

th heritage **HERITAGE**
Earth **HERITAGE**
heritage

The geological and landscape conservation magazine



Free reports

GCR site reports
rolled out for
free download

Issue
30

Summer 2008

Fossil Code

Voluntary code
encourages
responsible collecting

Looking at the big picture

Some significant current developments are likely to have wide-reaching impacts on geoconservation strategy and practice for years to come.

NATIONALLY, the UK Geodiversity Action Plan goes out for final consultation later this year (page 11). The Plan should provide an authoritative, one-stop reference and UK-wide framework for, among others, planners, politicians and funders. It will be the first agreed national framework for a multitude of geoconservation and geodiversity activities since Earth Science Conservation in Great Britain: A Strategy in 1991.

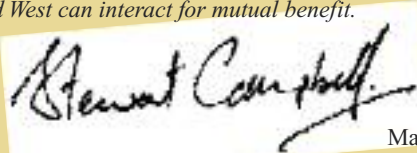
AT A CONTINENTAL LEVEL, the European Landscape Convention is a landmark recognition of the fundamental importance of geodiversity and the need to take an holistic approach to managing landscape change (page 4).

GLOBALLY, we have to deal with climate change. What are its potential effects on geodiversity? This major issue is explored by Scottish Natural Heritage, who reveal that lessons from the past will help us understand and manage our resources in the future (page 8).

Elsewhere, we report progress with RIGS with the completion of the large Central Wales project (page 14), and the gathering momentum of the world geopark movement.

It's always good to report on 'something for free', and the provision of GCR reports via the Web (page 18) is a welcome development, as are the free Earth Science web-based learning resources described on page 6. Topically, following the magnificent Olympic Games in Beijing, Cynthia Burek (page 20) reports on the Chinese capital's geopark, and explores how East and West can interact for mutual benefit.

Enjoy your reading!



Managing Editor

Earth heritage

Earth Heritage is a twice-yearly magazine produced by the Joint Nature Conservation Committee, Natural England, Scottish Natural Heritage and the Countryside Council for Wales. The voluntary geoconservation sector is a major contributor. We would like to thank all those who

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Cover photo



Central Wales RIGS Group members (see page 14) examine the Aberystwyth Grits in cliffs at Craig y Fulfran, Aberystwyth. This important turbidite sequence and its associated geological structures are described in the *British Silurian Stratigraphy and Caledonian Structures in Great Britain* volumes of the GCR. Reports from these seminal but expensive tomes are coming on-line free (see page 19). Photo by Stewart Campbell

Soils will enjoy a heightened profile



Erosion in upland blanket bog and arable soil in Scotland. Exacerbated erosion may lead to increased greenhouse gas emissions, as well as soil, carbon and pollutant loss. These have an impact on air, water and land quality.
Photo by Scottish Natural Heritage

Not so long ago, soil was described as the Cinderella of environmental policy with most attention focussing on water, air and biodiversity quality objectives. It is now widely acknowledged that the sustainable use and management of our nation's soils is key to the provision of a wide range of economical, social and environmental benefits.

Evidence of pressures on soils from emerging issues such as climate change and increased land demand for renewable energy and food supply, have been fed back into the development of new policies to safeguard soils.

Policy implementation and development for soil-related matters are a devolved issue in the UK, so delivery targets in the final policies across the UK administrations should reflect both the varied distribution of soils and different threats to them.

UK Government departments are now developing policies specifically aiming at the protection and sustainable use of soils. Details of those proposals can be found for England at www.defra.gov.uk, Wales www.wales.gov.uk and Scotland www.scotland.gov.uk.

The national policies address a similar range of issues:

- management of organic soil and control of organic matter loss, potential for carbon storage in soils;
- promoting the role of soil in planning development;
- reduction of greenhouse gas emissions;
- renewable energy – impact of new energy development on soil, suitability of land to support biofuel crops and biomass production;
- a soil monitoring scheme; and
- engagement with stakeholders (e.g. land managers, policy makers, land users, developers and scholars).

These issues are also at the heart of the development of the EU Thematic Strategy for Soil Protection (2006) and its draft Framework Directive establishing a framework for the protection of soil. See ec.europa.eu/environment/soil/three_en.htm

– *Patricia Bruneau, Scottish Natural Heritage & Soils Lead Co-ordination Network, Joint Nature Conservation Committee*

Return of the Rotunda

Scarborough's Rotunda Museum, restored to its former glory, has opened its doors again following two years of restoration work made possible by £4.4m funding from the Heritage Lottery Fund, Scarborough Council and various sponsors.

The Rotunda, one of the first purpose-built museums, opened in 1829 to interpret, through its circular plan, William Smith's 'fossil-ordered stratigraphy'.

The museum's original intention was '...to give energy,

concentration and effect to native talents; to examine the great laboratory of the earth, to establish the locality of natural objects to trace analogies with distant parts of the earth; to explore worlds of organised beings, till lately unheard of; and to make acquaintance with others now in existence of which we were before ignorant; to collect and

to arrange in a simple, harmonious and intelligible form, the various objects of natural science...'
 (Sir George Cayley Bart [1829])



The Rotunda's beautiful interior.
Photo by Jonathan Larwood/Natural England

This desire holds true today with the restoration of the original display cases, and the painted cross-section of the East Coast from the Humber to the Tees now joined for the first time by fossils from William Smith's own collection. Alongside this is the multi-media 'Shell Geology Now' gallery with centre stage the recently discovered

Speeton Plesiosaur. So, once more when you visit Scarborough you can visit the Rotunda and, as in 1829, see the wonders of Yorkshire's and the world's geology. For more details: www.rotundamuseum.co.uk

– *Jonathan Larwood, Natural England*

Can you help Scotland's newest RIGS group?

Scotland's newest RIGS group, Argyll, faces a formidable task in identifying, recording and interpreting the geodiversity of its area – and it's looking for all the help it can get.

Argyll stretches over 150km in length, from the Mull of Kintyre in the south to Appin in the north, and from Loch Lomond in the east to the island of Tiree in the west. It includes more than a dozen inhabited islands, ranging in size from Mull to Oronsay, and innumerable uninhabited islands. The geodiversity is equally wide-ranging – from the Lewisian gneiss of Coll, Tiree and Iona to the Dalradian rocks of much of mainland Argyll, and the Palaeogene strata of Mull. Much of the area lies between the Highland Boundary Fault to the south-east and the Great Glen Fault to the north-west, with the Moine Thrust affecting the far west of Mull.

Within Argyll are several famous tourist sites, from Fingal's Cave on Staffa to the banks of Loch Lomond. However, in a region of outstanding geology, there are many other geodiversity highlights with the potential for recording and interpretation.

Good examples are the sources of the stone used in the construction of the iconic Iona Abbey such as the famous old marble quarry on Iona, and the Easdale slate quarry on the Isle of Luing, from where the roof of the restored Abbey came. There are the textbook Palaeogene igneous features on Mull, forming the roots of a volcano, that have attracted generations of geology students. For the more specialist visitor, there are the Precambrian Port Askaig Tillite and the Tayvallich Volcanics, both of world significance.

The Argyll group was formed in April, in response to enthusiastic encouragement from Mike Browne, Chairman of UKRIGS, and the support of Seonaid Leishman of Strathclyde RIGS.

The group would be delighted to hear from others willing to be involved – we need a lot of enthusiasm as well as expertise to take on the task. Contact Alastair Fleming by e-mail: fleming.a.z@btinternet.com or post at: 23 Cullipool, Isle of Luing, Oban, Argyll, PA34 4UB.
– *Alastair Fleming*
Argyll RIGS Group

Landscapes:

The European Landscape Convention (ELC) is a landmark recognition that all landscapes are valuable and that landscape is 'a key element of individual and social well being and quality of life' (Council of Europe, 2007).

The ELC is exclusively devoted to the protection, planning and management of European landscapes. The UK Government signed and ratified the ELC in 2006 and it came into force in the UK in March 2007.

So what constitutes a landscape? The ELC defines it as 'an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors'. This covers all urban and peri-urban landscapes, towns, villages and rural areas, the coast and inland areas. It applies to ordinary and even degraded landscapes, as well as areas that are outstanding or protected.



The interaction between natural and human factors is evident in the Malvern Hills (above) where the igneous Precambrian rocks of the hills contrast with the gently dipping Silurian mudstones and limestones to the west and a related contrast



Granny Scotland's giant scarf knits a color

The 'Leading Edge' event of Scottish Natural Heritage's 'Sharing Good Practice' programme in 2008 focussed on getting people excited about Scotland's geodiversity. The programme encourages people to share ideas and approaches on topics relevant to their work or personal development.

Organised by SNH in association with the Scottish Countryside Rangers Association, the event at the Pitlochry

'Granny Scotland' played by Ness Kirkbride, making her first appearance at Pitlochry, holding her tangled (folded, faulted and metamorphosed) geological column, including some fossil dinosaurs. *Photo by Lorne Gill/SNH*

Festival Theatre brought together environmental education practitioners (including rangers, teachers, community group leaders, tourism staff and SNH staff). A key aim was to raise awareness of how much modern western lifestyle depends on geological resources: bricks, mortar, paints, plaster; fuel and sources of power generation. How better to do this than within the human-designed-and-built surroundings of a theatre?

An additional aim was to gain insights into Scotland's geological heritage and determine how best to interpret and stimulate interest in it, again based on the

recognition of big-picture issues

The ELC is the starting point for a Europe-wide initiative to understand the evolution, present state and potential future of European landscapes. In particular, it allows consideration of:

- what constitutes cultural landscapes;
- how we regard and protect landscape heritage;
- social and economic driving forces;
- how people influence landscapes; and
- the role of ‘ordinary’ landscapes in our cultural heritage and future health, wealth and happiness.

The ELC is the first international agreement that specifically addresses landscape issues and provides a holistic approach to managing landscape change.

The UK has been instrumental in developing the ELC and Defra has established the England Project Group to help deliver the Convention’s broad aims in England. Natural England is its project

manager. A Framework for Implementation, developed by Defra, Natural England and English Heritage, highlights two objectives:

- strengthening of institutional frameworks – promoting a landscape perspective to influence spatial planning, land use and resource management nationally, regionally and locally;
- creating an inclusive, people-centred approach – raising people’s awareness and fostering community engagement as well as working with professionals, specialist bodies and politicians.

