

# Earth heritage

# HERITAGE

# Earth

# heritage

The geological and landscape conservation magazine



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Thermal spring –  
visitor hot spot



A voyage of  
discovery

ISSUE

43

Spring 2015

Influencing  
decision makers



Making most of  
plant fossils

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A fossil fern – *Karinopteris jacquotii* (Zeiller) Boersma – recovered from a split ironstone nodule found in the Coal Measures sequence at Brymbo, near Wrexham.

Photo by Peter Appleton



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## EDITORIAL

### Providing food for thought

*Issue 43 of Earth Heritage* carries articles spanning a huge variety of topics within geoconservation and geodiversity. Ranging from the scientific and academic to the practical and ethical, somewhere in these pages will be something to provide you with food for thought.

It is always inspiring and encouraging to learn of new projects, especially at a time when resources are strained. Many of the features and 'outcrops' in this issue show that geoconservationists are skilful at adapting to changing circumstances. Such resourcefulness is essential in ensuring that our subject continues to rise up the agenda of decision makers and politicians while enthusing the wider public and engaging the attention of young people. All of this is reflected in the projects described in this issue.

As ever, we want to hear your views and to learn of new projects. To contribute, please contact the most appropriate editor (*below*).

Enjoy your reading!

Stewart Campbell, Managing Editor

PS: You can download this issue free, together with back issues, as pdf files at any time by visiting [www.earthheritage.org.uk](http://www.earthheritage.org.uk)

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## Keeping the GCR up to date

The Geological Conservation Review (GCR) provides the scientific underpinning for the designation of all geodiversity Sites of Special Scientific Interest (SSSI). Sites are included within the GCR on the basis of robust criteria applied across Great Britain by Natural England, Scottish Natural Heritage (SNH) and Natural Resources Wales (NRW). Although the main phase of the GCR was concluded in 1990, advances in science mean that periodic review of certain parts of the GCR is required in order to ensure that the GCR remains credible and robust.



Slade Brook SSSI in Gloucestershire is a classic GCR site for its active tufa features.

Photo by Roger Meade

Despite the fact that most resources go into managing existing SSSIs rather than into looking for new sites, updating the GCR is an ongoing process. Natural England has identified three areas of the GCR where reviews are needed to take account of recent scientific developments. These are, Palaeolithic sites in England with evidence of ancient human occupation; actively forming tufa sites in England; and sites demonstrating the Devensian Lateglacial and Holocene of England.

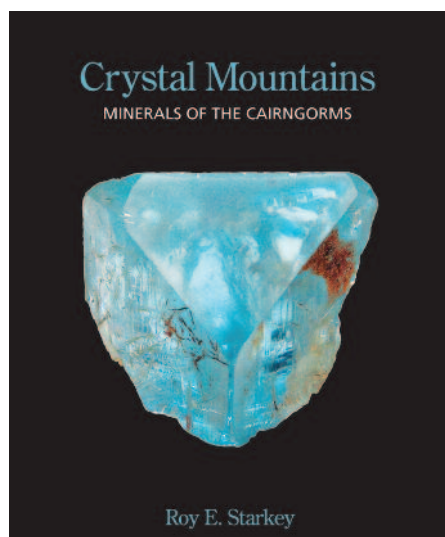
Natural England has embarked on a three-year project to examine existing and potential new sites in England in these subject areas, to ensure that sites of national and international importance are not overlooked. For each area, we will review the current coverage in the GCR, with external experts, updating any existing sites with new scientific evidence and describing any new nationally and internationally important sites (according to the established GCR criteria). This will enable us to update the GCR and should ensure that the SSSI and National Nature Reserve geodiversity series protect the best of our geological heritage.

The project, which started with a workshop involving a range of external experts on actively forming tufa sites, generated a list of 15 new sites to be documented and peer-reviewed, in conjunction with NRW and SNH. A decision will then be made as to which sites, if any, should be added to the GCR. Work will begin in 2015 on reviewing Palaeolithic sites in England with evidence of ancient human occupation. Devensian Lateglacial and Holocene sites of England will be considered in year three.

### Further information

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[eleanor.brown@naturalengland.org.uk](mailto:eleanor.brown@naturalengland.org.uk) regarding Palaeolithic sites in England with evidence of ancient human occupation or Devensian Lateglacial and Holocene sites of England.

*Hannah Townley, Natural England*



## A gem about geology and social history

*Crystal Mountains – Minerals of the Cairngorms* by Roy Starkey, unravels the story of Scotland's national gemstone – the Cairngorm. The book encompasses the social history of the people who sought 'Cairngorm Stones', geology, mineralogy and occurrence of the gem minerals, the lapidary and jewellery trades and links with Queen Victoria. Demand from the lapidary and jewellery trade in the 1800s was such that the supply of authentic local material could not keep up and, inevitably, imported material began to be passed off as Scottish. The book features numerous previously unpublished images of specimens from all the major public and private collections.

184 large-format pages (276×218 mm) softback, available direct from the publisher [www.britishmineralogy.com](http://www.britishmineralogy.com) priced at £25 plus p&p. ISBN 978 0 9930182 1 3

## The Old Red Sandstone: is it Old, is it Red, is it all Sandstone?

**That was the title of a three-day symposium dedicated to the geology of the Old Red Sandstone. The event drew over 100 delegates to Brecon in October 2014.**

Councillor Geraint Hopkins (Chairman of the Brecon Beacons National Park) opened the symposium and Brian Williams of Manchester University kicked off the first of three



**Duncan Hawley explains the palaeocurrent direction which laid down the rocks at Tredomen Quarry.**  
*Photo by Andy Kendall*

lecture sessions with a keynote address on the Lower Old Red Sandstone Continent. The sessions were titled Review of the ORS, Palaeontology, and Sedimentology and Lithostratigraphy. Lectures dealt with such subjects as historical figures in ORS geology, the Fforest Fawr Geopark, aerial photographic reconnaissance, fossil fish, plant evolution, soft-sediment deformation and ORS stratigraphy. The conference centre was also filled with exhibitions and posters from local groups and geological organisations.

Many of the attendees enjoyed a conference dinner at the Castle Hotel where Duncan Hawley provided the after-dinner entertainment in the form of a quiz on the subject of all things Old Red Sandstone (I don't think that I got a single question right!).

On the Saturday afternoon the symposium went public and many people joined a walk around Brecon to look at the building stones, led by Jana Horák and John Davies. Back at the conference centre visitors could visit an exhibition of low-level aerial photography of the ORS of the edge of Exmoor and north Devon, ask a geologist, browse stands from local groups and geological organisations, and youngsters (and the young at heart!) could try colouring in and lucky dips. A field trip led by John Davies on the Sunday examined the Senni Formation and overlying Brownstones Formation at Fan Fawr and Blaen Llia. A second trip, led by Duncan Hawley, visited Tredomen Quarry, Cockit Hill and Tremynfa Quarry to look at the St Maughans Formation and the Senni Formation.

The South Wales Geologists' Association, the Palaeontological Association, the Geologists' Association and the Fforest Fawr Geopark sponsored the event, which was organised by John Davies, Stephen Howe, Janet Hiscott, Hazel Trenbith, Linda Garfield and Alan Bowring.

The symposium showed that the ORS is a key component in shaping the character of Fforest Fawr Geopark, and the GCR sites and RIGS continue to play a key role in geological research. This was a fantastic event which sparked lots of debate and provided the opportunity to make new contacts.

