amongst those who are generally interested in the natural world. A wide range of earth science based leisure / interpretation 'products' are on offer, but the county has not been widely promoted as a destination for geotourism. A multi-agency geotourism plan would allow initiatives being undertaken by different groups to be linked together.

SGAP response: We will promote Shropshire as an excellent place to enjoy geology by engaging key audiences such as tourists, amateur geologists, policy makers and those interested in the natural world. We will also encourage relevant Shropshire organisations to include geology in their interpretation and geotourism materials.

Actions:

3.1a **Investigate ways of promoting and enhancing existing educational products, sites and infrastructure in a more effective way, including promoting these more widely as a package, coupled with the UKRIGS teaching material.** (**Responsibility**: SWT, LMRC, AONB; **Timescale**: Ongoing; **Resources**: 3)

3.1b **Approach Shropshire Tourism Research Unit (SCC) to gather information on and assess the potential for geological tourism in Shropshire.** (**Responsibility**: SCCP, SWT, AONB; **Timescale**: Ongoing; **Resources**: 3)

3.1c Develop an agreed Strategy to establish an appropriate network of sites for geo-conservation, identifying key sites suitable for use in fieldwork by schools and colleges. (**Responsibility**: SWT; SGS, LMRC, SCCP; **Timescale**: Dec 07; **Resources**: 2-3)

3.1d Investigate new educational products and services, such as lists of suitable sites with fact sheets, education packs, rockwatch etc. (**Responsibility**: SWT/ LMRC; **Timescale**: Ongoing; **Resources**: 3)

3.1e Provide teachers with opportunities to use Shropshire sites to study geology throughout the curriculum, including by using exam board links, teaching associations and inset sessions. (**Responsibility**: SWT; **Timescale**: Ongoing; **Resources**: 3)

3.1f Develop opportunities for people to stay longer in Shropshire by ensuring that a wide range of information is available to visitors and creating new products for the educational and amateur interest markets. (**Timescale**: ongoing; **Responsibility**: SWT, LMRC, AONB; **Resources**: 2-3)

3.1g Promote / brand the identifiable "geo-regions" of the county based upon their underlying geological characteristics: "Amongst Tropical Reefs" (Wenlock Edge), "Hot Rocks" (Stretton Hills and Wrekin), "Ice Age Relics" (meres and mosses) etc. Link to landscape character units. (**Responsibility**: SWT, SGS, AONB; **Timescale**: Dec 08; **Resources**: 2)

3.1h Run Shropshire Geology Extravaganza (**Responsibility**: SGS; **Timescale**: Annual; **Resources**: 1-2)

3.1i Geodiversity article in stakeholder newsletters and relevant publications. (**Responsibility**: SWT, LMRC, AONB; **Timescale**: Ongoing; **Resources**: 2)

3.1j Establish geodiversity exhibition at SWT headquarters and a mobile exhibition. (**Responsibility**: SWT, LMRC; **Timescale**: Dec 07; **Resources**: 2)

Interpretation and geotourism: Objective 3.2 – Geological interpretation

Issue: Interpretation materials such as leaflets, display boards and guides can provide information about key sites, allowing understanding of Shropshire's geology. The production of such materials needs however to be carefully targeted to maximise the benefits from the available resources.

SGAP response: We will aim to improve levels of geological understanding within the community, prioritising geological interpretation actions and identifying sites suitable for the provision of interpretation materials.

Actions:

3.2a Identify key object groups such as trilobite fossils or vein minerals within museum geological collections which would benefit from a publication (factsheet or pamphlet) to interpret them and tie this into Shropshire's geology on the ground. (**Responsibility**: LMRC; **Timescale**: Dec 2008; **Resources**: 2)

3.2b Prepare a series of geology guides. For example:

i) A simple guide to geology using Shropshire examples;
ii) Guides linking GCSE and A level geology syllabuses to examples in Shropshire;
iii) A guide illustrating the relationship between geology and landscape in Shropshire;
iv) A guide identifying Shropshire pubs with interesting geology in the vicinity;
v) Trail guides illustrating the use of stone in Shropshire's towns and buildings;
vi) A guide to vein minerals in Shropshire indicating where samples may be collected;
vii) A guide illustrating the relationship of Shropshire landscape and geology to the arts and literature (i.e. Mary Webb; A.E.Housman etc);
vii) A simple guide to the historical development of geology in Shropshire, including the famous geologists who came here to study.

(**Timescale**: To Dec 12; **Responsibility**: SGS; **Resources** 3)

Interpretation and geotourism: Objective 3.3 – Geopark feasibility study.

Issue: A geopark is an area with a geological heritage of international significance for scientific, educational and / or aesthetic reasons. Geopark status can bring a range of potential benefits, including for leisure and tourism. It is appropriate to consider whether the South Shropshire Hills Area of Outstanding Natural Beauty (AONB) should be afforded geopark status, given its internationally significant geology, scenic beauty and rich cultural heritage. In considering whether or not to proceed with a geopark bid we will need to liaise closely with the nearby Abberley & Malvern Hills Geopark.

SGAP response: We will assess the potential to establish a geopark centred on the South Shropshire Hills AONB.

Actions:

3.3a Commence review to identify the potential benefits and implications of Geopark status for the South Shropshire Hills, taking account of the experience of other British Geoparks. (**Responsibility**: AONB, SGS - through the Shropshire Geological Forum; **Timescale**: Dec 07; **Resources**: 2)

3.3b Report findings to relevant stakeholders and make recommendations for further action. (**Responsibility**: AONB, SGS; **Timescale**: May 2010; **Resources**: 2)

Interpretation and geotourism: Objective 3.4 – Raising awareness of RIGS

Issue: Shropshire has over 300 RIGS. Planning policies provide some protection but RIGS lack the statutory legal protection afforded to geological SSSIs. (See also objective 2.3).

SGAP response: We will seek to raise awareness by Local Authorities, developers and landowners of the value of Regionally Important Geological Sites in order to improve understanding of the need to protect such sites and how best to achieve this.