The Framework provides a structure for partners’ and stakeholders’ Action Plans which will contain a range of activities to achieve the ELC objectives. Natural England is developing Action Plan guidelines and drafting its first Plan to highlight policy and practical instruments that will assist the protection, planning and management of landscapes – alongside demonstrating European co-operation and leadership. More details from Gary Charlton, Landscape Senior Specialist, Natural England, tel: 01242 533264.



in land-use. Similarly the view from Wansfell Pike (above right) shows the contrast between the Ordovician Borrowdale Volcanics (foreground), Silurian slates and sandstones (background) and the influence of glaciation (Lake Windermere) with corresponding differences in human

use. The ELC recognises the importance of these factors and their interactions and it may lead to some new ways of thinking about geodiversity.

Photos by Dave Evans

urful story around a tumultuous geological evolution

materials and resources immediately available. Scotland’s landscape, a major tourist attraction, holds the evidence for much of the history of the Earth. The story can be revealed using building stone, even the gravel of a car park! Making use of what you have at hand to tell your story was an objective of the day, which started with a theatrical sketch involving a granny in a hard hat!

Scotland’s Earth history was interpreted theatrically through the character of 4.6 billion-year-old ‘Granny Scotland’ by means of her knitting, and recollections of her time carelessly driving her

continent-sized bulldozer. The brightly coloured, striped scarf, a massive 31 metres long, was knitted as a woolly geological column by staff at SNH’s Battleby offices to illustrate the rocks and geological events from the ancient Lewisian gneiss to modern soft sediments along today’s coasts.

The theme of using imagination and local surroundings continued in eight workshops on: stone carving (Gillian Forbes, stone carver), backyard geology (Colin MacFadyen and Susan Webster, SNH), recreating processes using everyday objects (Angus Miller,

Geowalks), fossil fuels (Ann McKillop, Colin Smith and Aileen McKean, Greenhead Moss Community Trust), reading the landscape (Ness Kirkbride, SNH), wild paint (Jan Hendry), linking the curriculum and Earth Science (Claire Britton), and Scotland’s dinosaurs (Neil Clark, Natural History Museum, Glasgow).

For more information about forthcoming Sharing Good Practice events, see www.snh.org.uk/ww0/education/educ-sgp.asp

– *Ness Kirkbride, Scottish Natural Heritage*

Tools to rock the pupils!

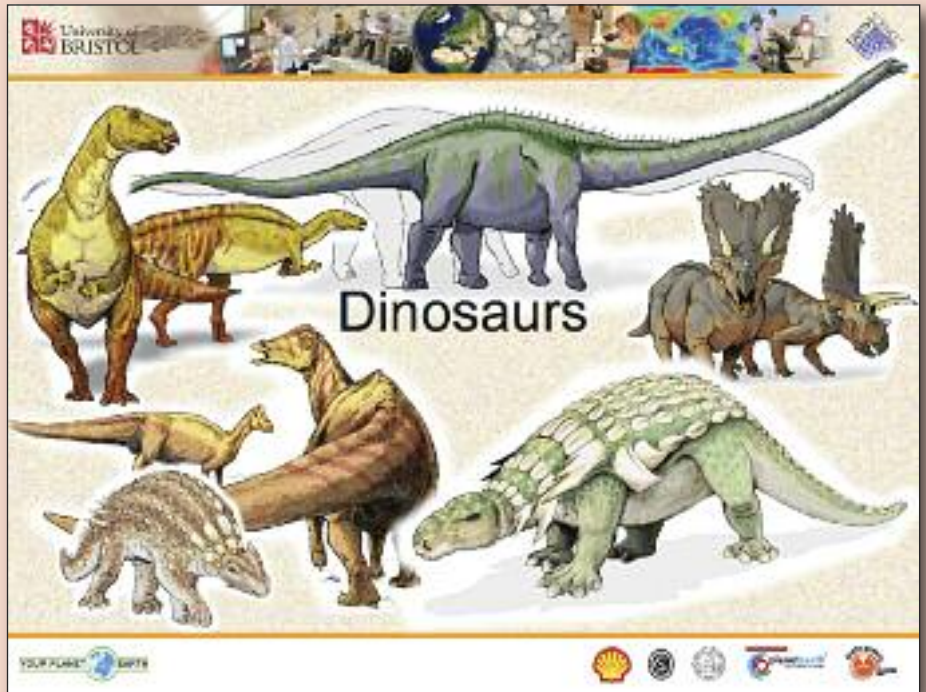
2008 is the International Year of Planet Earth, and one key theme is education. The Geologists' Association and the Geological Society have launched an initiative that we hope will contribute to getting the message across.

Lots of people go out to schools to talk about dinosaurs, volcanoes, mineral resources, climate change, and many other topics in the Earth sciences. Now they can use a new, free, resource. Aimed at students, teachers, and others who want to present talks on key Earth sciences themes, it is called Your Planet Earth (YPE) and can be found at www.earth4567.com. Note the web address: 4567 is the current best estimate of the Earth's age, in millions of years.

YPE is an integrated campaign that offers children interesting talks on topics from dinosaurs to volcanoes, posters that captivate and inform, and a portal that provides links to teaching material and information on jobs and careers that relate to the Earth, its resources and stewardship.

The key aims of the YPE programme are to:

- promote informed debate among children and their parents;
- use the Earth and environmental sciences to demonstrate the application of maths and basic sciences to real problems;
- make teachers aware of existing organisations (e.g. Earth Science Education Unit) that provide support to improve teaching and learning in



Dinosaurs is one of the Powerpoint talks available free under the YPE initiative from the Geologists' Association and the Geological Society.

science, particularly within Earth and environmental science;

- provide accurate and current information on geoscience careers.

The programme is funded so far by Shell, and its sponsors are the Geologists' Association, the Geological Society of London and the ESEU.

The website is just the beginning. In its initial form, we offer talks, aimed at 14-15-year-olds, on volcanoes, dinosaurs, natural hazards, plate tectonics, climate change and other subjects. The initial talks were put together by volcanologist Jess Trofimovs, and they are available free, for anyone to use as they are, or to edit in any way. As well as building the number of talks, we will translate each talk into a form suitable for 8-9-year-olds.

In addition, there is a training module. If an outreach/engagement co-ordinator

wants to train a group of students to give effective talks in schools, we offer a short Powerpoint talk, with exercises, that can be used for training. The module is based on the combined experience of people who have delivered geology talks in schools for many years.

It is also planned to develop a careers section on the YPE website, using existing resources and adding personal stories – young people who have completed degrees in geology and related topics, and who have gone on to interesting careers in the public and private sector.

If you have been put off giving a talk in a school because of the effort required to prepare a talk – then look no further than www.earth4567.com!

– *Mike Benton*
President,
Geologists' Association

Educational contacts needed

Numbers of people visiting Earthlearningidea.com, the free web resource for Earth science teaching, are building. By mid-April, the site had received over 4,300 visits from 93 countries and the people behind the idea, Chris King, Peter Kennett and Elizabeth Devon from Keele University, want more traffic to the site.

They are appealing to *Earth Heritage* readers to send contact details of any teacher trainer establishments and schools in

which you think Earthlearningidea activities would be useful. The e-mail address is info@earthlearningidea.com.

The site provides material to promote interactive teaching that demands minimal equipment and resources. Earth-related activities are published each Monday in English and Spanish and they are gradually also being translated to Norwegian. Some activities have video demonstrations and teachers' comments are published as 'extension' ideas.

Inspiration in Osnabrück

“.....We all want to preserve the natural and cultural heritage of our planet and inspire people to occupy themselves with this heritage in many different ways, so that we understand what has shaped this planet - and what we and the generations to come stand to lose if we do not protect this heritage. For we all know full well: We protect only what we love – and we are only able to love what we know. All of you here play a decisive role in this process.Use every reasonable opportunity to let the world know that your park is there, what it has to offer, and what makes it special.”

With an overall theme of communication, this was part of an inspirational opening keynote speech by **Klaus Liedtke**, Editor in Chief of National Geographic, Germany, for what was to become an inspirational 3rd International UNESCO Conference on Geoparks, held in Osnabrück, Germany.

Over 350 people, representing 47 countries, attended the event, organised by the Terra Vita Geopark team. It provided a unique opportunity to prove to the international geo-scientific community and to the representatives of other organisations and bodies, the strength and potential of the European and Global Geoparks Network.

The main conference was preceded by the first ever Global Geoparks Fair. This two-day event, held in Osnabrück's historic market place, enabled Geopark teams to explain and promote their locations.

The conference itself included presentations and workshops grouped into themes including: communication; young people



The first Global Geoparks Fair was an eyecatcher in Osnabrück's historic market place. Photo by Colin Prosser/Natural England

and Geoparks; socio-economic benefits of Geoparks; climate change, criteria for joining the Geopark family; and linking geology and soils on Geoparks. The emotive opening address was matched by an equally inspirational closing address from Ross Dowling, who predicted exciting times for geotourism in the years ahead.

The Conference also saw its 10 newest members officially welcomed into the Global Geoparks Network, and a Youth Camp. Fully funded, the Youth Camp enabled four students from each European Geopark to enjoy nine days exploring the Terra Vita Geopark, communicating, interacting and learning from each other during the various activities. These included rock climbing, fossil preparation, forging and making stone tools. In addition, they discovered the need for tact and diplomacy

while viewing the Euro 2008 finals as a mixed nationality group!

Successful in achieving Geopark status in September 2007, the English Riviera Geopark was one of the 10 newest members to be welcomed into the Global Network and this was the first official opportunity for the two representatives, Nick Powe, Chairman, and myself as Co-ordinator to exchange ideas, information and experiences. Among other new members are Lochaber from Scotland, Kanawinka from Australia, Papuk from Croatia, Adamello Brenta and Geological Mining Park Sardinia from Italy, Longhushan and Zigong from China, and Langkawi from Malaysia.

It was a great experience and wonderful to see all of the Geoparks working in close co-operation at both the Geotourism Fair and the conference. However, the real highlight for me, apart from presenting the new English Riviera Geopark, was watching the participants of the Youth Camp make their conference presentations. The team from the North Pennines Geopark made a really impressive film whilst those from Papuk helped design the fantastic new Papuk Geopark website. Of course I was biased and was most proud of the team of four boys from Torquay Boys' Grammar School who presented the English Riviera Geopark with professionalism and, it has to be said, true cosmopolitan style!

Langkawi will host the 4th International UNESCO Conference in 2010.