In terms of the question set? The Old Red Sandstone is clearly old, but not all red and not all sandstone!

Abstracts from the symposium will be available from [www.swga.org.uk](http://www.swga.org.uk).

***Rhian Kendall, President, South Wales Geologists' Association***





**Above, the cave entrance in 2006 prior to the start of excavations**

**Below, scaffolding and shoring protect the undug reserve**



## Ebbor excavations and challenges

**Ebbor Gorge, Somerset, is owned by the National Trust and managed as a National Nature Reserve by Natural England. Since 2006, ongoing excavations have taken place at Gully Cave, a previously unexplored cave with an entrance high on the flanks of the gorge (left).**

A cave with its geological infill intact, having escaped erosion and the attentions of Victorian antiquarians and modern cavers, is rare indeed and thus Gully Cave is a very precious resource. As part of permission to excavate, an agreement was reached with the National Trust to maintain an undug reserve and preserve part of the cave-fill for future research. Attention has accordingly been focused on the northern half of the cave fill, which is composed of a red, limestone-rich breccia that accumulated through material being washed down the gully and through a large fissure within the cave roof. The breccia was capped by a densely cemented carbonate flowstone, in turn overlain by organic sediment containing numerous fragments of modern wood and recent mammal bone.

The breccia has proved to be spectacularly fossiliferous, yielding the remains of many thousands of micro-mammals, as well as larger remains of mammals, birds and molluscs. No stone tools have been recovered, although the presence of broken and discoloured bones and charcoal fragments, together with other aspects of the faunal assemblage, hint at the possible presence of humans within the cave or at the recycling of anthropogenically derived material by carnivores. Radiocarbon dating of the assemblages reveals that they span the Lateglacial Interstadial (a brief period of rapid climatic warming, c.14,800–14,000 years before present) through to the early Holocene (c. 10,000 years before present). These assemblages contribute significant new information to our knowledge of late Pleistocene palaeoecology and the site is now one of the most complete reference localities for this period in Britain.

These findings underline the importance of such rare undisturbed deposits and the need to excavate and sample these records with the highest degree of resolution. The project has raised interesting challenges in terms of continuing research while protecting a repository of undug sediment and ensuring its future conservation.

Martin Papworth (National Trust), Simon Clarke and Bob Corns (Natural England) and Dennis Parsons (Somerset Heritage Service) have been key supporters of the research. The Ancient Human Occupation of Britain project, funded by the Leverhulme Trust, and several private sponsors have funded the excavations.

***Danielle Schreve, Royal Holloway University of London***  
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**Below, a reindeer lower jaw within the breccia**

**Right, the excavation of wild horse bones from the cave wall**

*All photos by Danielle Schreve*



## Global Geoparks choose Devon for 2016 UNESCO gathering

**The English Riviera Global Geopark in South Devon will host the 7<sup>th</sup> International UNESCO Conference on Global Geoparks, it was announced at the sixth such event, in the Stonehammer Global Geopark, New Brunswick, Canada in September 2014.**

Representatives of the English Riviera Global Geopark, Nick Powe (Director of Kents Cavern and Chair of the Geopark) and Melanie Border (Geopark Co-ordinator), along with members of the English Riviera's GeoCollective project, were in Stonehammer Geopark to receive the news from UNESCO. The event drew over 500 delegates from 30 countries.

The GeoCollective included young ambassadors Tarrin Marie, Joe Tomkinson and James Copland, who were there to gather inspiration and ideas for an innovative opening ceremony, visit Canadian schools, write songs and make contact with delegates from

other Global Geoparks. They performed at the closing ceremony, and following a standing ovation played an encore.

Professor Iain Stewart, patron of the English Riviera Global Geopark and TV broadcaster, said: "It's fantastic news – testament both to the world-class geology and landscape that we have along the Torbay coast and the exciting and imaginative ways that the Geopark – the world's first urban Geopark – has woven the 400 million-year-old rocky history of this region into the everyday lives of modern Devonians."

Melanie Border said: "We were up against some strong competition so I'd like to thank all, locally, nationally and internationally who supported our bid. To be chosen to host the Global Conference is a real honour and reflects our standing within the Global Geopark Network. Of course this is just the beginning."

"The GeoCollective members were a massive hit with local children and residents and were of particular interest to the delegates as they were able to share the health and well-being benefits of creative engagement which will be a major focus for our conference."

The 2016 Devon conference will be held on 27-30 September. If you want to be added to the 7<sup>th</sup> International UNESCO Conference on Global Geoparks mailing list, visit [www.englishrivierageopark.org.uk](http://www.englishrivierageopark.org.uk) to register your interest. A short promotional film about the Geopark can be seen at [www.youtube.com/watch?v=c-aywFmM7Ik](http://www.youtube.com/watch?v=c-aywFmM7Ik)

We look forward to seeing as many people as possible in 2016 to experience and celebrate the value placed on geoscience and geodiversity in the UK.

**Melanie Border**

*Co-ordinator English Riviera Global Geopark, Chair UK Geoparks Forum, Advisory Committee Member European Geoparks Network*



**Nick Powe (left) and Melanie Border (centre) with members of the Global Geopark Network Bureau, accepting the bid to host the 2016 UNESCO conference on Global Geoparks with Tarrin Marie, James Copland and Joe Tomkinson (left to right at front), young members of the English Riviera GeoCollective.**

*Photo by Stonehammer Global Geopark*

## 11 new arrivals boost Global Geopark network to 111 in 32 countries

The 6<sup>th</sup> International UNESCO Conference in Canada witnessed 11 new sites being added to the Global Geoparks network. They are: Ore of the Alps (Austria), Tumbler Ridge (Canada), Mount Kunlun (China), Dali Mount Cangshan (China), Odsherred (Denmark), Monts d'Ardèche (France), Aso (Japan), M'Goun (Morocco), Lands of Knights (Portugal), El Hierro (Spain, Canary Islands Autonomous Region), Molina and Alto Tajo (Spain). This brings the Global Geopark network to 111 sites in 32 countries. The announcement of Africa's first Global Geopark in Morocco was particularly well received, given UNESCO's priorities on that continent.





The Dan-y-Graig face before and after being cleaned of greenery is a graphic demonstration of the vast improvement in geological exposure.



Photos by Christina Byrne

## Benefits for all in SSSI work

Workers from the Wales Probation Trust have restored views of exposures of the Rudry Peritidal Formation by clearing scrub from the wildly overgrown Dan-y-Graig Quarry Site of Special Scientific Interest, near Risca, South Wales.

Despite the site being just 0.6 ha, it took a week of sustained effort to clear the access to the quarry faces and return the site to a favourable condition where sections can be studied with ease. The team comprised court offenders fulfilling their obligations under the Community Payback scheme. Projects are geared to provide an opportunity for offenders to learn new practical and other life skills that support employment. The website [walescrsc.co.uk/community-payback/](http://walescrsc.co.uk/community-payback/) states that the scheme encourages people to behave in a positive and law-abiding way, thereby reducing re-offending and making communities safer. It enables offenders to feel a valued part of the community and increases their self-confidence and civic pride.

The Rudry Peritidal Formation at Dan-y-Graig is a 38 m-thick succession of shallow-water limestones and dolomites, interbedded with clays, deposited during the Lower Carboniferous (Late Chadian/Arundian) on shallow intertidal flats. The site provides an important link between others in South Wales, being an intermediate palaeogeographical setting between the thick offshore High Tor Limestone to the south and the thin peritidal units of the Llanelly Formation farther north.