Actions:

3.4a **Prepare a leaflet on Shropshire RIGS to assist in engaging landowners and relevant local groups.** (**Responsibility**: SCCP, SGS, SWS, AONB,; **Timescale**: Dec 2007; **Resources**: 2-3)

3.4b **Notify RIGS owners and Parish Councils of the RIGS designations in their area and their significance, providing them with the RIGS leaflet (3.4a) and summaries of the respective RIGS recording sheets where appropriate.** (**Responsibility**: SCCP, AONB; **Timescale**: May 08; **Resources**: 3)

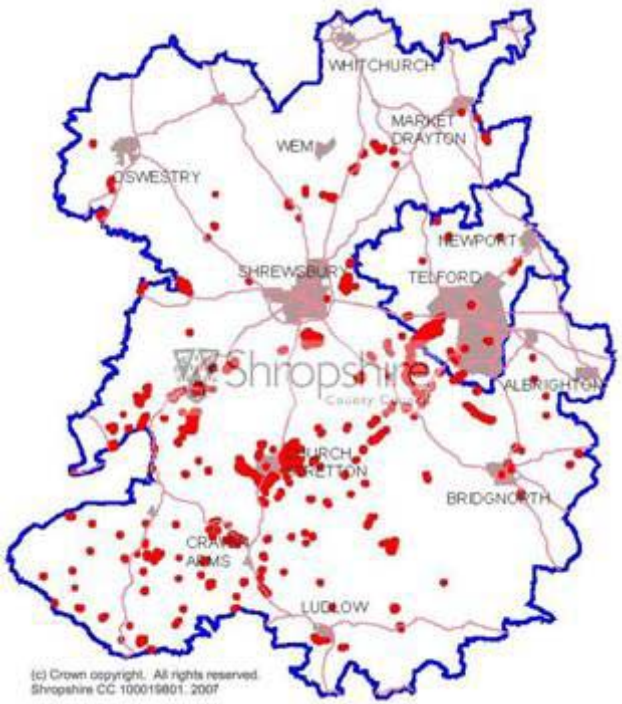

Figure 3 The location of Shropshire RIGS
More information on RIGS is available from the website of the Shropshire Geological Society: www.shropshiregeology.org.uk or from Shropshire County Council, Planning and Environment.

Interpretation and geotourism: Objective 3.5 – Promoting interpretation, understanding and conservation of geology in the landscape

Issue: The relationship between geology and landscape is particularly clear in Shropshire. There are textbook examples of geomorphological features including Wenlock Edge (scarp and dip), the Church Stretton Valley (fault bounded valley) and the meres and mosses around Ellesmere (glacial).

SGAP response: We will promote understanding of the relationship between geology and landscape in order to increase appreciation of Shropshire's landscapes and the need to conserve them. We will identify areas with valued geological landscapes and promote joined-up thinking with landowners and other stakeholders in order to conserve such landscapes. In the Shropshire Hills AONB this will be closely linked to the AONB Management Plan process.

Actions:

3.5a **Prepare guidance on conserving valuable geological landforms and approach land owners/managers.** (**Responsibility**: SCCP, AONB, SWT;

Timescale: May 08; **Resources**: 2-3)

3.5b Identify key viewpoints on GIS geodiversity layer and provide interpretation materials linked to viewpoints, either on site or as leaflets, study packs and web **Resources**. (**Responsibility**: SCCP, AONB, SGS, LMRC, SWT; **Timescale**: Dec 09; **Resources**: 2; See also 2.2 – GIS database)

A view of the Wrekin from Caer Caradoc

Interpretation and geotourism: Objective 3.6 – Conserving and promoting Shropshire's museum collections

Issue: A wide range of rocks, fossils and minerals representing Shropshire's geology are held in the county's museum collections and in other museums and external organisations. These collections are a valuable resource highlighting the county's geodiversity and making it accessible for viewing and study. The original outcrops yielding the specimens may have long-since deteriorated, hence such collections may provide an irreplaceable record. The Shropshire County Museum Service at Ludlow holds over 30,000 geological specimens mostly originating from Shropshire which represent much of the geological record for the county. Currently this information is not truly accessible as only a small percentage of these specimens are on display or can be viewed via the internet. Rowleys House museum in Shrewsbury was closed to the public in December 2006, but is scheduled for re-location to new premises at the Shrewsbury Music Hall by 2010. In the meantime information about the collection, including geological materials, is available online.

SGAP response: We will seek to ensure that all the geological materials in the county's museum collections are appropriately conserved, that appropriate space is made available for display and that they remain available for study and appreciation, including where appropriate, as an online resource.

Actions:

3.6a **Highlight the importance of geology in the story of what makes Shropshire unique by advertising and marketing geological displays at Ludlow and other museums.** (**Responsibility**: LMRC; **Timescale**: Ongoing; **Resources**: 1-2)

Section 4 – Delivering SGAP actions

Strategic aims:

- To ensure that actions are specific, measurable, achievable, realistic and time constrained (smart) including by identifying lead organisations and resource requirements;
- To encourage joint working and establish links with other plans and subject areas;
- To embed geological conservation more fully into land use planning and systems of land management;
- To encourage all organisations, companies and individuals who have an interest or involvement with any part of our geological heritage to join us to ensure that SGAP actions are fully inclusive.

Delivering actions: Objective 4.1 – Establishing a Shropshire geodiversity partnership

Issue: Establishment of a strategic partnership of geological stakeholders is essential in order to progress SGAP actions.

SGAP response: We will establish a Steering Group to take ownership of the Shropshire Geodiversity Action Plan and will assign clear actions and responsibilities to the SGP members.