– **Mel Border**,
English Riviera Geopark Co-ordinator

The foreshore at Corrie, on Arran's north-east coast, provides a near-continuous stratigraphic sequence from the late Devonian through the entire Carboniferous to the Lower Permian. Fully booked before the Festival even got underway, the walk highlights the interest in walking through 70 million years of Scottish history!
Photo by Dave Ellis



Festival incorporates geology

The Isle of Arran staged its third consecutive annual Arran Wildlife Festival in May. This event once again offered to bring people closer to some of Scotland's most iconic wildlife, from the majestic golden eagle to the imposing red deer. However, opportunities to experience the island's incredibly rich geodiversity also featured in the week-long series of events, with guided walks and talks provided by Colin MacFadyen and Rachel Wignall of Scottish Natural Heritage and Neil Clark from Glasgow's Hunterian Museum. Details of next year's festival at www.arranwildlife.co.uk.

Climate change:

why geodiversity matters

**John Gordon, Ness Kirkbride,
Alistair Rennie, Patricia Bruneau**

Scottish Natural Heritage

Climate change and sea-level rise are happening now and we are already locked into future changes as a result of past anthropogenic emissions of greenhouse gases. Climate change will extend well beyond the AD2100 timescale of current climate projections. Such a timescale is outside the normal time frames of most policy makers, planners and ordinary people. Scottish Natural Heritage is developing a Climate Change Action Plan. We outline some key considerations

for geodiversity and its wider role in adaptive management of ecosystems.

Learning from the past to understand the future

The geological record reveals how past environments responded to broadly comparable climate changes. The mid-Pliocene (~3-5 million years ago) is perhaps the closest geological analogue for a future warmer world. CO₂ levels in the atmosphere then were ~360-400 parts per million by volume [ppmv] (compared with 385 ppmv

today and rising at ~2 ppmv per year), global temperatures were ~3°C higher and sea level was up to 25m higher. Because of lags in the climate system, warming in the pipeline is now ~2°C and approaching the 2-3°C level and is considered to represent a threshold for dangerous risks (e.g. leading to irreversible ice-sheet melting).

Some of the more far-reaching effects of climate change are likely to be at the coast, and the latest projections from Defra show net regional sea-level rise of 7mm/yr in Scotland in the next few decades,

Table 1.
Potential responses of dynamic land-forming processes to climate change in Scotland

Location	Key properties	Key weather variables	Key human impacts	Potential effects
Soft-sediment coast	<ul style="list-style-type: none"> ● Sediment type and availability ● Wave energy ● Beach profile ● Sea-level rise 	<ul style="list-style-type: none"> ● Wind direction and speed (affecting both wave energy and sand movement) 	<ul style="list-style-type: none"> ● Interruption of sediment movement ● Sea walls – ‘coastal squeeze’ ● Development in flood-prone areas 	<ul style="list-style-type: none"> ● Increased erosion ● Increased flooding ● Changes to salinity of brackish waters ● Increased conflict between coastal land uses
Rivers	<ul style="list-style-type: none"> ● Sediment type and availability ● Runoff ● Changes in slope 	<ul style="list-style-type: none"> ● Precipitation duration and intensity ● Antecedent conditions ● Drought 	<ul style="list-style-type: none"> ● Interruption of sediment movement ● Re-profiling channels ● Development in flood-prone areas 	<ul style="list-style-type: none"> ● Increased erosion ● Increased flooding
Regolith: soils, slopes & summits	<ul style="list-style-type: none"> ● Sediment type – friction and cohesion ● Slope ● Soil moisture ● Soil organic matter 	<ul style="list-style-type: none"> ● Precipitation duration and intensity ● Antecedent conditions ● Drought ● Wind direction ● Snow cover ● Temperature regime 	<ul style="list-style-type: none"> ● Land use change altering vegetation cover, drainage, overuse of soils ● Over-steepening of slopes / cuttings ● Trampling 	<ul style="list-style-type: none"> ● Increased erosion by water and deflation ● Loss of soil fertility ● Loss of soil organic carbon



Grangemouth oil refinery and the Firth of Forth. Sea-level rise is outpacing isostatic uplift over an increasingly wider area of Scotland. In our heavily developed firths, there may be no room for ecological adaptation or relocation.

Photo by P&A Macdonald/SNH

outstripping rates seen in the last few thousand years. The effects are likely to be exacerbated by continued sediment deficit and possibly enhanced storminess.

Impacts on geodiversity

Climate change may have both negative and positive impacts on geodiversity. Rock and sediment exposures could be sealed behind coast defences and river-bank protection. Unique exposures may be lost through erosion, or access prevented through submergence or burial because of changes in sedimentation or landslides. Conversely, erosion may reveal new exposures that replace existing sites or reveal new interests. Changes in land use, arising from increased demands for food and energy crops, could also restrict access to rock exposures or obscure the visibility of landforms.

Dynamic sites will respond to changes in the nature, magnitude and frequency of geomorphological processes (see Table 1), which may result in the following scenarios:

- greater geomorphological heterogeneity (variety of geomorphological processes) and changes in landscape character (e.g. more bare slopes as a result of accelerated erosion);
- changes in the water and sediment discharges in rivers, resulting in readjustments in channel positions that have been stable in living memory;
- changed distributions of coastal and river landforms in response to altered patterns of erosion and deposition – this could cause the notified scientific interests to shift out of existing designated sites;
- decreased periglacial activity on some mountains;
- changes in soil biochemical processes (e.g. degradation of pollutants and carbon sequestration), leading to increased release of greenhouse gases and loss of carbon – this is of particular concern since Scotland’s soils contain the majority of the UK soil carbon stock;
- accelerated soil erosion in both arable and upland environments, especially during windy or very wet conditions, as a

result of land use changes and increased recreation pressures;

- increased demand for hazard mitigation, such as flood protection and coast protection.

Impacts on biodiversity and ecosystems

Ecosystem responses to climate change and sea-level rise will depend on geomorphological processes and their ability to resist change. For rivers, coasts and steep hillsides, successful and sustainable adaptation measures will require working with natural processes, not against them, at appropriate spatial scales (e.g. catchments and coastal zones). Some habitats may become more dynamic as a result of changes in the nature and rate of geomorphological processes (Table 1). Greater geomorphological heterogeneity may make it easier for biodiversity to adapt to climate change. Conversely, increased

Continued on page 10



The Insh Marshes, an area of natural wetland on the floodplain of the River Spey. Sustainable flood management will have wider benefits for restoration of floodplain habitats and natural processes.

Photo by John MacPherson/SNH

from page 9

rates of geomorphological activity may be too fast for some habitats and species to adapt.

The probable increased incidence of flooding, and consequent enhanced erosion and rates of sediment movement will affect the quality of freshwater habitats. Similarly, any changes in seasonal flows, for example the timing and duration of droughts, will have implications for freshwater habitats. Overall, there may also be less recovery time between extreme events, such as wash-out of spawning areas.

The geomorphological constraints on species adaptation centre on the speed of landscape readjustment and the length of time an area remains potentially unstable.

Management responses to sea-level rise (e.g. more coast protection) may also have significant knock-on effects for the natural heritage (e.g. reduced sediment supply to maintain beaches, machair and saltmarshes), notwithstanding our advocacy of 'soft engineering' solutions.

From a land-use and management point of view, it will be important to protect soil carbon stocks in peat and other organic soils against accelerated losses to the atmosphere and drainage systems. Knowledge of soils and soil processes (*see page 3*) and how they respond to climate change will be fundamental to work on management and restoring of wildlife habitats.

What needs to be done?

As a starting point, we need to assess the vulnerability of different types of geosites and develop appropriate management strategies. Adaptive management will need to address the links between geodiversity and biodiversity. Fortunately, a lot is already known about the relationships between active land-forming and soil-forming processes, biodiversity and climate factors. In addition, the recent geological archive documents the relationships between past changes in climate and changes in habitat and species distributions, changes in slope stability and sediment availability, floodplain and wetland histories and coastline changes. If this knowledge is systematically drawn together in scenario modelling, incorporating geomorphological and ecological resilience and sensitivity, it

will help inform ecosystem management and associated legislative and regulatory decisions.

Although we need more information on some key issues, uncertainty should not be an excuse for inaction. The immediacy of climate change and its implications for the natural heritage require that we start now with existing knowledge to develop policy and to plan sustainable conservation and landscape management.

Recognition of the linkages between geodiversity, biodiversity and landscape also needs to be integrated better into relevant policy areas, including the emerging UK Geodiversity Action Plan and Local Geodiversity Action Plans, and to include actions to manage change both in designated sites and the wider countryside. ■

Working with natural processes

As part of sustainable flood management, it will be essential to work with natural processes through creating room for rivers, floodplain restoration and coastal realignment. Soft engineering techniques involving minimal intervention should be deployed where possible to maximise nature conservation outcomes (e.g. restoring coastal habitat such as saltmarsh or mudflats) and reduce flood risk. However, this will require sediment supply to be maintained from 'sacrificial' areas.

There is likely to be acute demand for this interchange if recent projections of the rate of sea-level rise are realised – some habitats may need to be sacrificed to maintain others. The reality, in terms of understanding the natural processes and the politics of such approaches, will be complex. A significant challenge lies in helping the public understand the value of adaptive management in the face of sometimes-hazardous natural processes.



Coastline east of Golden Cap, Dorset. The Dorset LGAP includes actions for the whole of the Jurassic Coast World Heritage Site.

Photo by Hannah Townley

LGAPs foster closer working

Local Geodiversity Action Plans (LGAPs) are helping to bring together different organisations, groups and individuals, strengthening existing relationships and creating new links.

They are raising the profile of geodiversity and helping work in both policy and practical areas to be more closely targeted, and limited resources to be well prioritised.

These are some of the key conclusions in a review of LGAPs by Countrywise Consultants, commissioned by Natural England.

From a near-standing start in 2003, 41 LGAPs now exist or are being developed in England. In the background PPS9 guidance, Defra Local Sites guidance and, most recently, the National Performance Indicator for Biodiversity (197) all highlight the importance of LGAPs and the valuable role they play.

Continued on page 12

Hannah Townley
Natural England

Strong support for UK-wide plan

A consultation on a draft UK Geodiversity Action Plan (UKGAP) has revealed strong support for such a national plan, and a wide range of views on the potential activities that could contribute to its delivery.

The UKGAP Partnership (comprising the statutory conservation agencies and a number of national geological organisations) met in June 2008 at the Joint Nature Conservation Committee to discuss issues raised by a consultation conducted at the start of the year. It attracted 30 responses containing salient comments, ideas and suggestions from both individuals and organisations.

The Partnership believes the UKGAP should provide a framework for enhancing the importance and role of geodiversity in the UK. After analysing consultation contributions, the proposed UKGAP is being re-drafted to reflect views expressed and the document will be re-circulated as a final draft for comment later this year.

The original consultation documents, and the responses, can be viewed at www.geoconservation.com.