The site was quarried, presumably for limestone (but the area has historic lead mines too). Afterwards it was used for landfill by the now defunct Islwyn Borough Council and then it was landscaped, leaving the tops of the quarry faces exposed. Over time they disappeared under a jungle of vegetation.

Although the work team didn't have the chance to look at other sites of Lower Carboniferous significance, we hope the offenders drew some satisfaction from their work. It will certainly keep the SSSI in good order for several years.

*Christina Byrne, Natural Resources Wales*

## ProGEO – building influence and securing action

In 2015, it will be 27 years since the founding of the European Working Group on Earth-Science Conservation, and 22 years since the working group was transformed into the association now known as ProGEO. ProGEO has become an influential driver for geoconservation across much of Europe, with achievements including the organisation of seven international symposia. In the last year ProGEO has signed a co-operation agreement with EuroGeoSurveys, hopefully to increase its impact within the EU system.

The regular newsletter *ProGEO News* and website [www.progeo.se](http://www.progeo.se) offer geoconservation information and list achievements and activities. ProGEO's scientific journal *Geoheritage* offers a platform for the publication of the latest geoconservation science findings and discussions, and ProGEO's hardback publication *Geoheritage in Europe and its conservation* has been well received and is regularly cited (*see page 31*). ProGEO is affiliated to the International Union of Geological Sciences (IUGS) and a full member of the International Union for Conservation of Nature (IUCN). It was represented at the IUCN World Parks Congress in Australia and its members within the IUCN Geoheritage Specialist Group have contributed to producing IUCN guidelines on best practice, among other work.

ProGEO's 8<sup>th</sup> International Symposium takes place in Reykjavík, Iceland, from 8-12 September 2015 with the theme *Geoconservation strategies in a changing world*.

**Lars Erikstad, ProGEO Executive Secretary, Norwegian Institute for Nature Research**  
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Veidivötn, in the southern part of the Bárðarbunga volcanic system, Iceland, is an important volcanic geosite. A fissure eruption occurred here in 1477 and was one of the largest known after the settlement of Iceland.

Photo by Lovísa Ásbjörnsdóttir

# Thermal spring is visitor hot spot again

Gareth Farr, British Geological Survey

Alun Huish, Rhondda Cynon Taf County Borough Council

Sources of clean water for drinking, bathing or soothing ailments have long been held in high regard. Early cultures must have known of the benefits and dangers of various sources of water. In Britain, many of the Christian Holy wells and springs have previous histories as Pagan sites of worship, offering cures to numerous ailments and the blessings of many saints. In this modern world we may simply regard these as curiosities or archaeological sites. However, many are still visited by religious and non-religious people seeking cures or spiritual benefits. St Winefride's Well at Holywell in North Wales 'springs' to mind as a famous example.

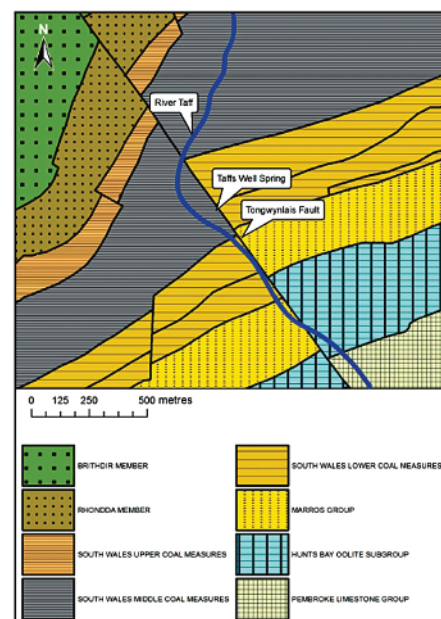
Spring waters can be fresh, saline, sulphur or iron rich (chalybeate) and on some rare occasions 'thermal'. Thermal waters in the UK gain their heat by descending to great depths where the geothermal gradient warms the water before it ascends to the surface. This process is entirely controlled by the structure of the geology; principally synclinal structures offer pathways for water to descend and faults act as pathways for or barriers to water re-ascending to the surface.

The only thermal spring in Wales, Taffs Well, is in a village that takes its name from the spring, a few miles north of Cardiff. Although not as warm as the waters at Bath (~45 °C), the waters at Taffs Well maintain 21 °C, at least twice as warm as most spring waters in the UK. It is thought that the Taff's waters gain their heat by flowing as deep as 400 m below the synclinal basal structure of the South Wales Coalfield, most likely within the Marros Group (Millstone Grit) and the Carboniferous Limestone (Farr & Bottrell, 2013).

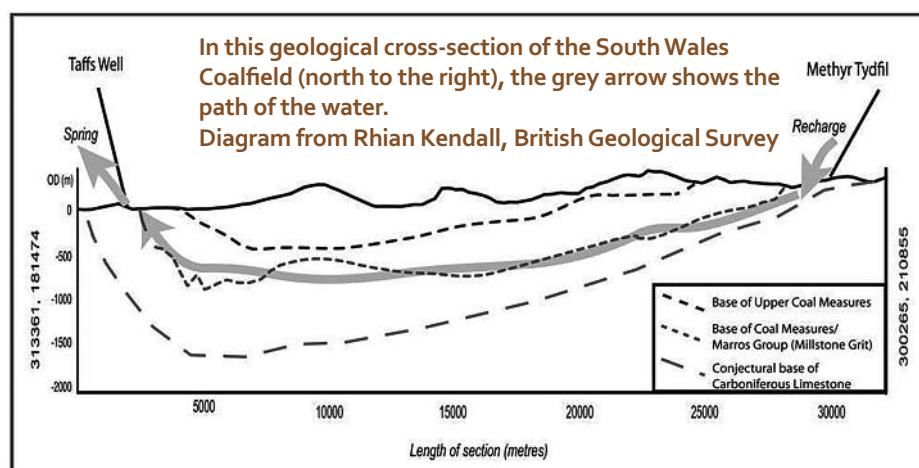
Human interaction with this hydrogeological curiosity can only be traced back to the 1700s, when it was no more than a small plunge pool with a wooden structure to protect the bathers' modesty. Development of the South Wales Coalfield and associated transport networks enabled people to visit, and by the late 1800s a permanent stone structure enclosed the spring surface waters. Although there was no religious significance attributed to the water, people flocked to bathe, in search of promised cures for rheumatism. By the 1930s an outdoor swimming pool was constructed and remained popular until the late 1950s. Thereafter the pool and well fell into disrepair, the doors were locked and the pool filled with rubble during the early 1980s.

The doors were still locked and the well house flooded and strewn with rubbish when I paid my first visit in 2010. Even in this sad state of repair, the waters (dated to over 5,000 years old) were still flowing gleefully and I was totally captivated. Luckily I wasn't on my own and the owners, Rhondda Cynon Taf County Borough Council (RCTCBC) had the vision to realise the spring's potential as a small, quirky tourist attraction, particularly when included as part of a wider visitor offer. In the subsequent years RCTCBC helped oversee the installation of a new outflow system, allowing the water level to be controlled, revealing the tiled floor and spiral staircase into the water.

*Continued on following page*



This geology map from Farr & Bottrell (2013) shows the geological features that lead to Taffs Well producing its hot waters.



Taffs Well in 2010. The well building was flooded, access was unsafe and the doors had been shut for most of the previous 50 years.