Actions:

4.1a **Formalise the position of the Shropshire Geological Forum as the SGAP Steering Group, ensuring that all stakeholders with a significant direct role in geodiversity or practical geoconservation are represented on the SGP.** (**Responsibility**: SGS, (**Responsibility**: AONB, SCCP, SWT, LMRC; **Timescale**: By Dec 07; **Resources**: 1)

4.1c **Establish a constitution for the Steering Group which can drive forward the agreed SGAP agenda and invite all potential partners to an inaugural meeting to ratify the SGAP.** (**Responsibility**: AONB, SCCP, SGS, SWT, LMRC; **Timescale**: March 08; **Resources**: 1)

Delivering actions: Objective 4.2 – Extending the geological stakeholder network

Issue: Establishing a wider partnership network of geological stakeholders is essential in order to support the role of the SGAP Steering Group in progressing SGAP actions.

SGAP response: We will aim to extend the network of individuals and organisations who are involved in work which assists the objectives of the SGAP. In so doing we will compile a database of geological stakeholders and will encourage links between relevant individuals and organisations in order to promote and coordinate SGAP activities.

Actions:

4.2a **Implement a strategy to identify potential new geological stakeholders and provide web-based opportunities to become affiliated to the SGAP process.** (**Responsibility**: SCCP, SGS; **Timescale**: Agree strategy by May 07; **Resources**: 1)

4.2b **Set up working parties and establish stakeholder networks in order to progress individual SGAP actions, including academic projects, GIS and site conservation actions.** (**Responsibility Timescale** and **Resources**: Dependent upon action. Initial working parties set up by March 08)

Delivering actions: Objective 4.3 – Securing a county Geodiversity Officer

Issue: None of the organisations involved in geological conservation and interpretation based work in Shropshire currently have resources specifically to progress SGAP actions. A Geodiversity Officer would provide a significant boost to geological conservation in Shropshire and the SGAP process.

SGAP response: We will promote the need for a Geodiversity Officer in order to progress and coordinate SGAP actions.

Action:

4.3a **Investigate options for securing a Geodiversity Officer including options for funding and location.** (**Responsibility**: SCCP, AONB, SWT; **Timescale**: By May 08; **Resources**: 1 for investigation, 3 for funding Geodiversity Officer)

Delivering actions: Objective 4.4 – Identifying and promoting links with the planning system

Issue: The planning system controls most significant forms of development in Shropshire. It can therefore be an important influence on existing geological features and can also determine where new outcrops are likely to occur, for instance by approving new quarry workings or engineering schemes. (see also objective 1.8)

SGAP response: We will identify links with the planning system and will promote the incorporation of geological conservation principles into planning policies and development proposals where appropriate.

Actions:

4.4a **Prepare guidance for planners and developers on geological conservation and organise a series of workshops to inform planners and policy makers.** (**Responsibility**: SCCP, SGS, SWT, AONB; **Timescale**: Dec 08; **Resources**: 2-3)

4.4b **Review existing policy documents from local authorities and partnerships to determine whether appropriate policies exist to safeguard geodiversity.** (**Responsibility**: SCCP; **Timescale**: May 08; **Resources**: 2)

4.4c **Prepare / circulate 'model' geodiversity policies to relevant organisations.** (**Responsibility**: SCCP, AONB; **Timescale**: Dec 08; **Resources**: 2)

4.4d Provide specialist site specific advice to Local Planning Authorities and developers on individual planning applications that raise geological conservation issues. (**Responsibility**: SGS, SCCP; **Timescale**: Ongoing; **Resources**: 2)

Delivering actions: Objective 4.5 – Identifying and promoting links with other subject areas

Issue: A number of other plans and environmental initiatives have the potential to influence geodiversity and promote SGAP actions:

Biodiversity There are clear overlaps between biodiversity and geodiversity. Many disused quarries in Shropshire are significant both for biodiversity and geological interest. Biodiversity Action Plans (BAPs) have long been recognised as an important mechanism for safeguarding the wildlife and ecology of specific areas. We hope the SGAP will achieve equivalent and complimentary benefits for Shropshire's geodiversity.

Landscape Character Assessment Shropshire's landscape shows a strong relationship to the underlying geology. We will promote land management techniques within different landscape character units which conserve and where appropriate reinforce the appearance of geologically derived features in the landscape. This includes geological landforms, rock outcrops, building stones and historic mining features. In so doing we hope also to promote enhancement of the character and distinctiveness of the landscape generally.

Archaeology There are many important overlaps between archaeology and geology. Geology can be a major influence on historic settlement patterns and the distribution of archaeological remains. Geological techniques can also be used to increase our understanding of such remains, for example, by determining the source of a stone artefact. We will encourage cooperation between archaeologists and geologists to achieve mutual conservation and knowledge-based objectives.

SGAP response: We will identify links with other plans and initiatives in order to promote SGAP actions where appropriate.

Actions:

4.5a **Review current plans and initiatives with relevance to geodiversity, including leisure/tourism, natural environment, conservation, development and research.** (**Responsibility**: SCC, AONB, LMRC; **Timescale**: Ongoing; **Resources**: 1-2)

4.5b Incorporate the SGAP within the Shropshire Hills AONB management plan. (**Responsibility**: AONB, SGS, SWT, SCCP; **Timescale**: Discussions with AONB partnership by May 08; **Resources**: 1-2)

4.5c Evaluate links / mutual interests between SGAP and Shropshire Biodiversity Action Plan. Meet with biodiversity partnership and assess scope to integrate objectives. (**Responsibility**: SCCP, SGS, SWT; **Timescale**: By Aug 08; **Resources**: 1)

4.5d Integrate geodiversity information into Shropshire's landscape character units and natural areas and appraise the value of geomorphological features within them. (**Responsibility**: SCCP, SGS; **Timescale**: Dec 07; **Resources**: 2)

4.5e Use the Landscape Character Assessment framework to help target **Resources** in Shropshire for geodiversity conservation. (**Responsibility**: SCCP, SGS, AONB; **Timescale**: May 08; **Resources**: 2-3)

4.5f Identify opportunities where appropriate to capture geological information and provide geological advice in association with archaeological excavations and the preparation of archaeological reports. (**Responsibility**: SCCP; **Timescale**: Ongoing; **Resources**: 2)