E-mail hannah.townley@naturalengland.org.uk if you are not already on the e-mail circulation list and would like to be consulted. ■



High Force, Upper Teesdale. The North Pennines AONB was one of the first areas to produce an integrated geodiversity action plan and audit.

Photo by Mick Murphy

from page 11

The review emphasises that resources remain critical and it is important that the momentum gained in developing LGAPs is not lost – a challenge for all existing and new LGAP partnerships. Researchers found that monitoring progress was not being widely undertaken, but the report concludes that this needs to happen to help celebrate successes, identify problems and provide an important justification for increasing the resources available to support the delivery of LGAPs.

LGAPs set out actions to conserve, enhance and promote the geodiversity of a particular area and have been widely adopted across the UK, in part supporting the delivery of geoconservation.

Countrywise Consultants identified and investigated 41 LGAPs. These comprised 23 launched LGAPs, 14 LGAPs in development, four as proposals and a number of company Geodiversity Action Plans (cGAPs) for aggregates industry land-holdings. The majority of launched LGAPs were published between 2004 and 2007. Six in development are planned for launch in 2008.

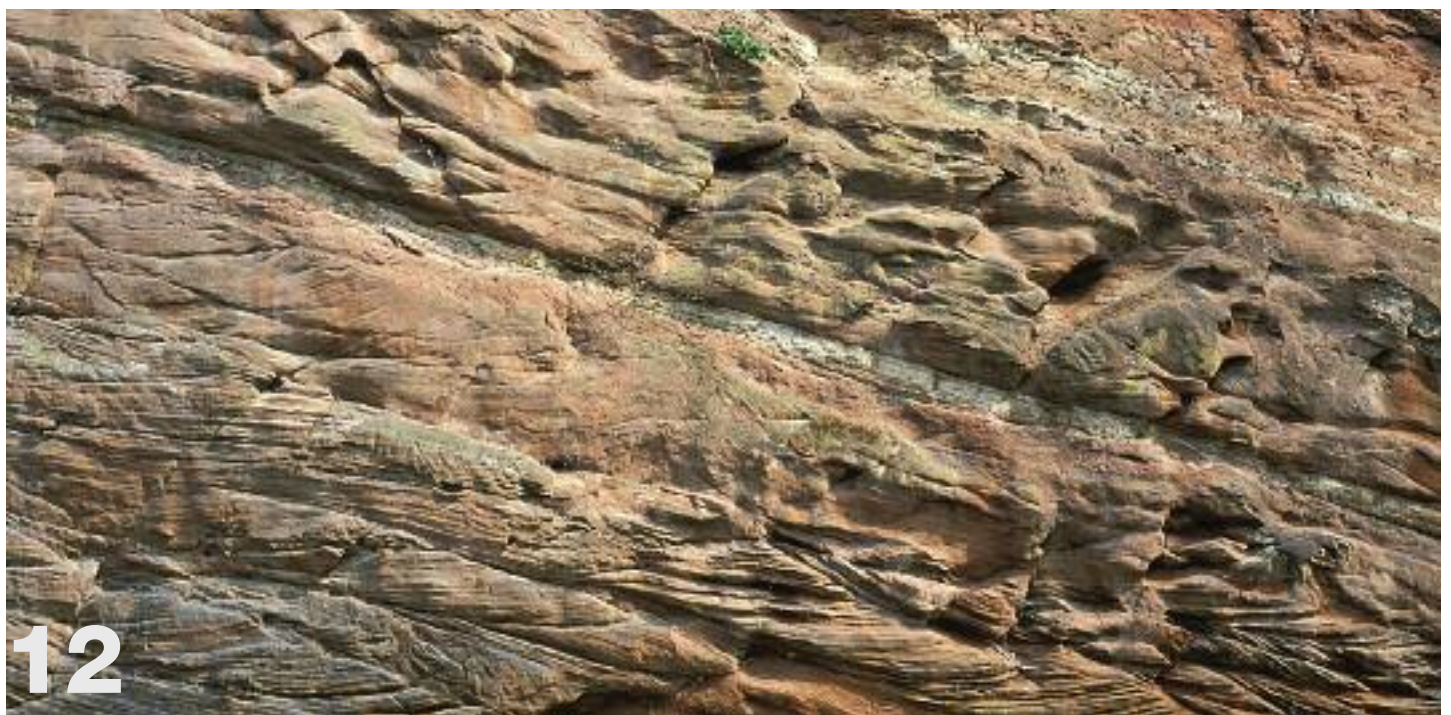
Partnerships

The principal organisations involved in LGAP production are local geoconservation organisations (usually as a lead partner) including RIGS Groups, Geology Trusts and geological societies, with a lesser but still important role being played by BGS,

National Park Authorities, AONB Partnerships, museums and record centres, Natural England, wildlife trusts, universities and geoparks.

In relation to other aspects of partnership working that were investigated by the questionnaire, key conclusions are:

- few partnerships had changed in terms of their core composition, although in several cases more partners were expected to join as the LGAP process progresses;
- the effectiveness of partnerships is enhanced by a strong commitment and input from the public sector, since this enables geodiversity issues to receive a



- high profile within local or regional policy;
- the active involvement of the voluntary sector is also important for its geological knowledge and expertise and the ability to bid for otherwise inaccessible funds;
- partnership difficulties may be largely due to a lack of funding for implementation, a lack of commitment from the public sector or too great a reliance on volunteers.

Implementation and review

Priorities for LGAP implementation focused primarily on the development of interpretative and educational material. Other key priorities included site audit, research or monitoring; site management and conservation; developing the LGAP partnership and getting more partners involved in delivery; acquiring funding – particularly to support an LGAP co-ordination role; influencing planners and local authorities and designation of RIGS.

Site audit work is seen as a critical part of any LGAP. Opinion was divided on the timing of audit work, but on balance it is not a pre-requisite for an LGAP. However, if geodiversity information is lacking, audit is likely to be an important early action.

Twelve respondents indicated that their LGAPs are being actively monitored or that a monitoring system has been incorporated within the LGAP. However, in many of these cases it was acknowledged that this is not being carried out in a systematic or structured way. Only two LGAPs (Devon and Cheshire Region) had been formally reviewed.

Benefits and challenges

In many cases it was considered that having an LGAP has raised the awareness/profile

of geodiversity, in particular with local authorities and the quarrying and minerals industries.

Other important differences of having a LGAP include: providing a focus for activity and/or a structured approach for delivery of geoconservation, demonstrating the linkage between geodiversity and other elements of the landscape (e.g. buildings, land use, industry), demonstrating the importance of geoconservation, gathering support for funding applications, raising the profile of the organisations developing or implementing the LGAP, encouraging partnership working and demonstrating the importance of volunteers in getting things done.

However, a number of common problems emerged including: difficulties in raising funding; support or interest in the LGAP – a linked problem being an unrealistic expectation of what an LGAP can achieve; and difficulties finding adequate funding or time for LGAP development and implementation. In some cases it was felt that the LGAP should have been simpler and clearer. ■

■ The full report *Local Geodiversity Action Plans – a review of progress in England* will be made available at www.naturalengland.org.uk later this year.



Left:
Triassic red beds at Dee Cliffs, Farndon. The Cheshire Region LGAP was the first LGAP to be produced in Britain and was launched in 2003.

Photo by Mick Murphy

Above right:
Beds rich in ammonites in the Blue Lias Formation, Lyme Regis. This is one of many features to which the actions of the Dorset LGAP can apply.

Photo by Colin Prosser

Right:
Flint and brick house in Lewes, Sussex. LGAPs help to link features of the built environment to geodiversity, giving the subject a new relevance to people.

Photo by Mick Murphy

Putting a sparkle

The two-year project to record about 130 Regionally Important Geodiversity Sites (RIGS) in Ceredigion and Powys is complete.

All the sites have been recorded in Association of Welsh RIGS Group format, each with 6-8 pages of text, a GIS site map, an aerial photograph and site photographs. The reports have been written for amateur and professional geologists, keeping jargon to a minimum.

The information for the project was given to site landowners and is held by the Welsh Assembly Government, the Countryside Council for Wales, the planning offices of Ceredigion County Council in Aberaeron and Powys County Council in Llandrindod Wells, and is archived with local records offices.

'Geodiversity' covers everything from hard igneous rocks to soft soils and landscapes. To report on this diversity, Central Wales RIGS Group received numerous contributions from geology and geography staff at Cardiff, Lampeter and Swansea universities, as well as mineralogist John (the Rock) Mason and retired geologists who live in and near Aberystwyth. Countryside Council for Wales geologists also helped with advice and GIS support. The project was financed largely by the Aggregates Sustainability Levy Fund, under the auspices of the Welsh Assembly Government, and was co-ordinated by myself.

There are lots of grey rocks in Central Wales but fortunately many of them sparkle with ore and secondary minerals, display spectacular sedimentary and tectonic structures and contain well-preserved fossils. This prompts many requests to Central Wales RIGS Group for field trips in the region for amateurs and professionals. Talks include those to the Science Café group at Aberystwyth University, the Cambrian Mountains Society and 7-8-year-old children (guess which was most challenging!).

To boost public awareness, the Group produced several geological leaflets (including a couple of field guides), a 50-page booklet on the Central Wales Orefield, and information panels about the geological background to the mining heritage of the region. They are all bilingual and aimed largely at the 'educated public'. They were supported by Spirit of the Miners (European Union funding), CCW, the Geologists' Association, National Trust, Environment Agency and the National Museum. The leaflets and booklets are distributed to museums, schools, tourist offices, hotels and other places to help publicise geodiversity. ■

Anticline in sandstones of the early Silurian Aberystwyth Grits are echoed by a rainbow over the Irish Sea, New Quay RIGS.

Photos by Central Wales RIGS Group



Powis Castle built largely of local red early Silurian sandstone, near Welshpool.



Brian Clissold, geology teacher in Aberystwyth, discusses samples with a visitor to an open-day at the Ceredigion Museum in Aberystwyth.



Further information about Central Wales RIGS reports, leaflets and booklets can be found on the website www.geologywales.co.uk/central-wales-rigs and/or by contacting Bill Fitches (billfitches83@hotmail.com)

Bill Fitches

Central Wales RIGS Group

e on a sea of grey



Pistyll Rhaeadr in northern Powys is the tallest waterfall in Wales, dropping 65m, and was designated a SSSI for its fluvial geomorphological features. It is also designated as a RIGS because of its spectacular volcanic tuff layer. This makes the lip of the fall and protects underlying Ordovician slates.

Trilobite in Ordovician shale, Bailey Einion RIGS, Powys.



The 100-year-old arch in the Tanygraig railway tunnel mimicks a 400 million-year-old Acadian anticline that deformed 450 million-year-old Ordovician sandstone layers – a RIGS in the Aberystwyth district.