# POPULARISING GEODIVERSITY

## From previous page

The well was open for one day only in 2012 as part of the European Open Doors event, Wales' biggest celebration of architecture and heritage. We were overwhelmed with more than 300 visitors in just a few hours and since then over 1,000 people have enjoyed the talk about its history. More recently, the area's Destination Management Partnership secured funding through the local authority and Capital Region Tourism (Welsh Government) to carry out essential structural improvements to the well building and to develop a vibrant audio-visual experience. The well building is now open daily from Easter to August so visitors can discover the historical journey of the warm waters, which still have the power to captivate the imagination.



**In 2014, Taffs Well was officially re-opened to the public for the first time in over 50 years after the building had been made safe and the provision of disabled access and a bilingual audio-visual display. It is open daily to visitors from Easter to August free of charge.**

Taffs Well thermal spring is recorded as a RIGS (Regionally Important Geodiversity Site) and is housed within a Grade II listed building, supporting geotourism and heritage in the South Wales area. The waters could further support the local community if plans to install a ground-source heat exchanger, to warm the nearby pavilion building, can be realised.

## Further reading

Farr, G. & Bottrell, S. (2013). *The hydrogeology and hydrochemistry of the thermal waters at Taffs Well, South Wales, UK*. Cave and Karst Science Transactions of the British Cave Research Association, 40 (1), 5-12.

*Photos by RCTCBC*



**Left, a view inside the well house reveals red staining from iron in the water.**

## VISITING THE SITE

Taffs Well Thermal Spring can be found in Taffs Well Park, Cardiff Road CF15 7PR. Parking, toilets and disabled access are all available and entrance to the well is free.

# Celebrating a voyage of discovery

**Martin Gostwick**, Friends of Hugh Miller

**Joyce Gilbert**, Scottish Geodiversity Forum

In September 2014, the Friends of Hugh Miller (FHM) and the Royal Scottish Geographical Society (RSGS) chartered a traditional sailing boat to follow the journey of discovery taken by Hugh Miller in the summer of 1844 on the sail boat, the *Betsey*, a voyage immortalised by him in his book *The Cruise of the Betsey*. On board the modern-day version was an intergenerational mix of geologists, geographers, artists, writers, ecologists, storytellers and musicians, aged 18 to 68. Geology, landscape, people and story were at the heart of the journey.

### OBAN – LOCHALINE, MORVERN PENINSULA

And so we board the *Leader* at the North Pier in Oban, surrounded by incoming and outgoing Calmac ferries serving the Small Isles. *Leader* built in 1892, is a handsome ketch and, at 120 feet long, is at least twice as big as the Free Church yacht *Betsey*. She will carry a crew of four and 14 passengers, compared with *Betsey*'s two crew, Miller's friend the minister and skipper John Swanson, and island mate John Stewart, and Miller himself as the one passenger. Having not left Oban until late afternoon, dusk has some time since fallen before we tie up at Lochaline Pier, where we experience the unfamiliar sensations of our first night at sea. Storyteller Claire Hewitt finds in *Leader*, a living, breathing creature, behaving much as the *Betsey* had, playing, in Miller's words, the 'voyager's concert' of 'guggle, clunk, and splash, - of low continuous rush, and bluff, loud blow'.

### LOCHALINE TO TOBERMORY, ISLE OF MULL

Tacking to Tobermory, we land at the new-ish pontoons, a few hundred metres in front of those brightly colour-washed housefronts made famous in umpteen brochures and in the children's TV series *Balamory*. A group takes a shore walk led by Simon and Ro and later, on deck, geologist Simon thrills us with Hugh's narrative of his own arrival in Tobermory to join the *Betsey*, about midnight on 16 July 1844.

### TOBERMORY TO ISLE OF EIGG

We set sail for Eigg, the principal focus of the whole trip, made famous by Miller, his contemporaries and their successors, for its landmark Sgurr ridge, its Singing Sands, and the remains of a great reptile, the Plesiosaur. Hugh also preserved for posterity the appalling hardships of the Eiggachs (islanders) under cruel landowners.

It is decided by consensus that we will circumnavigate the entire island aboard *Leader*, and so we trace from on board, and in reverse, Hugh's epic walk in a single day, which he accomplished with John Stewart, geologising all the way as they went. Finally, in late afternoon, we are dwarfed under the impossibly imposing, all-but-perpendicular Sgurr ridge, a pitchstone colossus, called the glass mountain because of its lustrous black rock, resting on a Jurassic pine forest. We anchor at almost the exact same spot at which Swanson and Hugh moored 'in the tideway about 50 yards from the rocks'.

### ON EIGG

"We had rich tea this morning," wrote Hugh about his first breakfast aboard *Betsey* in Eigg harbour, and Simon reads the extract while we have ours. Hugh and John Swanson were sent

*Continued on following page*

*Photos by Simon Cuthbert*



**Barney Strachan, Richard Bracken, Derry Wilkinson and Rosie Bradshaw help to haul up the anchor on *Leader*.**



**The *Leader* is seen here at anchor off Eigg.**



# POPULARISING GEODIVERSITY

## From previous page

bottles of cream, butter, eggs, tea, and oaten cakes by the islanders (only the meal for the cakes came from the boat's store). After breakfast we are greeted at the pier by one of the greatest geologists of his time, Professor John Hudson, aged 82, still looking hale and hearty, and with over 50 excursions to Eigg sites behind him. He is leading the onshore field trips, jointly with Edinburgh Geological Society's Angus Miller.

We are immediately excited by the island's welcome sign and display board proclaiming: 'Big Green Footsteps'. This refers to perhaps the single greatest success of the Isle of Eigg Heritage Trust, the collective which famously and triumphantly bought out Eigg in 1997. Hugh Miller would be astounded at the island's transformation from poverty, depopulation and inexorable decline, to the forward-looking, thriving community of today.

The following morning, a group of us led by Angus Miller scale the great ridge. Hugh Miller ends Chapter II of *The Cruise of the Betsey* with the dramatic announcement: "The gigantic Scur of Eigg rests on the remains of a prostrate forest." The area where Miller was among the first to discover the remains of *Pinites eiggensis* is an extraordinary feature in itself. From distance it looks like a great horizontal cave, cut into an otherwise vertical cliff. It is known today as the Recess and, as we discover, it is very hard to reach over the rough and extremely steep scree slopes.

## AT THE CEILIDHS

It is a most perfect evening, and through it we enjoy two very special parties in succession. The first is a community ceilidh at the Glebe Barn, at which the legendary tradition-bearer Essie Stewart is to preside with storyteller Claire Hewitt, Gaelic singer Kate Langhorne and a poet, Norrie Bissell of Luig, Argyll. Norrie's poetry, known as Geopoetics, makes extraordinary connections between landscape and nature and how we experience them. Later, back on the boat, a fat full moon smiles down on us as we continue our own ceilidh until well past midnight.

## EIGG TO LOCH SUNART, ARDNAMURCHAN PENINSULA

We set sail the following morning and are not far southbound when a shout from Skipper Ben announces fins on the starboard beam. In no time, anything between 50 and 100 common dolphins are with us. For over 20 minutes, they break surface with barely a ripple, soar upwards and forwards and land just as smoothly, to glide again for a few seconds, before leaping again. The whole episode is punctuated with our cries of wonder.

And so we enter Loch Sunart, longest sea loch of the Ardnamurchan peninsula. At the eastern end of Loch Sunart lies Strontian, site of an all-but forgotten, yet notorious Disruption episode, where Episcopalian gent Sir James Riddell would not allow even a tent to be put up by the Free Churchers. The congregation got a 'floating church' built on the Clyde, apparently of cast-iron, a Noah's Ark of a hulk complete with pulpit, vestry and seats for 750 people, moored about 150 metres offshore.