4.5g Establish links between the SGAP and the Discovering Shropshire's History Project, particularly in relation to mining and quarrying history. (**Responsibility**: SCCP; **Timescale**: Ongoing; **Resources**: 1)

4.5h Establish links between the SGAP and the BGS's building stone database and map. **Resources** and the English Heritage stone store at Atcham and liaise with English Heritage on the national building stones project. (**Responsibility**: SCCP, SGS; **Timescale**: May 02; **Resources**: 1; See also objective 1.6 – promoting access to local building stone sources)

4.5i Establish links between the SGAP and other leisure products like local food, walking festivals, art and literature appreciation etc. (**Responsibility**: SWT, SGS, AONB; **Timescale**: Ongoing; **Resources**: 2; See also objective 4.5)

Delivering actions: Objective 4.6 – Community involvement

Issue: We recognise the importance of providing opportunities for local communities to become involved in geological conservation and interpretation initiatives. This can make those communities more aware of geological resources in their areas, their significance and the need to protect them, thereby securing local support for SGAP actions.

SGAP response: We will promote and assist in the delivery of projects that support community involvement in geological conservation initiatives.

Actions:

4.6a Identify a network of knowledgeable people who are willing to give talks and guided walks to local groups. (**Responsibility**: SCCP, SGS, SWT, LMRC, AONB; **Timescale**: By Dec 09; **Resources**: 1-2)

4.6b Promote consideration of geodiversity as appropriate in Community Strategies and Parish Plans, including measures to safeguard valuable geological sites and landforms.
(**Responsibility**: SCCP, SGS, SWT, LMRC, AONB; **Timescale**: By Dec 09; **Resources**: 1-2)

Delivering actions: Objective 4.7 – Monitoring and review of the SGAP

Issue: It is essential to monitor and review the success of SGAP actions. This will allow problems to be identified and actions to be modified where necessary in order to maximise the success in achieving SGAP objectives. Some monitoring indicators to be applied to SGAP:

- Raised general usage of sites, especially by school groups;
- Inclusion of geodiversity in plans and planning policy guidance;
- Success in achieving management plans for geological sites;
- The number of organisations involved in SGAP actions, directly or as consultees;
- Number of geological sites in ownership of SGAP affiliated organisations;
- Percentage of Shropshire's area reviewed within a time frame;
- The number of sites designated as RIGS and LIGS;
- Number of new geological trails established;
- Numbers of people using these trails;
- Number of interpretation facilities leaflets and posters prepared;
- The proportion of targets achieved

SGAP response: We will monitor success in implementing SGAP actions on an ongoing basis with a view to creating a rolling programme of successful geological projects across the partnership and will review the SGAP formally at 5 year intervals.

Actions:

4.7a **Establish a methodology to identify which actions should be prioritised.** (**Responsibility**: SCCP, SGS, SWT, LMRC; **Timescale**: By Dec 07; **Resources**: 1)

4.7b **Assess all potential actions in detail to ensue that they are specific, measurable, achievable, realistic and time constrained.** (**Responsibility**: SCCP, SGS, SWT, LMRC; **Timescale**: Ongoing; **Resources**: 1)

4.7c Establishment of a monitoring and review strategy for the SGAP, including a formal review in 5 years. (**Responsibility**: SCCP, SGS, SWT, LMRC; **Timescale**: Ongoing, first review by Feb 2012; **Resources**: 1-2)

4.7d Hold quarterly meetings of the SGAP steering group and publish a web-based SGAP review document. (**Responsibility**: SCCP, SGS, SWT, LMRC; **Timescale**: Ongoing; **Resources**: 1)

Delivering actions: Objective 4.8 – Promotion of the SGAP

Issue: Promotion of the SGAP will spread knowledge of plan and understanding of its actions to a wider audience. This has the potential to increase levels of

support for the SGAP, thereby increasing the chances of achieving SGAP objectives.

SGAP response: We will promote the SGAP, engaging with relevant organisations and stakeholders in order to maximise success in achieving actions.

Actions:

4.8a **Raise geodiversity awareness generally through distribution of paper copies of the SGAP to landowners, mineral operators, libraries, museums and appropriate educational institutions and through making the SGAP available online.** (**Responsibility**: SCCP, AONB, LMRC, SWT; **Timescale**: Ongoing from May 07, including distribution at Marches Festival of Geology in Sept 07; **Resources**: 2)

4.8b **Establish SGAP website including regular updates and inclusion of all documents on the website.** (**Responsibility**: SCCP, SGS, LMRC, SWT; **Timescale**: May 2007; **Resources**: 2

Delivering actions: Objective 4.9 – Securing Resources to achieve actions

Issue: An SGAP action will not be progressed unless there are adequate resources. It may be possible to progress some actions using staff and volunteer resources available to the SGAP Steering Group and/or the wider Shropshire Geological Forum. In other cases however additional resources will be required, including for example grant funding and a dedicated Geodiversity Officer.

SGAP response: We will aim to secure sufficient resources to achieve SGAP actions.

Action:

4.9a **Prepare a strategy to identify existing and potential Resources to assist in achieving SGAP actions.** (**Responsibility**: SCCP, SGS, SWT, LMRC, AONB; **Timescale**: Produce initial strategy by July 07; **Resources**: 1)

APPENDIX 1

Geological Conservation – The National Policy Context

The National Parks and Access to the Countryside Act 1949 Nature conservation protection in Britain began in 1949 with passing of the National Parks and Access to the Countryside Act and the formation of the Nature Conservancy Council (NCC). The 1949 Act introduced Sites of Special Scientific Interest (SSSIs). The protection given to SSSIs was subsequently strengthened by the Wildlife and Countryside Act 1981 and the Countryside and Rights of Way Act 2000. Natural England is now the relevant nature conservation agency for England.