Some of the literature produced by the Central Wales RIGS Group project.



Fossil Code makes a debut



A specimen of *Diplacanthus crassisimus* found at Hugh Miller's collecting locality in Cromarty. It was one of the specimens used in a workshop on fossils for pupils from Cromarty Primary School held during the launch of the Scottish Fossil Code. Photo by Scottish Natural Heritage

The Scottish Fossil Code, probably the first national code of its kind in Europe, was launched by Michael Russell, the Scottish Government Environment Minister, in Cromarty in April 2008.

Produced by Scottish Natural Heritage (SNH) under a provision of the Nature Conservation (Scotland) Act 2004, the Code aims to promote responsible collecting whilst helping to conserve the country's fossil heritage.

The Code, produced with assistance from palaeontological researchers, land managers, collectors and others with an interest in Scotland's fossil heritage, provides advice on best practice in the collection, identification, conservation and storage of fossil specimens found in Scotland. It is hoped that the Code will enhance public interest in the fossil heritage of Scotland and promote responsible collecting of fossils for science, education and recreation. Already widely distributed in Scotland, the Code is being promoted by SNH in the wider UK and mainland Europe to encourage responsible collecting by those travelling to Scotland to search for fossils.

SNH plans to review the Code's effectiveness in a few years time and, if required, revise it.

The Code can be viewed and downloaded from www.snh.org.uk/fossilcode. Printed copies can be obtained from the Scottish Natural Heritage Publications Department, phone: 01738 444177, e-mail: pubs@snh.gov.uk

The essentials of the Scottish Fossil Code:

- **SEEK PERMISSION** – You are acting within the law if you obtain permission to extract, collect and retain fossils.
- **CHECK ACCESS** – Consult the Scottish Outdoor Access Code prior to accessing land. Be aware that there are restrictions on access and collecting at some locations protected by statute.
- **COLLECT RESPONSIBLY** – Exercise restraint in the amount collected and the equipment used. Be careful not to damage fossils and the fossil resource. Record details of both the location and the rocks from which fossils are collected.
- **SEEK ADVICE** – If you find an exceptional or unusual fossil do not try to extract it; seek advice from an expert. Also seek help to identify fossils or dispose of an old collection.
- **LABEL AND LOOK AFTER** – Collected specimens should be labelled and cared for.
- **DONATE** – If you are considering donating a fossil or collection choose an accredited museum, or one local to the collection area.

The Code and promotional leaflet. Photo by Lorne Gill/ Scottish Natural Heritage



Test bed



Fossil-rich former quarry is ideal proving ground for new Code

Achanarras Quarry Site of Special Scientific Interest (SSSI) is a remote, world-class, fossil-fish locality tucked away in Caithness, in the far north-east of Scotland. The launch of new interpretative facilities at the former building stone quarry, owned by Scottish Natural Heritage, coincided with the removal of an old system of permitted fossil collecting that will provide an opportunity to test the effectiveness of the Scottish Fossil Code.

A feature in issue 18 of *Earth Heritage* outlined the efforts of the Caithness Fossil Group and SNH to raise the profile of this famous site.

Work included producing a leaflet, interpreting the fossil fauna and the installation of road signs to direct visitors. The item also outlined the aspiration of replacing a couple of low-key information boards with something more in keeping



Professor Nigel Trewin (centre) with Susan Davies SNH North Areas Director and Councillor Ian Ross, member of SNH's Local Advisory Committee, at the launch of the new Achanarras interpretative facility, seen in the background. The fossil specimen is an armoured fish, *Pterichthyodes*, a reconstruction of which is held by Nigel Trewin. Photo by Robert

Colin MacFadyen Scottish Natural Heritage

with the site's international significance and importance as a collecting locality.

In June 2008 the aspiration became a reality with the launch of new facilities comprising: interpretation at the visitor car park and within the quarry; a new flagstone

shelter within the quarry; and a geological 'time-line' which, in the walk from the car park to the quarry, depicts the period from the present day back to the 'Age of the Fishes'. For every three metres walked, the visitor is taken back one million years. They ultimately arrive at 380 million years ago, in the 'Age of the Fishes', when the land that is now Scotland was an arid mountainous region lying south of the equator. The time-line was created with grant aid from Highland and Islands Enterprise – Caithness & Sutherland.

These exciting new facilities should make a visit to Achanarras both educational and enjoyable for an even greater range of people. They will also help to meet an increasing public interest in geology and Earth heritage, with geo-tourism now being a recognised market in the Highlands.

Protected as a SSSI, Achanarras Quarry is a well-known fossil-collecting locality. The considerable quantities of loose fossiliferous quarry spoil have attracted collectors for many years, and continue to yield fresh fossil material including, on occasion, items of major scientific significance. Several of these new finds have been made by amateur collectors.

Peering into Lake Orcadie

Achanarras Quarry was once worked for roofing slate, and has been a focus for the collecting and study of fossil-fish material since the 19th Century. It provides exposures of a Middle Devonian rock sequence that reveal layers of sediment that accumulated in an extensive freshwater lake given the name Orcadie. The lake contained an abundant fish fauna, the remains of which became incorporated into the accumulating sediment and fossilised.



Pupils from Halkirk Primary School take part in a fossil foray during the launch of the new interpretative facility. Photo by Robert Macdonald/SNH

There are several fossil-bearing beds in the Orcadian basin. The Achanarras 'fish bed horizon', named after the exposed section in the quarry, contains the most varied fossil fauna. The bed, about two metres thick, was deposited over a period of about 4,000 years. Achanarras Quarry's international scientific importance is due to the abundance of fossil vertebrates. It is also a 'type locality' for four species of fish and one arthropod.

Continued on page 18

Test bed

From page 17

Recent discoveries comprise the arthropod *Achanarraspis*, the primitive jawless fish *Cornovichtys*, and a single specimen of the placoderm (armoured) fish *Actinolepis*. This most recent find is described by Mike Newman and Professor Nigel Trewin in the *Scottish Journal of Geology* (2008). It is the first record of the genus in Scotland, and it suggests Mid-Devonian geographic links with Estonia.

Around 25 years ago, in an effort to prevent large-scale and irresponsible fossil collecting at Achanarras, SNH's predecessor, the Nature Conservancy Council, designed a system of permitted collecting. Collectors applied for permission to collect up to 10 specimens from the heaps of loose quarry spoil. Many responsible collectors applied for permits and, on the face of it, the system appeared to work.

Some individuals ignored the system

However, some individuals ignored the system and collected irresponsibly by removing large amounts of fossil material, in particular targeting the *in situ* Fish Bed exposure. There were further problems in that genuine collectors sometimes arrived at short notice and were unable to get a permit at a weekend.

With the Scottish Fossil Code now applicable to all fossil localities across Scotland, the permit system at Achanarras has been scrapped. Collectors visiting the site are encouraged to collect, but responsibly – as outlined in the Code. In time, a measure of the effectiveness of the Code may be gained by determining if there has been an increase in the number of reported fossil finds and collectors seeking expert advice to help with fossil identification; and a reduction in the instances of the *in situ* Fish Bed being targeted.

Realistically, it is likely that Achanarras and other locations will be subjected to occasional irresponsible collecting. However, the simple fact that there is now a widely circulated national Code outlining an accepted standard of good collecting behaviour, should eventually end instances of reckless damage at Achanarras and elsewhere in Scotland. ■



The new interpretative facility within Achanarras Quarry consisting of a flagstone visitor shelter and interpretative panels.

Photo by Jenny Grant/SNH

GCR site report

Data from 16 Geological Conservation Review (GCR) volumes detailing some of the most important geological sites and areas in Britain are now available on the World Wide Web.

The volumes were originally produced as extremely high-quality printed books, which, because of their specialist nature and production costs, had relatively low print runs. With price tags that reflected those factors (but which never covered the costs of research, editing, photography, artwork, reproduction and copyright), the books were purchased mainly by libraries and institutions rather than individuals. Now, however, the Web and digitisation mean that details from some of the volumes are available on-line to allcomers, and our intention is to increase this freely available resource over time. This not only makes the detailed geological information more widely available, it also addresses the issue of supplying back-ordered copies of earlier volumes that have since gone out of print. It additionally provides the



Neil Ellis at Hunstanton Cliffs, Norfolk, an excellent GCR site for demonstrations to groups. The description of the Chalk at this site is now freely available on-line. The Red Chalk and underlying Carstone deposits seen in the picture are to be described in a forthcoming GCR volume on Marine Lower Cretaceous Stratigraphy. Photo by Cathy Gardner/JNCC

ts on-line for free! Neil Ellis Joint Nature Conservation Committee

opportunity to update reports whenever new information comes to light.

While the on-line versions cannot match the quality and clarity of the original books, they nevertheless carry the self-same GCR site reports, diagrams and photographs. So you might not have the coherent, high-quality presentation of the book, but you will have home-printer output or screen-friendly reports for free.

The Joint Nature Conservation Committee (JNCC) has published the printed GCR volumes directly for some years. In the early days of the GCR, the commercial publisher (Chapman and Hall and its successors) helped us get the books physically produced, but they were unable to make it a profitable enterprise, and pulled out at volume 14, even though many of these early volumes are now out of print with backorders.

New titles in pipeline

Alongside the digitisation of early volumes, JNCC is busy producing the latest GCR books. We are now producing volume 34 (so 20 volumes to our credit directly as a publisher and a mere dozen more to go!): *Lewisian, Torridonian and Moine Rocks of Scotland* will be the next book. We will be engaged in finalising the last volumes of the series over the next two years. These books are already nearing completion, in terms of writing and compilation.

Once again the printed volumes will carry purchase prices reflecting production costs only. JNCC has never sought to make a profit from the GCR series. It sets its prices merely to recoup print costs, and not the outlay of geoconservationist research or staff time in production. What purchasers get is an absolutely outstanding book on the subject at hand; and the whole series, when complete, will provide an encyclopaedic coverage of British geology that will be an essential reference for years to come. JNCC is committed to making this massive GCR resource freely available over time to further the cause of geoconservation in Britain.