Ben pilots us ashore on Leader's inflatable. We cross a bog, and wild woodland, to ascend a firm forestry track. At its foot, Simon explains a geological unconformity in the cliffs above: we stood on ancient basement rocks - the Moines - originally formed as sediments about 900 million years ago and then repeatedly deformed and metamorphosed. Above are basalt lavas erupted a mere 65 million years ago; they lie across the planed-off ends of the Moine strata - a great erosion surface that was flooded over by the lavas. We climb up to a promontory from which we will behold the sea-loch and beyond, the mountain ranges of Argyll. Leader looks like a toy boat in a pond far below. Yet again we are favoured by a purple-golden sunset, followed by the full moon, both reflected perfectly in the stillest, calmest water. *Continued on following page*



Earth scientist Derry Wilkinson shows us a pitchstone column from the Sgurr of Eigg at the Recess – the site where Hugh Miller found fossils of *Pinus eiggensis*, trees that were buried by the great ignimbrite flow that created the rocks of the Sgurr.



Looking down to Loch Sunart towards Ben Resipol with Leader (a tiny speck) moored in the pool of Loch na Droma Buidhe. We stand on the Palaeogene Morvern flood basalts that rest with profound unconformity upon the Moine Supergroup psammites exposed around the loch shores below.



*From previous page*

## LOCH SUNART TO LOCH SPELVE

The next day we retrace our course back into the Sound of Mull, making for Loch Spelve. In the bright sunshine it suggests the flawless, mountain-ringed Hebridean idyll you dream about. The peaks are grey pinnacles, pyramids and towers; in the foothills green swathes abound in lush flora, and the water is a Mediterranean blue. Simon shows us, on deck, a strikingly coloured British Geological Survey map of south-eastern Mull, explaining the mapping process which involves a lot of inference and deduction based on previous experience and the surface features. After supper, it is time for one more moonlit ceilidh. Mairi's fiddle, Kenny and Barney's guitars, Claire's harp and bodhran, fire up the on-deck dancing; the planking thuds to the jigs and reels, all the Scots airs which have resounded in these waters for centuries. Clapping hands and whoops echo between mountains and sea.

## LOCH SPELVE TO OBAN

All too soon we are returning to the home port Oban and The Friends' hand-sewn banner flies for the final time from under the mains'l boom, all the way to docking and disembarkation at the North Pier.

However, this may not be the end of the story. Films have been made, and recordings taken. Primary and secondary pupils have been following our journey while piloting linked Betsey resource materials. A Betsey reunion is planned ...and importantly the Leader has been chartered for a second voyage of geological discovery in summer 2015.

RSGS and FHM's partners in this venture were the Scottish Geodiversity Forum, Lochaber Geopark and Isle of Eigg Heritage Trust. Financial support came from Scotia Exploration Ltd and Aberdeen, Glasgow & Edinburgh Geological Societies.

## More information

[www.cruiseofthebetsey.wordpress.com](http://www.cruiseofthebetsey.wordpress.com)

To register interest in being part of the crew in 2015, contact  
[joyce@scottishgeodiversityforum.org](mailto:joyce@scottishgeodiversityforum.org)

Rum through rigging – the east coast and mountains of the Isle of Rum are seen through Leader's rigging in the Sound of Rum as we circumnavigate the Isle of Eigg. Hugh Miller visited Rum with his old friend the Reverend John Swanson during the Cruise of the Betsey to collect specimens from Bloodstone Hill. With his usual incisive writing, Hugh Miller commented in his book *The Cruise of the Betsey* on the injustices and ironies of the Clearances on Rum and the uses that had been made of its land.



## Vote for your top fossil

**Lara Reid**, Freelance geoscience writer

**T**he Scottish Geodiversity Forum is running an online poll to find the public's top five fossils from Scotland. The fossil record in Scotland is as diverse as it is fascinating, and covers 1,200 million years of Earth's history. From some of the earliest life-forms, to giant reptiles and dinosaurs stomping across the landscape, Scotland's fossils have contributed much to the study of evolution and Earth sciences across the world.

To promote this superb fossil record, the Scottish Geodiversity Forum is inviting allcomers to vote for their favourite fossils in a poll at [www.scottishgeology.com/poll](http://www.scottishgeology.com/poll). The site displays background information on each of the fossils as well as the click-vote link. There are 16 different fossil types representing some of the most interesting and important finds in Scotland and participants can vote for up to five. The nation's favourite fossils will be announced in spring 2015.

One highlight includes stromatolites, algal organisms that absorbed carbon dioxide from Earth's young atmosphere and released oxygen, thus aiding the development of complex life-forms on our planet. Another is Devonian fish fossils which hit the headlines recently, as scientists discovered that one species of armoured fish pioneered sexual intercourse as a method of reproduction.

The 'Bearsden Shark', discovered by Stan Wood in a Glasgow burn in 1981, is the best-preserved shark skeleton of its age in the world. The skeletal remains of *Westlothiana lizziae*, or 'Lizzie', also found by Stan in central Scotland in 1984, represent a crucial link between amphibians and reptiles. On Arran and Skye, there are footprints of 12-foot-long crocodile-like reptiles and carnivorous dinosaurs.

Head to the website to find out more about these, and all the other fantastic fossils in our poll, and vote for your favourites. Keep up-to-date with the latest from the poll and other news by following the Scottish Geodiversity Forum on Twitter [@ScotGeodForum](https://twitter.com/ScotGeodForum).

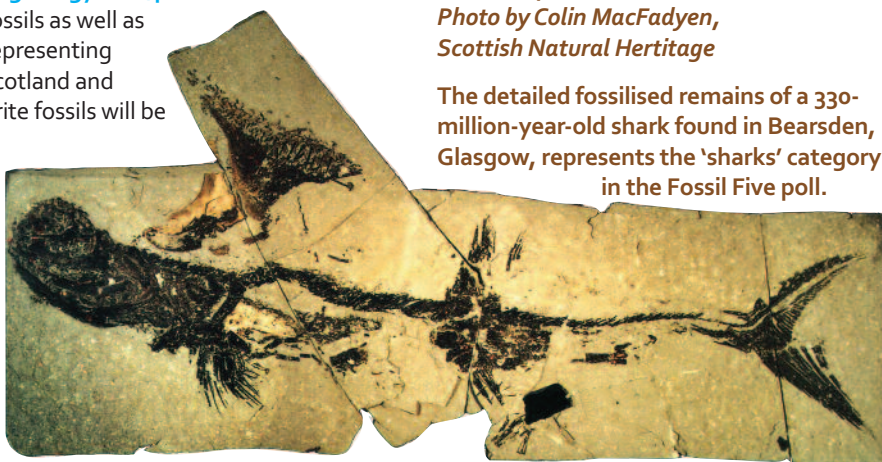
The SCOTTISH GEODIVERSITY FORUM is a non-governmental organisation focused on promoting Scotland's amazing landscapes and geodiversity, as well as influencing local and governmental policies. Membership is free. More information at [www.scottishgeodiversityforum.org](http://www.scottishgeodiversityforum.org)



Stromatolites aided the development of complex life-forms on Earth. These Devonian stromatolites occur at Yesnaby on Orkney.