The Geological Conservation Review In 1977 the NCC commenced the Geological Conservation Review (GCR), a major initiative to identify and record the most important geological sites in Britain. By its completion in 1990 the review had identified about 2300 geological SSSIs in Britain. In the same year the NCC published 'Earth Science Conservation in Great Britain – A Strategy'. This identified for the first time the overall needs of Earth Science conservation, the means by which these could be achieved and the bodies most able to take an active role. The Strategy had six main themes:

1. Maintain the SSSI network
2. Expand the Regionally Important Geological Sites network
3. Develop new conservation techniques
4. Improve site documentation
5. Increase public awareness
6. Develop international links

English Nature, the successor to the NCC, updated this approach in 1995 in their publication "Towards the millennium – conserving England's earth heritage". This took account of new concepts such as Sustainable Development and emerging international aspects of earth heritage conservation.

Regionally Important Geological Sites Regionally Important Geological Sites (RIGS) are selected by regional and local RIGS groups based upon educational, scientific, historical or aesthetic value. The number of RIGS now significantly exceeds the number of geological SSSIs. RIGS groups are supported by Natural England and are coordinated by the Association of UK RIGS Groups (UKRIGS). RIGS do not enjoy the same statutory protection as SSSIs. However, government advice including Planning Policy Statement 9 (see below) makes it clear that RIGS should be taken properly into consideration in the planning process.

Local Agenda 21 Local Agenda 21 (LA21) was agreed at the Rio Earth Summit in 1992. LA21 emphasises the importance of communities engaging in environmental conservation actions at a local level, in order to conserve natural environmental resources. This includes resources derived from or dependent on geodiversity. The SGAP promotes improved understanding of geological conservation issues and puts forward specific actions which can be carried out locally in accordance with the principles of LA21.

Natural Areas In 1993 English Nature and the Countryside Commission produced a map dividing England into a series of 'Natural Areas' based on similarities in geology, landform, vegetation, land use and settlement patterns. This provided a strategic framework for

progressing earth heritage actions, emphasising the interrelationships between the various aspects earth heritage, including geology, and the need to manage them in a holistic way.

Planning Policy Statement 9, Biodiversity and Geological Conservation (2005) PPS9 provides advice by central government on the relationship between biodiversity, geological conservation and planning. The guidance promotes conservation and, where possible, enhancement of the diversity of England's wildlife and geology. It also recognises the significant role that the planning system has to play in achieving these objectives. A number of key principles are set out, including:

- Ensuring development plan policies and planning decisions are based on up-to-date information about the environmental characteristics of an area. This includes the relevant biodiversity and geological resources and the potential to sustain and enhance them.
- Ensuring plan policies and planning decisions aim to maintain and enhance, restore or add to biodiversity and geological conservation interests. This includes by ensuring that appropriate weight is attached to designated sites of international, national and local importance, protected species, biodiversity and geological interests within the wider environment.
- Plan policies on the form and location of development should take a strategic approach to the conservation, enhancement and restoration of biodiversity and geology. This should recognise the contributions that sites, areas and features make to conservation of these resources, both individually and in combination.
- Plan policies should promote opportunities for the incorporation of beneficial biodiversity and geological features within the design of development.
- Development proposals where the principal aim is to conserve or enhance biodiversity and geological conservation interests should be permitted.
- The objective of planning decisions should be to prevent harm to biodiversity and geological conservation interests. Where granting planning permission would result in significant harm to those interests, local planning authorities will need to be satisfied that the development cannot reasonably be located on any alternative sites that would result in less or no harm and that adequate mitigation measures are put in place. If significant harm cannot be prevented, adequately mitigated against, or compensated for, then planning permission should be refused.

Local planning policies as set out in the Local Development Frameworks should indicate amongst other matters the location of designated sites of importance for biodiversity and geodiversity. They should also make clear distinctions between the hierarchy of international, national, regional and locally designated sites.

A good practice guide to accompany PPS9 was published in March 2006 (Planning for Biodiversity and Geological Conservation – A Guide to Good Practice). The following are cited as examples of good practice:

- making full use of GIS and other web-based information sources;
- identifying key information gaps and filling these with further survey work;
- using information to identify and map areas best suited for proactive enhancement measures;
- integrating information and priorities established in biodiversity/geodiversity action plans and partnerships;

- supporting the establishment of a Local Record Centre;
- ensuring access to in-house or shared ecological/geological expertise; and
- tapping the knowledge and experience held within the wider community.

The requirements of PPS9 are reflected by policies in a number of existing and emerging planning policy documents in Shropshire.

APPENDIX 2

Geological Conservation in Shropshire

Shropshire Geological Society The SGS was established in 1979 and charitable status was granted in 2002. The society's main objectives are:

- to provide a programme of winter lectures and summer field trips to further the geological interests of members
- to encourage research into aspects of Shropshire geology
- to undertake where practicable, active geoconservation measures
- to survey and record geological sites of special interest

The SGS represents the county nationally through membership of the Geologists's Association, UKRIGS (the national association of RIGS groups) and The Geology Trusts (a consortium of county geoconservation organisations in central England). It also maintains close links with the West Midlands Regional Group of the Geological Society of London.

Since 1998 the SGS has secured sufficient grant aid for volunteers to run a series of funded projects administered by a part time paid manager. It has also collaborated with Shropshire Wildlife Trust in their joint 'Shaping of Shropshire' project and has worked closely with Shropshire County Council on a number of schemes. These include Shropshire Hills Discovery Centre / Ludlow Museum exhibitions on Silurian Seas (2005), Fantastic Fossil Forests (2006) and the Marches Festival of Geology (2007). Since the mid-1990s the SGS has held an annual one-day exhibition at various venues around the county ('the Geological Extravaganza'), latterly in conjunction with local festivals. These activities have been supported largely by voluntary contributions.

Until a Shropshire Geodiversity Officer is appointed, the Shropshire Geological Society (SGS) will be a first point of contact for geodiversity liaison matters across the county. The SGS will work closely with the Ludlow Museum Resource Centre (LMRC) to establish a single "public face" for planning, academic and recreational enquiries concerning geology. The SGS will also be the main lead organisation for many of the field based research actions promoted by the SGAP. In consultation with Shropshire County Council, the SGS is investigating the establishment of a permanent base at the LMRC.