To search for a GCR site on our database go to www.jncc.gov.uk/page-2949 (scroll down to the section 'Navigating the GCR Database' on that page). To read published GCR site reports on-line, where available, go to www.theGCR.org.uk. ■



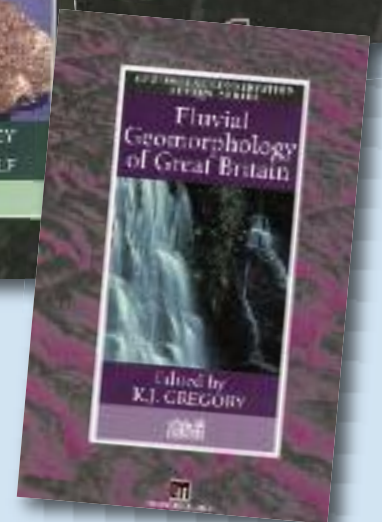
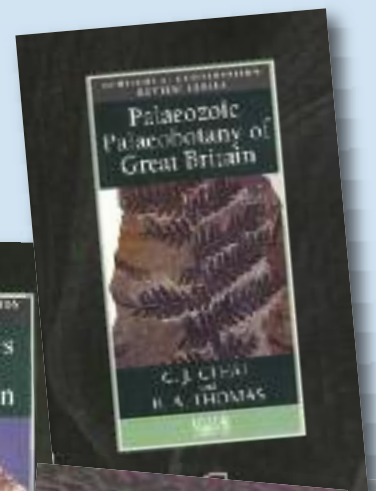
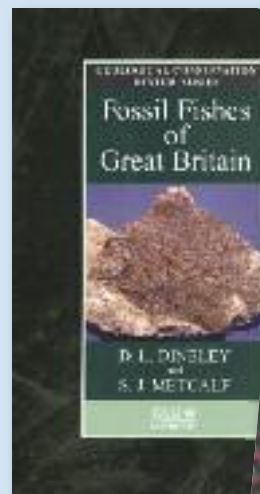
Aberffraw on western Anglesey is one of the nationally important coastal process and landform GCR sites described in the *Coastal Geomorphology of Great Britain* GCR volume.

Photo by Stewart Campbell

Volumes with information on the Web

Data from these 16 GCR Volumes (of the 34 published) available on-line at www.theGCR.org.uk:

- Caledonian Structures in Britain South of the Midland Valley
- Coastal Geomorphology of Great Britain
- Fluvial Geomorphology of Great Britain
- Mass Movements in Great Britain
- The Old Red Sandstone of Great Britain
- British Silurian Stratigraphy
- Marine Permian of England
- Permian and Triassic Red Beds and the Penarth Group of Great Britain
- British Upper Jurassic Stratigraphy: Oxfordian to Kimmeridgian
- British Upper Cretaceous Stratigraphy
- Quaternary of Scotland
- Palaeozoic Palaeobotany of Great Britain
- Fossil Fishes of Great Britain
- Caledonian Igneous Rocks of Great Britain
- Carboniferous and Permian Igneous Rocks of Great Britain north of the Variscan Front.
- British Tertiary Volcanic Province



CAPITAL IDEAS

in China's Fangshan Geopark

China has 20 Global Geoparks – more than any other country. The UK is second with seven and Germany has six. How do the Chinese go about site interpretation and raising awareness of geodiversity to the general population?

A small party of Western visitors, myself included, was invited to analyse the interpretation at Fangshan Global Geopark and offer constructive ideas. Fangshan is the only geopark in the world to be located within a capital city district, Greater Beijing. It lies 40 km south-west of Beijing centre, providing the city with an impressive green lung covering 954 km². It is divided into eight scenic and functional districts with a head office in south-west Beijing within the Ministry of Land and Resources, which also houses the UNESCO Geopark Network HQ.

I visited three of the eight scenic areas: Zhoukoudian, where 'Peking Man' (*Sinanthropus pekinensis*) was discovered in 1929; the Shidu karst area in the far south-west of the geopark, bordering on the Hebei Province; and the Shihua cave system.



A scene typical of the Geopark.

Cynthia Burek

University of Chester & UKRIGS

Zhoukoudian

Zhoukoudian became a UNESCO World Heritage Site in 1987. Peking Man is dated at about 500,000 years, the same as Boxgrove Man in the UK. A modern museum and a trail around the location of the 'Peking Man' discovery is set within a larger park.

Much of the interpretation is static, both in the museum and on the trail, but the full-scale models of Peking Man and associated animals are eye-catching. A computer game in the museum is the only interactive item, and it is a good one: it uses a camera to show children and adults alike what they would look like as Ice Age animals.

The site manager was interested to know what he could do to raise the interest of the general public. The site itself lacks visual impact and it was suggested that interpretation time lines might enliven it and improve visitors' understanding. On average the site receives about 200,000 visitors per annum, mostly Chinese tourists (both local and regional) or visiting scientists.

However, with a nod to the increasing importance of overseas visitors some interpretation is bilingual (Chinese and English) or trilingual (with Japanese). However, not all boards carry all languages yet. The use of non-intrusive waste bins (disguised as tree trunks) for recycling was clever.

Right: Peking Man (and woman) brought to eye-catching life for visitors in the grounds of Zhoukoudian Museum.



Above: Cynthia Burek with Luo Twanjie at the UNESCO offices.

Right: a trilingual signage board.

All photos courtesy Cynthia Burek



Shihua

Shihua Cave System is vast, covering 36.5 km², and public access covers the upper four of its seven levels. It was discovered in 1446 AD during the Ming Dynasty but has only been open to the public since 1987. All tourists must be accompanied by a guide who comments on the structures – but often without much geological interpretation.

Many of the explanations (like some of the show caves of the UK), concentrate on the shape of structures or mythical interpretation rather than a scientific description. Measures have been adopted to protect the stalactites and stalagmites by enclosing the visitors either in cages or tunnels, or by meshing the features. Following advice given previously by Patrick McKeever, lighting is now on time switches to minimise algal encroachment. Most notices are only in Chinese and those in English offer somewhat strange translations,



A mesh tunnel protects the delicate stalactites.



Clever lighting and moulding mirror the cave experience.

although the intentions and key messages are clear. The so-called Stone Flower Cave has about 200,000 visitors per annum and suggestions for further improvements to the facilities were

welcomed. The most obvious one was to increase the scientific interpretation and translate it into English to acknowledge the global aspect of the geopark.

Shidu

Shidu is 70 km from downtown Beijing and covers an area of 301 km². It lies at the junction of the Juma River and the Tanghang mountain range and extends into the adjacent Hebei Province. The carbonate and silicate rocks date from 800-1,400Ma (Precambrian) and show fascinating rock formations and landscape features. Stromatolites are common and physical features such as ripple marks along with the 'rock within rock' feature of the Gushanzhai Valley, beg for interpretation boards and/or leaflets. All are mentioned in a glossy guidebook, but many of the tourists have neither the money nor inclination to purchase this.

On-site interpretation was suggested and is to be followed up. The importance of using diagrams for interpretation, especially as language is difficult, was also suggested. The leaflets produced for North Welsh towns by NEWRIGS and Gwynedd & Môn RIGS groups were given to show how photos and diagrams can explain geological features and processes and bridge the language divide. The whole area is an outdoor playground, used for bungee jumping, boating and fishing, so interpretation must be broad enough to interest a vast range of local and international tourists.

A small museum has been set up, but its interest is limited – it is confined to one room and lacks publicity. Improvements in the pipeline include signage at the front of the building in both Chinese and English. It was suggested that increased income could be achieved by sale of posters of some of the amazing landscape features, including the carbonate peaks and pinnacles. Faults (like the 'gleam of the sky', *right*) and folds are evident and readily accessible, but not publicised.



The 'rock within rock' feature (above) and (below) a fault spectacularly revealed as a 'gleam of the sky'.



Overall the Fangshan Global Geopark has a wonderful opportunity to publicise geodiversity at many different levels, but it is only just embarking on this approach. At present, the cultural and mythical side of geodiversity is given, but scientific explanations, both aural and visual, are severely limited.

The Chinese were evidently interested in expanding the levels of publicity and interpretation, judging by their reactions to a presentation on the role of geoconservation initiatives in the UK. Interest was shown in the concepts of RIGS, LGAPS and even the recently approved aim of the UKGAP and the applicability of those approaches for Chinese Geoparks.

Certainly some improvements will follow this exchange of ideas between two very different cultures.

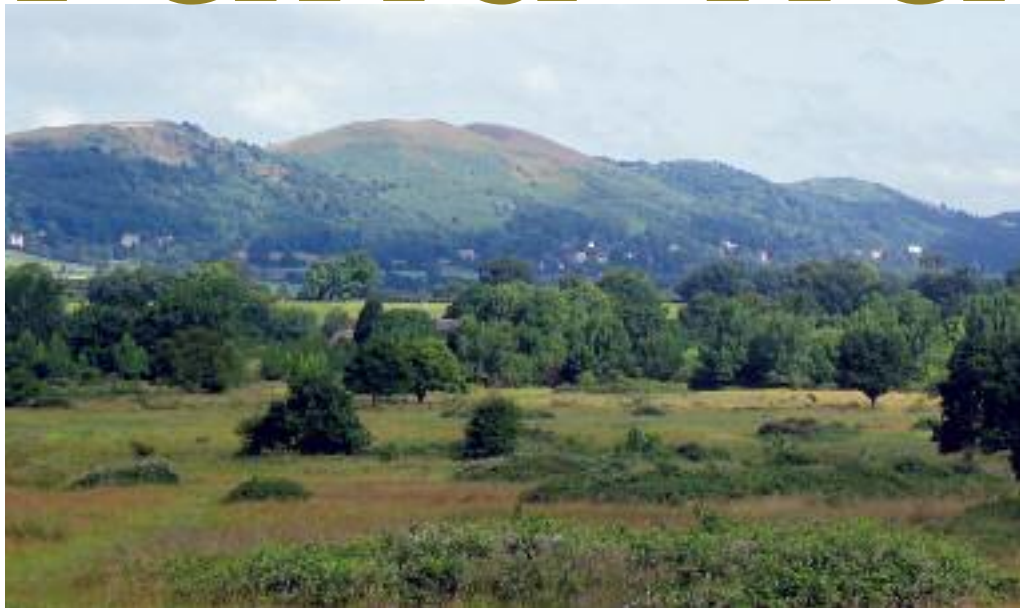
Park and wa

A new and unique long-distance walking trail, the Geopark Way, winds its way through the Abberley and Malvern Hills Global Geopark for 108 miles. Conceived to highlight geology, landscape and associated heritage and to make these accessible to all, this inspiring route is due to be launched in Autumn 2008.

The Geopark Way trail links sites of geological interest, whilst the 136-page guidebook interprets the sites and vistas along the route. Alongside the geological interpretation, the guide draws attention to examples of how geology has influenced wildlife and archaeology, and also social and industrial history.