*Photo by Colin MacFadyen, Scottish Natural Heritage*

The detailed fossilised remains of a 330-million-year-old shark found in Bearsden, Glasgow, represents the 'sharks' category in the Fossil Five poll.



Above, footprints of a large carnivorous dinosaur found on Skye.

*Both above photos by Neil Clark, Hunterian Museum, University of Glasgow*

Left, a superb specimen of *Dipterus*  
*Photo by Nigel Trewin*



# Outreach project that keeps reaching out...

**Rob Butler,**  
Geological Society Geoconservation Committee and University of Aberdeen

**M**illook Haven, Stonehenge, the hills of Assynt and Ironbridge Gorge: what have they got in common?

Well, they all came top of their respective categories in a public vote held by the Geological Society of London to find 100 Great Geosites in the UK and Ireland. The Geosites project formed the cornerstone to the Society's activities during the 2014 Earth Science Week. The week was themed on Our Geo-Heritage, with outreach activities throughout the UK. The aims of the Geosites project were essentially two-fold: to engage the public by using geoheritage as a shop-window into our science; and to develop a resource that can be drawn upon should key sites become threatened.



The final 100 geosites are listed in 10 categories – capturing a range of different types and uses for geology. Some reflect areas of scientific discipline – such as the ‘fire and ice’ and ‘folding and faulting’; others areas of broader significance (‘human habitation’, ‘industrial and economic importance’). Of course many geosites transcend such simple pigeonholes, but all offer stories of scientific discovery and endeavour that can enthral practitioners and public alike. The final list contains some of the crown jewels of British geology – such as Cwm Idwal and Lulworth. But there are also ‘unsung heroes’ like the Lewisian rocks at Achmelvich or the ‘Snowball Earth’ deposits on Islay. Away from outcrops are archaeological locations such as Stonehenge and Ceide Fields Bog, sitting alongside more modern engineering of the Channel Tunnel and the Dinorwig pump-storage scheme. The watchword is variety – testament to the oft-cited notion that these islands have the greatest concentration of geodiversity on the planet.

The hills of Assynt were voted the favourite landscape. They are seen here from above Knockan Crag (which featured in the 100 list as a great education resource).

*Photos by Rob Butler*

At Broadhaven, Pembrokeshire, the classic fold-thrust structures that mark the ‘Variscan Front’ have attracted student parties for decades - to inspire generations of structural geologists.

The Geosites project partnered the enthusiasms of the Society's Geoconservation Committee with the networks and expertise of its policy and media department. So, how successful has the 100 Geosites project been? As sites were nominated during the summer of 2014 there was extensive activity on social media. Over 400 nominations were received through the Society's Facebook and Flickr pages, supplemented by proposals from members of the Geoconservation Committee. After short-listing, over 1,200 votes were cast. 100 Great Geosites went live at the start of Earth Science Week (13-19 October), alongside nationwide activities – guided walks, special events and exhibitions, with the Society devoting its London Lecture to the UK's most significant geological sites. But it was as a media event that the Geosites project far exceeded the Society's expectations. *Continued on following page*





# POPULARISING GEODIVERSITY

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Top of the public poll came Siccar Point. Scotland provided four of the 10 peoples' favourites, and 34 of the 100. This caused something of a storm in parts of the media, with the list being published within a month of the Scottish referendum. The *Telegraph* took great exception to the apparent Scottish bias, demanding that Westminster Abbey featured in the top 10. MacAulay & Co. on BBC Radio Scotland also suggested that Scotland was 'punching above her weight'. On the other hand, there's an awful lot of rock and landscape in Scotland – not to mention three billion years of Earth history. These points made, the media were calmed.



Famous tourist sites such as Malham Cove and its much-stumbled-upon limestone pavement made the 100 list.

For a time on the launch day the story was the second-most re-tweeted on the BBC – with its website displaying spectacular images from its own archives of many of the most dramatic geosites. Most encouraging, there was extensive coverage from local radio networks and papers, which is a great way to build local pride in nearby rocks and landscape.

Over the coming months the Geological Society will be adding more photographs and commentary to each site, perhaps linking in published scientific articles and further educational resources. There are plans to add blogs to each – adding to the richness of experiences at these places. Even now there are extensive online resources available through the Geological Society's web pages ([www.geolsoc.org.uk/100geosites](http://www.geolsoc.org.uk/100geosites)), including a full listing of all 100 sites, an interactive map and links to the Earth Science Week materials. This includes a webcast of the London lecture.

There is no intention to let the Geosites project slowly disappear. At the time of writing, photographs of the 100 – together with commentary – were still coming in via Twitter. The outreach project just keeps reaching out.



Looking down onto the classic outcrop at Siccar Point - the single most voted-for nomination - and arguably one of the most important locations in World geology. The final approach however is not for the faint-hearted (see *issue 42* of *Earth Heritage*)!



# Carving out rock routes

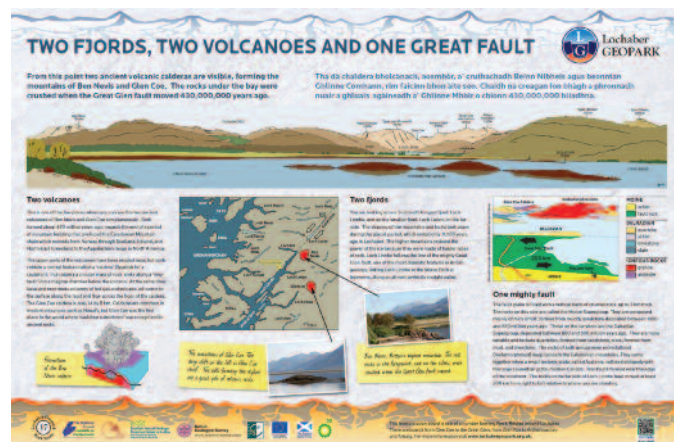
Ian Parsons, Lochaber Geopark

The 4,648 km<sup>2</sup> of Lochaber district in the West Highlands of Scotland includes the highest mountain and some of the most rugged scenery in the UK and a long fjord coastline of exceptional beauty that includes the magical Small Isles of the Inner Hebrides. It has a large number of summer visitors, two ski resorts and a vast range of adventure activities.

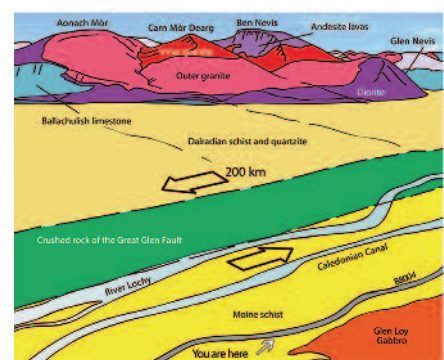
Lochaber's wonderful scenery is a product of its geology. The combination of busy outdoor tourism and the geological treasure trove led to the formation of Lochaber Geopark in 2004. A major project between 2010 and 2012, financed by Scottish Natural Heritage and the European LEADER fund, was the installation of 20 interpretative panels throughout Lochaber. The panels form a series of 'Rock Routes', taking a variety of themes and of various lengths. These are described in a free pamphlet available at Tourist Information Centres and some shops. In addition, our new Geopark website ([www.lochabergeopark.org.uk](http://www.lochabergeopark.org.uk)) has PDF images of all the panels with a brief description of what each portrays.