Shropshire RIGS Group (Regionally Important Geological Sites) RIGS in Shropshire are recommended by a working group of the SGS and are compiled on behalf of Shropshire County Council, which maintains the publicly accessible database. The RIGS group was formed in 1990 and reports to the Projects Subcommittee of the SGS. The group, which comprises a small number of volunteers with significant expertise in geological surveying, may co-opt other members of the SGS as necessary to assist in RIGS work. Through the SGS, the

group has strong links with other organisations including Shropshire County Council, Natural England and the Shropshire Wildlife Trust.

Shropshire Wildlife Trust (SWT) SWT is one of the major owners and managers of sites of geological interest in the county. It is therefore well placed to deliver many of the targets for geological conservation, management and interpretation outlined in the SGAP. SWT has volunteer commitment, funding resources and strategic support from statutory bodies and other conservation land managers. This enables the SWT to deliver both practical on-site works and interpretation, either unilaterally or in partnership with other bodies. The SWT's membership is now in excess of 8000, meaning that it is able to promote and publicise the process of the SGAP to a large and supportive audience. The SWT has been extensively involved in providing geological interpretation and learning resources throughout the county, including in association with the Ludlow Museum Resource Centre.

The SWT will be responsible for establishing strategies for the practical management of geological sites, and will promote the geological interest of its own Nature Reserves. Through its existing work, SWT is well placed to harness practical experience of geological site maintenance in order to provide advice to owners. The SWT will liaise closely with other partners, and especially SGS and LMRC in the production of appropriate interpretation leaflets, on-site panels and exhibitions. It will also continue to be the primary source of liaison with schools within the county on geodiversity related matters.

Shropshire County Museum Services (SCMS) The geology collections (specimens and literature) of Shropshire County Council's Museum Services (incorporating the Ludlow Museum and Resource Centre - LMRC) are one of the most comprehensive regional collections in the country. The collection includes internationally significant material that reflects Shropshire's important geological heritage. One of the primary purposes of the SCMS is to provide interpretation and support for geotourism relating to the collections it holds. SCMS offers both formal and informal opportunities to learn about Shropshire's geology. The main objectives of the SCMS are as follows:

- to provide effective access to collections information through the Discovering Shropshire's History website, including information about the object, its general find location and a digital image of the object;
- continuing to provide geological interpretation through its museum sites including temporary exhibitions making use of its collections;
- continuing to provide geology based events and activities at our museum sites;
- continuing to provide adult education opportunities to study Shropshire geology;
- continuing to provide opportunities for schools to study Shropshire geology;
- continuing to work with SWT and SGS to produce trails and guides for Shropshire's geology, including a revision of the Teme Bank Trail.

SCMS has jointly prepared a series of education packages ranging from early key to As/A2 level, and is planning an exhibition as part of the Marches Festival of Geology in Summer/Autumn 2007. Information on these resources exists on the SCMS website: www.shropshire.gov.uk/llmrc.nsf/

The Ludlow Museum Resource Centre will consolidate its role as host to the main Geological Records Centre for Shropshire. It will be a focal point in the SGAP's objective to increase provision of public interpretation of geology and will also facilitate improved access to academic geological records.

Shropshire County Council Planning SCC planning will take the lead for those matters relating to planning and geodiversity, liaising as appropriate with other local authorities, planning consultees mineral operators and applicants in order to promote geological conservation

through the planning system. SCC planning will continue to maintain a GIS database of RIGS and mineral workings, including historic workings. It will also liaise closely with SGS on matters relating to RIGS designation and the accessibility of information on geodiversity.

AONB Team The Shropshire Hills Area of Outstanding Natural Beauty (AONB) is a national designation covering 23% of the county. The AONB contains significant areas of geological interest relating to Shropshire's older rocks and highest density of RIGS sites in the county. The Shropshire Hills AONB Partnership brings together local authorities, statutory, voluntary, business and community interests, and co-ordinates conservation and sustainable development activity through a Management Plan. The AONB partnership will work with other steering group members in order to co-ordinate geological conservation, interpretation and management based actions within the AONB.

British Geological Survey The BGS will assist other steering group members in collating baseline academic knowledge of Shropshire's geology as part of a geological audit process, and will provide advice on proposed SGAP actions.

Shropshire Mines Trust (SMT) and Shropshire Caving and Mining Club (SCMC) The Shropshire Mines Trust currently operates a programme of open days at Snailbeach and Tankerville mines and advises the Bog Centre. Shropshire Caving and Mining Club organises occasional trips for local residents into Clive mine and Scott's Level at Snailbeach.

Table A1 – Some different expressions of geodiversity in Shropshire

Geodiversity can be expressed in many different ways. The actions set out in the SGAP are designed to help us recognise, conserve and promote all significant forms of geodiversity in Shropshire, to help ensure that they remain available for enjoyment and study by current and future generations:

1) Intrinsic geodiversity

Intrinsic geodiversity is the basic diversity of an area's geology, before human factors such as quarrying have intervened. This includes the degree of variation in the ages and types of the rocks and soils, the conditions in which they were deposited, the forces they have been subjected to and the diversity of their fossil and mineral content. It also includes natural landscape features such as outcrops and valleys which have been formed by geomorphological processes such as glaciation, rivers and weathering. In addition, it can determine the location of man-made features such as quarries.

We cannot increase levels of intrinsic geodiversity as they are a function of the underlying geology. However, the evidence of geology in the landscape can be strengthened or weakened by human factors such as farming patterns and we can also increase our knowledge of geology through study.

2) Cultural geodiversity

Mining and engineering features with geological significance such as mines, quarries, shafts, spoil tips and road and rail cuttings can enhance our appreciation of Shropshire's geodiversity.

Buildings and structures can provide evidence of Shropshire's geodiversity through use of local building stone or locally made bricks. Settlement patterns are also often influenced by geological factors.