The rocks along the Geopark Way tell amazing stories of continental collision, of tropical seas, hot deserts, equatorial swamps and coastal lagoons and of vast ice sheets and polar deserts. But just as interesting are the building stones of churches, bridges, town halls, cottages and a cathedral (at Gloucester). These stories can be followed in the guidebook, across different parts of the four historic counties (Shropshire, Herefordshire, Worcestershire and Gloucestershire) that make up the Geopark. They deliver a totally new perspective on long-distance walking.

Starting in Bridgnorth, Shropshire, the Geopark Way explores the Permian sandstone cliffs that separate Bridgnorth



The Malvern Hills, seen from Castlemorton Common, are the centrepiece of the new trail.

Natalie Watkins

Herefordshire & Worcestershire Earth Heritage Trust

into a High and a Low Town, overlooking the River Severn. The trail runs south through the Wyre Forest Coalfield where, along with exposures of Carboniferous cyclothem lithologies, it encounters evidence of the social and industrial impact that mining the natural resources had on local communities.

The trail then passes over a succession of Permo-Triassic sedimentary rocks and visits the Quaternary wind-blown sands covering the lower terrace of Hartlebury Common. This local nature reserve is celebrated not only for its geology, but as a lowland heath

and as a common with at least 2,000 years of social history.

Next it crosses over the East Malvern Fault where the topography becomes more dramatic as the Silurian limestones and shales of the Abberley Hills appear. Rock exposures, fossils, bentonites, quarries and abandoned lime kilns collectively tell a compelling story of this series of rocks.

Continuing south and travelling farther back in time to the Precambrian, the route encounters the Malvern Hills; an area still not geologically fully understood, or at least



Lavingtons Cave and St Mary's at Bridgnorth are memorable starts to the walk while Woodbury Quarry in the Teme Valley provides fossil-rich features.

108 (for 108 miles!)



late Triassic and early Jurassic sediments, unveiling the River Sever's formational history, before the final destination, Gloucester Cathedral. This building's oolitic limestone is a fitting end to a traverse across 700 million years of Earth history.

DAY WALKS

The Geopark Way guide conveniently splits the trail into 18 comfortable day walks, each with its own detailed map. It is possible to combine the walking with a trip on the Severn Valley Railway, with bus and train connections, with visitor centres and with bed and breakfast and hotel accommodation. The guide comes with a slim supplementary booklet detailing public transport routes, tourist amenities and attractions, further geological walks and countryside sites within the Geopark.

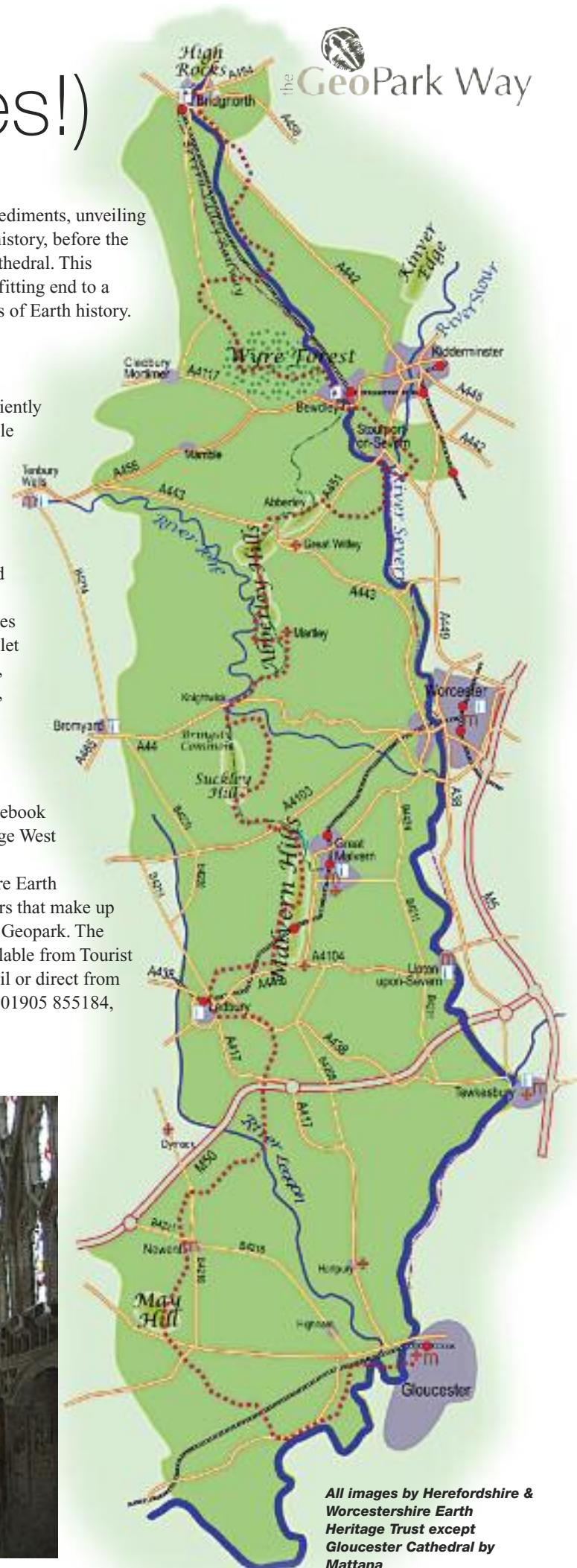
The Geopark Way trail and guidebook project is supported by Advantage West Midlands and is managed by Herefordshire and Worcestershire Earth Heritage Trust, one of 14 partners that make up the Abberley and Malvern Hills Geopark. The guidebook, priced £6.95, is available from Tourist Information Centres near the trail or direct from the Earth Heritage Trust: phone 01905 855184, e-mail eht@worc.ac.uk or web www.earthheritagetrust.org

with theories of chronology still fuelling debate amongst geologists. The Geopark Way visits several sites on the hills to capture their geological history, peppering the science with tales of folklore and the Victorian Water Cure phenomenon that placed Malvern on the map – what better way to explain hydrogeology!

Next, the Cotswold Hills come into view. Into Gloucestershire the trail passes over the inlier of May Hill, before entering Huntley Quarry Geological Reserve to explore the fault and fold structures seen on the quarry face. The final leg crosses the plains of



Gloucester Cathedral's oolitic limestone is a fitting end to the walk.



All images by Herefordshire & Worcestershire Earth Heritage Trust except Gloucester Cathedral by Mattana

Geology in Trust

Lucy Cordrey
The National Trust

The geodiversity within the care of The National Trust is immense, challenging, complex and stunning. With over 250,000ha of land and 50,000 built structures, there are ample opportunities for engagement, learning, conservation and celebration.

While the Trust has not always truly acknowledged this resource, it has assessed its priorities and, mindful of additional external factors such as sea-level rise and climate change, it is giving geodiversity a higher profile. Revised policies are helping to unveil once hidden geological and geomorphological gems for wider appreciation.

Understanding the geodiversity resource, including its associated dynamic processes, is fundamental to much of the conservation work of the Trust. Issues include coastal erosion and realignment, wise use of soil and water, the sourcing of suitable stone for the repair of historic buildings and the appropriate curatorship of geological specimens.

Furthermore the great wealth of geodiversity gives rise to all of the fantastic landscapes – and the biodiversity they underpin. Chalk downlands, vegetated cliffs, lowland heaths, bogs and limestone pavements all owe their essential character to the underlying rocks and the weathering processes acting on them.

Policies reflect practice

The Trust's geodiversity policies¹ bring together current thinking and practices, which are integrated with other Trust



The shingle bar at Man Sands beach.

Photo by NT/Mike Ingram

Managing for change by working with nature

A major management principle of National Trust policies is to work with natural processes wherever possible. For example, the Trust accepts that, due to the dynamism of the coast, geological features may be lost, gained, modified or replaced, and it is looking to adopt management solutions which enable or adapt to these processes. These two studies illustrate this approach.

At **Man Sands beach** in Devon, following the removal of the deteriorating steel gabions installed as a sea defence in 1985, the naturally occurring shingle bar is being allowed to function.

This has restored a nationally rare wetland habitat in the fields inland from

it as water has accumulated behind the bar. In 2007, storms breached the bar, which has now rebuilt itself naturally. This breaching and rebuilding continues and allows the coastline here to realign, evolve and adapt itself.

Impacts of storminess and adverse weather related to climate change (see

policies². In short the aim is to:

- Care for the natural and cultural geological significance of all properties;
- Manage change in the geological environment through learning, identifying, recording, understanding and communicating its significance; and
- Share the geological significance of properties with all to appreciate and enjoy.

The policies illustrated on these pages are helping the Trust to achieve a wider awareness of and appreciation for geodiversity, which has been a little understood but significant asset. In order to do this the Trust wants to harness the expertise that exists and engage better with the geoconservation community.

Continued on page 26

Providing an inspiring learning experience



Working with children indoors...



The Giant's Causeway World Heritage Site.

Photo by NTPL/Joe Cornish

page 8) could mean some geological features become exposed whilst others become submerged.

For example, a future coastal scenario study³ on the **Giant's Causeway World**

Heritage Site in Northern Ireland, highlighted that by the end of this century we are likely to see more Causeway stones washed by waves and some under water intermittently or fully during the winter. There will also be

increased erosion, slope instability and reactivated slips. This is clearly an active coastline and the Trust will consider how best to continue to care and provide access to the Causeway in the face of change.

ning environment

Providing an inspiring learning environment is also essential to achieving the conservation aims of the National Trust's policies. This is offered in both countryside and built properties by staff, volunteers and local experts and may be promoted through publications and the website.

In the **Shropshire Hills**, the Trust's Learning Officer works with experts from the Shropshire Geological Society to offer geological education activities at Carding Mill Valley and Knowle Quarry on Wenlock Edge, a UKRIGS Education Project site. Here, school groups get to grips with faults, discuss the advantages and disadvantages of quarrying, hunt for fossils and identify rocks. **Continued on page 26**



...and outdoors.

Photos by National Trust

(from page 24)

A geo-diverse future

The Trust commented recently on the emerging UK Geodiversity Action Plan (see page 11) and identified potential areas where it could contribute. These included:

- building knowledge and understanding through auditing and identifying new sites;
- site conservation and management by working with, protecting and recreating natural processes, continuing the work to get SSSIs into favourable condition, and using Coastal Risk Assessments to inform management decisions;
- increasing awareness by promoting responsible collecting, demonstrating the connection between the natural and cultural heritage and providing opportunities to learn about and get involved with geology.

The Trust made the point that with its limited internal expertise and resources more external help would be needed. It intends to establish a register of staff, volunteers, consultants and other individual experts who have an interest in geodiversity and can help incorporate it more fully into Trust activities and initiatives.