The high relief and good exposure in Lochaber mean that panels can be placed at scenically exceptional viewpoints from which the geology can be explained at the grand scale. Most of the panels are mounted on plinths built of local stone and are installed in large lay-bys or car parks. I provided the content, sometimes using photographs and diagrams provided by other members of the Geopark, and the project was managed by Alison Martin, who is also a talented artist. The crisp and distinctive overall style, and the panoramic and other drawings, are her work.

There is more to managing a project like this than meets the eye. The opinions of local people must be sought, planning permission obtained, sometimes permission from the roads authority, and builders must be found. We abandoned some potential sites because we could not find who owned the land! We made much use of oblique geological maps draped over the scenery constructed using software in BGS in Edinburgh. We are very grateful to Hugh Barron of BGS for the time he gave on this. The final electronic versions were produced and printed on aluminium and composite panels. After 40 years teaching geology in two ancient Scottish universities, writing concisely for a general audience was a new challenge. The panels are all different and self-contained, although there is some unavoidable overlap in content. The text had to be as up-to-date scientifically as possible. One panel, I fear, has already been rendered partly obsolete by new research!



Examples of the boards and within them the drapes that explain the landscape to visitors



Panels can be sited at scenic viewpoints. This one at Mallaig looks towards the Isle of Rum 16 miles away.



## LOCHABER'S EXCEPTIONAL VARIETY OF ROCK TYPES

Lochaber's geology includes an exceptional variety of rock types, ranging in age from Archaean to post-glacial. Intensely folded metamorphic rocks, Dalradian to the south and Moine to the north, cover the greatest area, brought together along the transcurrent Great Glen Fault, a terrane boundary. The Caledonian Canal follows this important crustal feature across Lochaber. The southern extension of the Moine Thrust runs under the Sea of the Hebrides, and un-metamorphosed Torridonian sandstones form the northern part of the Isle of Rum.

Two great igneous episodes are recorded. In the east, late-Caledonian granite magmatism led to the formation of the celebrated caldera structures of Glen Coe and Ben Nevis. In the west, the famous Rum layered intrusion and Ardnamurchan ring complexes and associated lavas formed when the North Atlantic began to open. Lavas from the Mull volcano form trap topography in the Morvern region, and the dramatic pitchstone ridge forming the Sgurr of Eigg is an ignimbrite that travelled from Skye.



# Influencing England's decision makers

**Lesley Dunlop**

Chair, English Geodiversity Forum & Northumbria University

**T**he English Geodiversity Forum's 'Geodiversity Charter for England' was launched at an MPs' briefing at Westminster on Trafalgar Day, 21 October 2014. The launch was historic in that it was the first time in England that a geodiversity initiative has received a ministerial launch and the first time that the geological community working together has reached so many influential people, MPs and a Minister of State. It was wonderful to witness the excitement and the willingness to support the Charter by those present.

The Charter, drawn up by the English Geodiversity Forum (EGF), encourages everyone to work together to promote and manage England's geodiversity, and to ensure that it is better integrated into policy and guidance consistent with the economic, social, cultural and environmental needs of England.

Julian Smith, MP for Skipton and Ripon, invited politicians and representatives from all organisations interested in geodiversity to the briefing and he introduced Lord de Mauley, Parliamentary Under Secretary for the Natural Environment and Science to introduce the Charter. Professor Rory Mortimore, Julie Harrauld and Natural England had briefed Lord de Mauley prior to the launch on the key rôle of geodiversity and he duly enthused on the importance of geodiversity to the country's resources and the fashioning of landscape, and the crucial part played in the Industrial Revolution, economic development, food and farming, and the countryside. He recognised the value of geodiversity in the National Planning Policy Framework (NPPF) and in SSSIs, National Parks, AONBs and the wider countryside especially for tourism. He saw geodiversity as the link between landscape, people and their culture. He was pleased that Natural England was a signatory to the Charter that raises awareness of geodiversity and seeks recognition of the value it makes to society.

Following Lord de Mauley, Rory Mortimore gave an excellent introduction about the concept of geodiversity.

*Continued on following page*

**Cornwall's Bedruthan Steps were selected as the image to capture imaginations on the cover of the newly launched Geodiversity Charter for England.**  
*Photo by Julie Harrauld*





# GEODIVERSITY CHARTER LAUNCH

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Using his experience from industry and education he demonstrated how an understanding of geology and geodiversity is critical to being able, for example, to run engineering projects safely and successfully and why education is important.

Presentations from the Jurassic Coast World Heritage Site (England's only natural World Heritage Site), the English Riviera Global Geopark, a minerals industry perspective from Aggregate Industries, and a reflection on the importance of geodiversity in local communities from Dudley Museum and Art Gallery gave a flavour of what has been, and can be, achieved for geodiversity. Spectacular fossils from the Natural History Museum were also on show, alongside a beautiful textile geological map of Hampshire (*Earth Heritage 40*). All the speakers demonstrated the importance of geodiversity in their particular area of interest and their enthusiasm engaged the audience well.

Andrew Sells, Natural England's Chairman, commended the Forum on the quality and clarity of the Charter and concluded that "The fact that we are all here today in Westminster is a very positive sign. I encourage everyone here to play their part and to work with or even join the English Geodiversity Forum in the months ahead."

The MPs' briefing signified the importance of accessing politicians at the highest level but the Charter is only the beginning. Creating an All Party Parliamentary Working Group on geodiversity would bring together sympathetic politicians so EGF could brief them on important items such as: provision of geology in schools, improved collection storage and other topical matters. A case in point was Adrian Sanders MP for Torquay, who said that the only reason he was at the briefing was because the English Riviera Geopark was in his constituency. A working group could go a long way to harnessing the goodwill and influence of Adrian and others like him, and personal approaches to individual MPs may be a good way to start building that.

The power of an individual approach was demonstrated by the fact that the MPs' briefing came about after Mick Stanley talked to his MP, Julian Smith, about the draft charter. This led to Julian Smith speaking to Richard Benyon when he was Minister. Other examples of an effective personal approach were shown by Keith Ambrose who went to see his MP, Ken Clarke, who stayed for most of the briefing, and Julie Harrauld who spoke with Nicky Morgan MP, who in turn spoke with Lord de Mauley.

The Geodiversity Charter for England follows on from the impressive Scottish Geodiversity Charter which was published in 2012 and has proven to be a good focus point for highlighting geodiversity. It is hoped that other countries within the UK will also produce their own.

*Continued on following page*



**A riot of geodiversity (from the top): 'Ammonite' lamp post inspired by the fossils of the Jurassic Coast World Heritage Site.**

**Rock Detectives explore Jacob's Pot, a small cave in the Great Limestone at Harehope Quarry, County Durham. Orchids growing at Marsden Old Quarry Nature Reserve, Tyne and Wear. Sharply folded Carboniferous rocks in Millook Haven, North Cornwall.**





# GEODIVERSITY CHARTER LAUNCH

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Supporters of the Charter range from national organisations such as Natural England, British Geological Survey, the Geological Society, Geologists' Association and the two UNESCO Global Geoparks through to more local ones such as Kents Cavern, London Geodiversity Partnership and Limestone Landscapes. To date 33 organisations have agreed to support the aims of the Charter. The British Geological Survey provided free design services for the Charter and Natural England provided expertise and support in production of banner, website and printing.

The Charter highlights the UK Geodiversity Action Plan (UKGAP) which plays a role in collecting and publishing information from UK-based groups relating to geodiversity conservation and action. By co-ordinating information from a wide range of sources there is knowledge available and good practice can be promoted. The English Geodiversity Forum will contribute to the UKGAP and support its delivery. Get involved at [www.ukgap.org.uk](http://www.ukgap.org.uk).