Interpretation facilities such as museums and geological trails can enhance appreciation of geodiversity.

Knowledge including academic research, books, literature and maps can increase our understanding of an area's geodiversity and the geological skills of the local and national population.

Other factors such as farming, biodiversity, archaeology and art can also enhance the evidence of geodiversity and our appreciation of it.

APPENDIX 3

Useful documents and further reading

Allbutt, M., Moseley, J., Rayner, C. & Toghill, P. (2002). GA Guide No.27: The Geology of South Shropshire (3rd edition). Published by the Geologists' Association, 116pp.

Andrew, K. (2002). Teme Bank Trail. Published by Shropshire County Museum Service.

Bowen, D.Q. (1977). Guidebook for Excursions A8 and C8: Wales and the Cheshire-Shropshire Lowland. Published for the 10th INQUA Congress, Birmingham, 65pp.

Dean, W.T. (1968). Geological Itineraries in South Shropshire (2nd edition). Published by the Geologists' Association, 48pp.

Etheridge, E. (2005). Shropshire exposed: a guide to our rocky past. Published by Shropshire Wildlife Trust, Shrewsbury SY2 6AH, 51pp.

Jenkinson, A., Pannett, D. & Rayner, C. (2006). Geological Management Plan for Lyth Hill. Prepared for Shropshire County Council. 14pp.

Jenkinson, A. (2000). Mortimer Forest Geology Trail. Published in association with the Forestry Commission (West Midlands Forest Division) and Scenesetters, 25pp.

Lapworth, C. & Watts, W.W. (1908). Shropshire. In Geology in the Field: the Jubilee Volume of the Geologists' Association (1858-1908), eds. Monckton, H.W. & Herries, R.S., 30, 739-769; subsequently published (1910) by Edward Stanford, London, 916 pp., illustrated by 32 plates and 138 figures in the text.

Lawson, J.D. (1973). New exposures on forestry roads near Ludlow. Geological Journal, 8 (2), 279-284.

Lewis, S.G. & Maddy, D. (1997). The Quaternary of the South Midlands and the Welsh Marches. Field Guide. Published by the Quaternary Research Association, 146pp.

Murchison, R.I. (1839). The Silurian System founded on geological researches in the counties of Salop, Hereford, Radnor, Montgomery, Caermarthen, Brecon, Pembroke, Monmouth, Gloucester, Worcester, and Stafford: with descriptions of the coal-fields and overlying formations. John Murray, Albermarle Street, London, 768 pp (2 vols plus geological map).

Norton, W.J. (1971). Geology; in: Faulkner, M. (ed.) A guide to the Welsh Marches: Ludlow area. The British Publishing Company Ltd, Gloucester, 28-39.

Owens, R.M., Lane, P.D., Thomas, A.T., Fortey, R.A., Siveter, Derek J., Owen, A.W., Dean, W.T. & Sheldon, P.R. (2001). 3rd International Conference on Trilobites and their relatives: post-conference excursion guide: South Wales and the Welsh Borderlands. Published by National Museum of Wales, Geology Series, No.20. Cardiff, 47pp.

Philips, P.F. & Stratford, J.R. (1999). Shropshire Geology: a visitor's guide (2nd edition). Published by Phillips Tutorials, 76pp.

Rayner, C., Rayner, M. & Rosenbaum, M.S. (2007). A Geological Trail through the landslides of Ironbridge Gorge. Proc's. of the Shropshire Geological Society, **12**, 39-52.

Rosenbaum, M.S. (2007). The building stones of Ludlow: a walk through the town. Proceedings of the Shropshire Geological Society, **12**, 5-38.

Rosenbaum, M.S. (2007). A Geological Trail in front of the last glacier in South Shropshire. Proceedings of the Shropshire Geological Society, **12**, 56-69.

Rosenbaum, M.S. & Wilkinson, G.B. (2005). *Geological Trail for Titterstone Clee and Clee Hill*. Shropshire Geological Society Special Publication, Printed by Scenesetters, Bucknell SY7 0AL, UK, 27pp..

Scard. M.A. (1990) The Building Stones of Shropshire. Swan Hill Press, 102pp.

Shropshire Geological Society (2005). GeoTrails Project: North Stiperstones. Available as a printed booklet (8pp.), leaflet (1pp.) or in digital form on CD.

Shropshire Geological Society (2007). Geoconservation Trail: Llanymynech. Geoconservation Trails at Shropshire Aggregates Sites Project. Shropshire Geological Society Special Publication, Printed by Scenesetters, Bucknell SY7 0AL, UK.. Available as a leaflet (1 page A3) or in digital form on CD.

Shropshire Geological Society (2007). Geoconservation Trail: Along Wenlock Edge. Geoconservation Trails at Shropshire Aggregates Sites Project. Shropshire Geological Society Special Publication, Printed by Scenesetters, Bucknell SY7 0AL, UK.. Available as a leaflet (1 page A3) or in digital form on CD.

Smith, R., Waters, R. & Davies, J. (1990). Field Guide No.20: Late Ordovician and Early Silurian turbidite systems in the Welsh Basin. Published for the 13th International Sedimentological Congress, Nottingham, 45pp.

Siveter, D.J., Owens, R.M. & Thomas, A.T. (1989). Silurian Field Excursions: a geotraverse across Wales and the Welsh Borderlands. Published by National Museum of Wales, Geology Series, No.10. Cardiff, 133pp.

Thompson, D.B. (1995). A guide to the history and geology of quarrying at localities along the natural history trail in Corbet Wood, Grinshill, North Shropshire. Published by Clive and Grinshill Conservation Committee, 55pp.

Thornhill, R. (2001). Wigmore glacial lake. Published by Herefordshire and Worcestershire RIGS Group, leaflet.

Thornhill, R. (2002). Severn Valley Railway. Published by Herefordshire and Worcestershire RIGS Group, leaflet.