In addition, as part of the national strategy, all work needs to demonstrate that the Trust is engaging supporters, improving conservation and environmental performance, investing in people, and financing the future. Our geodiversity provides plenty of scope to achieve this. The National Trust wants it to continue to inspire and fascinate generations to come. ■

References

1 *The National Trust Geological Policy* (2007) and *The National Trust Policy for the Collecting of Geological Materials* (2007) www.nationaltrust.org.uk/main/w-chl/w-countryside_environment/w-nature/w-nature-geology.htm

2 *Nature and the National Trust* (2005) www.nationaltrust.org.uk/main/w-chl/w-countryside_environment/w-nature/w-nature-strategy.htm

Coastal Policy (2005) www.nationaltrust.org.uk/main/w-chl/w-countryside_environment/w-coastline/w-coastline-resource_reference.htm

Shifting Shores – Living with a changing coastline (2005) www.nationaltrust.org.uk/main/w-chl/w-countryside_environment/w-coastline/w-coastline-shifting_shores.htm

Water Policy (2006) – *Blueprint for Water* www.blueprintforwater.org.uk/Soils Policy (2000)

3 Orford, J.D. et al (2007). *Future Coastal Scenarios for Northern Ireland*. Unpublished report for The National Trust (Northern Ireland).

4. *IYPE NT & EHS NI walks* www.ehsni.gov.uk/other-index/events/iype_2008.htm

5. National Trust events can be searched via www.nationaltrust.org.uk/events

Further general information at www.nationaltrust.org.uk

Providing an inspiring learning environment (from page 25)

At **Ilam** in Staffordshire a multi-media touch-screen enables visitors to explore the geology of the White Peak. The geology is further explained on guided walks given by the South Peak Volunteer Geologist who is also compiling a register of the Trust's geological sites. The register includes sites of scientific and educational value which can be used to demonstrate a wide range of geological topics. These include karst features, climate change, geomorphology, rock deformation and plate tectonics.

At **Biddulph Grange**, also in Staffordshire, a geological gallery with a frieze and some fossils grouped from their respective strata is being restored. Experts from Dudley Museum, volunteers and a local school are closely involved in this unique restoration project.

As a contribution towards International Year of Planet Earth, the Trust has joined forces with Northern Ireland's Environment and Heritage Service in running free guided walks on a variety of sites. These include Journey to the centre of the Volcano at **Carrick-A-Rede**, Granites and Turbidites at **Mourne** and Puddingstone and Caves at **Cushendun** ⁴.

At **Hardwick Hall** in Derbyshire the Trust offers a series of exclusive stone-carving courses with expert masons⁵. This provides a unique insight into the stone used in buildings and an opportunity for the public to create a piece of carved stone to take home. Guided tours by the stone mason at **Castle Drogo** in Devon also help to make the links with geology by highlighting the local Dartmoor granite used to build the castle.

A framework for responsible collecting

The Trust's policy for the collection of geological materials and the local codes of conduct together provide a framework for responsible collecting (see page 16). The policies recognise and support the contribution that collectors make to geology as a science and demonstrate positive ways of working and communicating.

However, the Trust will take steps to stop irresponsible activity. For instance, at a site in **Dorset**, persistent digging of *in situ* fossils is reducing the quality of the site, is dangerous, and generates complaints from those who see it. It is in clear breach of the local code of conduct.

In contrast, at another site in Dorset, permits will be issued on a trial basis to allow the recovery of fossil brittle stars, found in fallen blocks, using rock-saws. Without being collected, the brittle stars would never be fully exposed for

all to see and would be destroyed by the elements eventually. With these factors in mind, the Trust has agreed to the use of rock-saws, considering it acceptable if undertaken responsibly and thus within current codes of practice and policies.

The National Trust feels strongly that, wherever possible, collected geological specimens should be displayed to

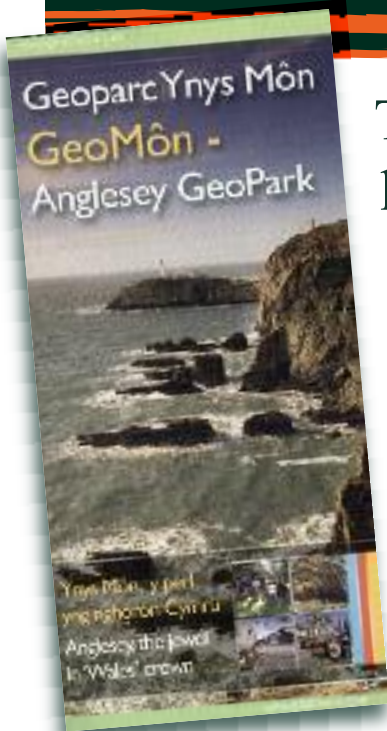
ensure some public benefit. To this end, specimens may be housed and cared for by accredited establishments.

For example, a recently acquired geological collection of many unusual items is on

public display at the **Royal School of Mines** (part of the Combined Universities of Cornwall) near Falmouth. Significant collections in the Trust's care are being catalogued as part of the Collections Management Project, which will be made available to all once complete.

Fossil brittle star
Photo © David Sole





The potted highlights of Anglesey

Anglesey's rocks reveal evidence of four geological eras, 12 geological periods and 1,800 million years of deep history. How do you shoehorn that lot into an A3 sheet of paper (and do it in two languages!!)? GeoMôn, the Anglesey Geopark people, have made a fine job of it by being ultra-selective.

They've boiled down the heritage to a dozen key sample sites, given potted descriptions of the highlights, incorporated a postage-stamp-sized photo and pinpointed each site on a map. Aside from an eye-catching front cover, they've also managed to incorporate a timeline. It would have been good to see each site referenced on the timeline as well as the map, but that's a small detail. It's a superb handy reference for anyone who wants a fascinating day or two touring a representative cross-section of the island's geological wonders.

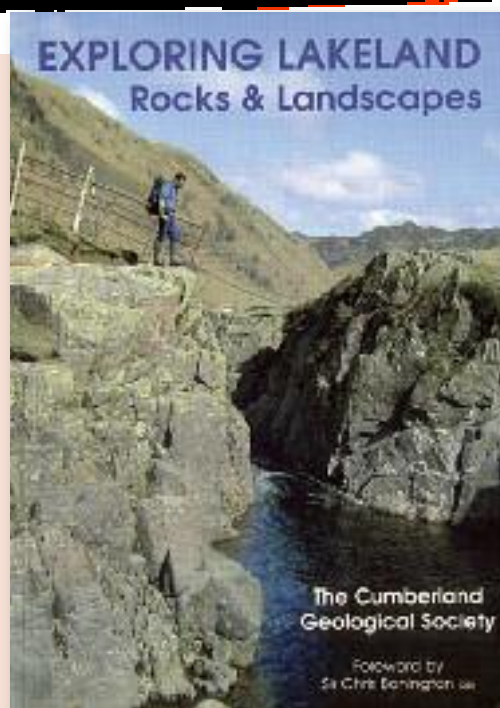
The leaflet (folded from A3 to DL) is free from Anglesey and North Wales tourist offices, or direct from GeoMôn, tel: 01248 440888, e-mail Geomon@btinternet.com.

17 walks to greater geological knowledge

Exploring Lakeland Rocks & Landscapes. Susan Beale and Mervyn Dodd (eds). The Cumberland Geological Society. 2008. £9.50. ISBN 978-0-9558453.

In his foreword, mountaineer and long-time Lakeland resident Chris Bonington points out that the many recent changes wrought by humans in the area are superficial when you look at the hills, crags, ridges and valleys that have formed over millions of years – and which themselves lure increasing numbers of people.

One of the Cumberland Geological Society's stated aims is to encourage everyone to enjoy and understand more of the rocks and landscapes of Cumbria, and the 17 walks in this 163-page A5 book do that. Each walk presents the reader with a geological purpose; practical access and walking detail; a good map; and understandable geological descriptions illustrated with good colour photographs. Emboldened words signify geological terms which are explained in a glossary. It's a publication that will please anyone who picks it up.



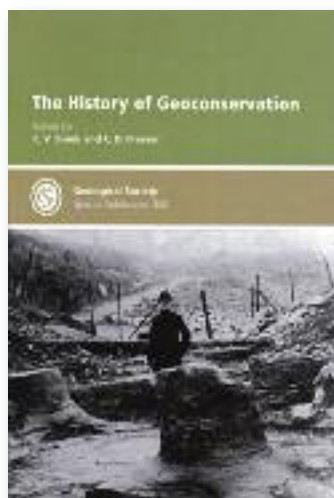
The history of geoconservation – in print

The History of Geoconservation. Burek, C. V. and Prosser, C. D. (eds). 2008. Geological Society Special Publication. Volume 300. ISBN 978-1-82639-254-0.

In November 2006, a one-day seminar was held jointly between Natural England, the Geoconservation Commission and History of Geology Group of the Geological Society, as well as the Black Country Geological Society. Contributions to the discussion came from a broad range of practitioners and the printed outcome is *The History of Geoconservation*, a series of papers by contributors to the seminar, with some additional contributions.

This book provides the first collection of papers to address the history of geoconservation and seeks to explore the origins of the subject as well as the concepts that helped define it. It covers the history of geoconservation in the UK whilst also looking to Ireland, mainland Europe and Australia. It also explores the evolution and impact of global conservation initiatives, including World Heritage Sites and Geoparks.

The book highlights the invaluable contributions to geoconservation made by academics, geological societies, governments,



The History of Geoconservation was launched at the Open University Geological Society (OUGS) annual symposium on History of Geology in London in August 2008. Sandy Smith, the President, acknowledged the close synergy between OUGS activity and RIGS groups both working at the local level.

She said she viewed geoconservation as the newest, most exciting branch of geology. Cynthia Burek thanked her and acknowledged the support of the HOGG group of the Geological Society and the financial support of Natural England in publishing the book.

conservationists, volunteers and local communities. The 22 papers demonstrate that the origin and development of the subject are interesting in themselves but more importantly, through revealing historical successes and failures, they provide an increased understanding of how we got to our present position and a set of references that may help meet future geoconservation challenges.

Earth Heritage magazine is published twice a year to promote geological and landscape conservation.



The view across central Mull towards Ben More, the only island Munro outside Skye, from Mull's western coast at Gribun, highlights some aspects of the geodiversity of Argyll. A pile of Palaeogene lavas overlies Cretaceous, Jurassic and Permo-Triassic sediments that rest unconformably upon one-billion-year-old Moine metasediments. Geomorphological features include an end-moraine and areas of mass-movement. See page 4 to see how you can help conserve and promote Argyll's stunning geodiversity.

Photo by
P&A Macdonald/SNH