Toghill, P. (2006) Geology of Shropshire (2nd edition). The Crowood Press Ltd., 256pp..

Toghill, P. & Beale, S. (1994). GA Guide No.48: Ercall Quarries, Wrekin Area, Shropshire: Geology Teaching Trail. Published by the Geologists' Association, 21pp.

Toghill, P. (1992). GA Guide No.45: Onny Valley, Shropshire: Geology Teaching Trail. Published by the Geologists' Association, 20pp.

Whittard, W.F. (1958). British Areas: Geological Itineraries for South Shropshire. Published by the Geologists' Association, 48pp.

Wilkinson, G. & Wilkinson, W.B. (2006). The Simon Evan's Way: features of geological interest - a hundred million years walk. Prepared for the Cleobury Mortimer Footpath Association. 22pp.

Shropshire County Council Publications:

Shropshire Telford & Wrekin Minerals Local Plan 1996-2006. April 1996.
Sustainable Shropshire – A Local Agenda 21 Strategy for Shropshire. December 2000.
Shropshire Biodiversity Action Plan. Shropshire County Council. 2002.
Mineral **Resources** Development Plan Document. Preferred Options. February 2006
Core Strategy Development Plan Document. Preferred Options. February 2006.

Government Publications:

Planning Policy Statement 9: Biodiversity and Geological Conservation; DCLG, August 2005.
ODPM circular 6/2005: Biodiversity and Geological Conservation – statutory obligations and their impact within the planning system. DCLG, August 2005.
Planning for Biodiversity and Geological Conservation – A Guide to Good Practice; DCLG, March 2006.
Minerals Policy Statement 1; Department for Communities and Local Government, Nov 2006.

British Geological Survey Publications:

Regional Geology Guides:
Central England. Hains B.A. 3rd Edition. 1969 (reprinted 1987)
The Welsh Borderland. Earp, J.R. 3rd Edition. 1971 (reprinted 1981)

Geological maps S&D = solid and drift (bedrock and superficial deposits respectively):
Classical Areas, 1 – Church Stretton, 1:25,000 (S&D), 1968

Classical Areas, 4 – Craven Arms , 1:25,000 (S&D), 1969
Classical Areas, 5 – Wenlock Edge , 1:25,000 (S&D), 1969
Classical Areas, 16 – Leintwardine, Ludlow , 1:25,000 (S), 1973
Classical Areas, 28 – Telford , 1:25,000 (S&D), 1978
Classical Areas, 44 – Shelve Ordovician inlier and adjacent areas , 1:25,000 (S&D), 1991
E121 – Wrexham, 1:50,000 (S&D), 1993
E122 – Nantwich, 1:50,000 (S&D), 1967
E123 – Stoke-on-Trent , 1:50,000 (S&D), 1994
E137 – Oswestry , 1:50,000 (S&D), 1999
E138 – Wem , 1:50,000 (S&D), 1967
E139 – Stafford , 1:50,000 (S&D), 1974
E152 – Shrewsbury , 1:50,000 (S&D), 1938 & 1978 (S)
E153 – Wolverhampton , 1:50,000 (S&D), 2001
E165 – Montgomery , 1:50,000 (S&D), 1994
E166 – Church Stretton , 1:50,000 (S&D), 1967; SWD 1974
E167 – Dudley , 1:50,000 (S&D), 1975
E181 – Ludlow , 1:50,000 (S&D), 2000
E182 – Droitwich , 1:50,000 (S&D), 1976.
52N 04W – Mid Wales & Marches. 1:250,000,1990

1:50,000 Sheet Memoirs and explanatory booklets:
E121 – Wrexham. Lower Palaeozoic and Lower Carboniferous rocks (M). Webb C.B. 1927
E121 – Wrexham. Part 2. Coal Measures and newer formations. Webb C.B. 1928.
E122 – Nantwich & Whitchurch (M). Poole E.G. 1966.
E123 – Stoke-on Trent (M). Rees J.G.A. 1998.
E137 – Oswestry (M). Webb C.B. 1929.
E138 – Wem (M). Pocock R.W. 1929.
E139 – Stafford & Maarket Drayton (M). Whitehead T.H. 1927.
E152 – *not published*.
E153 – Wolverhampton & Telford (SD). Bridge D. 2003.
E165 – Montgomery & the Ordovician rocks around Shelve (M). Cave R. 2001.
E166 – Church Stretton, Craven Arms, Wenlock Edge & Brown Clee (M). Greig D.C. 1968.
E167 – Dudley and Bridgnorth (M). Whitehead T.H. 1947.
E181 – *not published*.
E182 – Droitwich, Abberley and Kidderminster (M). Mitchell G.H. 1962.
1 – Geology of the Church Stretton Area. Wright J.G. 1968
4 – Geology of the Craven Arms area. Hains B.A. 1969
5 – Geology of the Wenlock Edge area. Hains B.A. 1970.

Some useful web addresses:

Abberley & Malvern Hills Geopark: http://www.geopark.org.uk/
British Caving Association (BCA): www.british-caving.org.uk
British Geological Survey: http://www.bgs.ac.uk/
Geological Society: http://www.geolsoc.org.uk
Good Quarry.com (quarrying & environment): http://www.goodquarry.com/Default.aspx
National Association of Mining History Organisations: www.namho.org.
Natural England: http://www.naturalengland.org.uk/
Shropmap: http://193.132.103.52/website/shropmap/viewer.htm
Shropshire Geological Society: http://www.shropshiregeology.org.uk/
Shropshire Wildlife Trust: http://www.shropshirewildlifetrust.org.uk/
Shropshire County Council, Planning: http://www.shropshire.gov.uk/planning.nsf
SCC, Sustainability: http://www.shropshire.gov.uk/sustainability.nsf
SCC, Museum Services: http://www.shropshire.gov.uk/museums.nsf
UKRIGS: http://www.ukrigs.org.uk/html/ukrigs.php
Virtual Shropshire. Tourist information guide: http://www.virtual-shropshire.co.uk/