The Charter is intended to widen understanding of the importance of geodiversity and the influence it has on daily lives and in shaping the natural and built environment. The Charter encourages everyone to work together to promote and look after England's rich geodiversity. It provides a focus for action that recognises and integrates geodiversity conservation and management into policy, practice and decision making at a national and local level and in both the natural and built environment.

## Starting point for further action

The Charter is a starting point for further action and it will be over the next few months and years where the benefits will be seen. The process of producing and launching the Charter has opened many doors and brought geodiversity awareness to some sectors where knowledge was limited. Lord de Mauley has been able to highlight the rôle of geodiversity and will request its inclusion in policies such as the Agri-Tech initiative as well as providing direct contact to key players in education and policy. Geotourism is also a major focus where we can utilise some of the contacts and links already made as well as working with industry to promote and extend good practice. We aim to use the momentum created by the launch to continue to enlist supporters and to enthuse more people in education, conservation and promotion of geodiversity.

The English Geodiversity Forum was established in 2013 and is open to all organisations and individuals interested in promoting England's geodiversity and sharing experience and good practice (*Earth Heritage* 40).

The Geodiversity Charter for England is available at [www.englishgeodiversityforum.org](http://www.englishgeodiversityforum.org) and we welcome comments and information. Please also contact Lesley Dunlop, [chair@englishgeodiversityforum.org](mailto:chair@englishgeodiversityforum.org).



**Natural wonder: an eye-catching display of tufa at North Dock, Sunderland**

**Photo by Jonathan Larwood, Natural England.**

**Previous page photos: ammonite lamp post by Hannah Townley, Natural England; rock detectives by Harehope Quarry; orchids by Lesley Dunlop; Carboniferous rocks by Mick Murphy.**



# Storm damage is a blessing and a curse

Christina Byrne, Natural Resources Wales

**S**torm damage can be a blessing and a curse; while our heads understand that the destructive power of the sea created our dramatic coastline, it freshens outcrops and reveals new geology; at the same time our hearts sink at the destruction of cherished sites.

The winter of 2013/14 was particularly notable, as storm after storm rolled in from the Atlantic, lashing the British coastline, destroying landmarks such as Dorset's Pom Pom Rock, the rock arch in Porthcothan Bay, Cornwall and reshaping parts of Chesil Beach. At the same time the huge volumes of sediment moved revealed delights such as the submerged forest at Borth. While we were sat warm and snug in the office it was easy to make plans to go out and look for storm damage, but in reality the gap between the storms was too short and even the non-storm tides were still too high to allow safe access!

Once things had calmed down, one site where obvious change had occurred was Cwm Nash in the Vale of Glamorgan, which forms part of the Monknash Coast SSSI, designated for its Liassic limestones cliffs, tufa deposits, coastal geomorphological features, flora and fauna. The tufa deposits contain a rich variety of fossil snails and record a detailed sequence of environmental and climatic changes spanning the last 12,000 years. The site is also important for the tufa currently forming in Nash Brook. The low cliffs of soft tufa, about seven metres high, have formed where the river reaches the sea. These have been retreating gradually for years – the tufa is incredibly soft (tempting many beach visitors to carve their names into it) so offers little resistance. However the cliffs are usually only touched by the highest of high tides. Around 5 January 2014, a large chunk of cliff became detached from the main face and slumped onto the beach. Further cracks were visible in the cliff face and several other large blocks fell over the next few months.

### Down to the bone

The main fall was significant for the local archaeological community (and also Barry Police and the area coroner) as a passer-by found human remains in the fallen tufa. Several bodies have been eroded out of the cliff since the 1980s, thought to be from a post-mediaeval burial ground (some of the bones have previously been radiocarbon dated to 1640-1690 AD). A geophysical survey early in 2013 had not shown conclusive evidence of any remaining graves. On this occasion 52 bones from two individuals were recovered and Glamorgan Gwent Archaeological Trust is applying to CADW for funds to recover the rest. It is hoped that the increased level of archaeological interest will give extra cause to monitor the rate of retreat of the finite tufa deposit. This part of the Welsh coastline, with its high cliffs, sandbanks and reefs, has a long history of shipwrecks, and it may be that the burials here in unconsecrated ground are those of shipwreck victims, uncovered now by storms similar to the ones that fatefully brought them here.

Nowadays, modern GPS, lighthouses and the RNLI mean we are somewhat safer from winter storms, but it would be remiss not to take this opportunity to remind people of an easily forgotten danger related to extreme weather. Every time Cwm Nash has been visited we have found people walking and sitting close in under the cliffs, absolutely oblivious to the potential threat from above. Several large rockfalls occurred on the Liassic limestone cliffs and from the tufa deposits in the weeks after the winter storms. Rockfalls do happen at other times, but are likely to be given a helping hand by storms that can undercut cliffs, weaken rocks and increase water content of previously dry areas. It is impossible to predict exactly when they will fail, but when it is more likely try to avoid the danger areas!



At Cwm Nash in the Vale of Glamorgan, soft tufa blocks have become detached from the main cliffs.



Snail shells trapped within the tufa and exposed by the storms can give clues to the Holocene climate change record.



Human remains have also come to light. If you look carefully, two bones, possibly femurs, can be seen poking out from the grave cut at the top of the cliff, and presumably the feet are still in there too. Some of the bones have previously been radiocarbon dated to 1640-1690 AD.



Liassic limestone cliffs here are prone to periodic rockfalls.

*Photos by Christina Byrne*



# Making the most of Brymbo's plant fossils

**Peter Appleton, Brymbo Heritage Group**

**Caroline Buttler, Amgueddfa Cymru – National Museum Wales**

**Raymond Roberts, Natural Resources Wales**

**T**he Brymbo Fossil Forest near Wrexham, North Wales, was revealed in 2004 during restoration of the site of the former Brymbo Steelworks. Opencast recovery of coal was made from reserves found in several seams where historic mining had been by 'bell pits' or 'pillar and stall' working (see photo below). Large lycophyte stumps and numerous *Calamites*, most in growth position, were found in a six-metre sequence of mudstones and sandstones between the 'Crank' and the 'Two-Yard' coals of lower Westphalian B age. Other plant fossils included fern-like foliage, stems, cones, seeds and megaspores.

The discovery was reported in the Summer 2005 edition of *Earth Heritage*, where a proposal to mount a museum and educational display at the newly built Brymbo Enterprise Centre was outlined. A more ambitious plan, subsequently agreed with the site developers, and now gaining momentum, is to excavate part of the remaining fossil area to create a covered visitor and educational spectacle to go hand-in-hand with the historic Ironworks project being developed by the Brymbo Heritage Group (BHG).

As a first stage in 2005, overburden was removed with heavy machinery; many fossils were recovered, accessible *in situ* examples mapped and the geological interest assessed. A substantial area was protected from rainwater ingress with a waterproof membrane bedded in and covered with sand. This work was possible with the generous support of Brymbo Developments Limited. In 2008 it became necessary to remove a strip of ground from the margin of the fossil area for a road to access developments within the wider site. The site owners generously put an excavator and skilful operator at the disposal of our small group for three months. That was when most knowledge on the variety and distribution of fossil types within the range of rock units was realised. An extensive fossil collection accumulated which, having to keep up with the pace of excavation, was wrapped and stored for future study. Samples varied from small hand specimens to large *Calamites* and hefty sections of lycophyte stem. *Continued on following page*

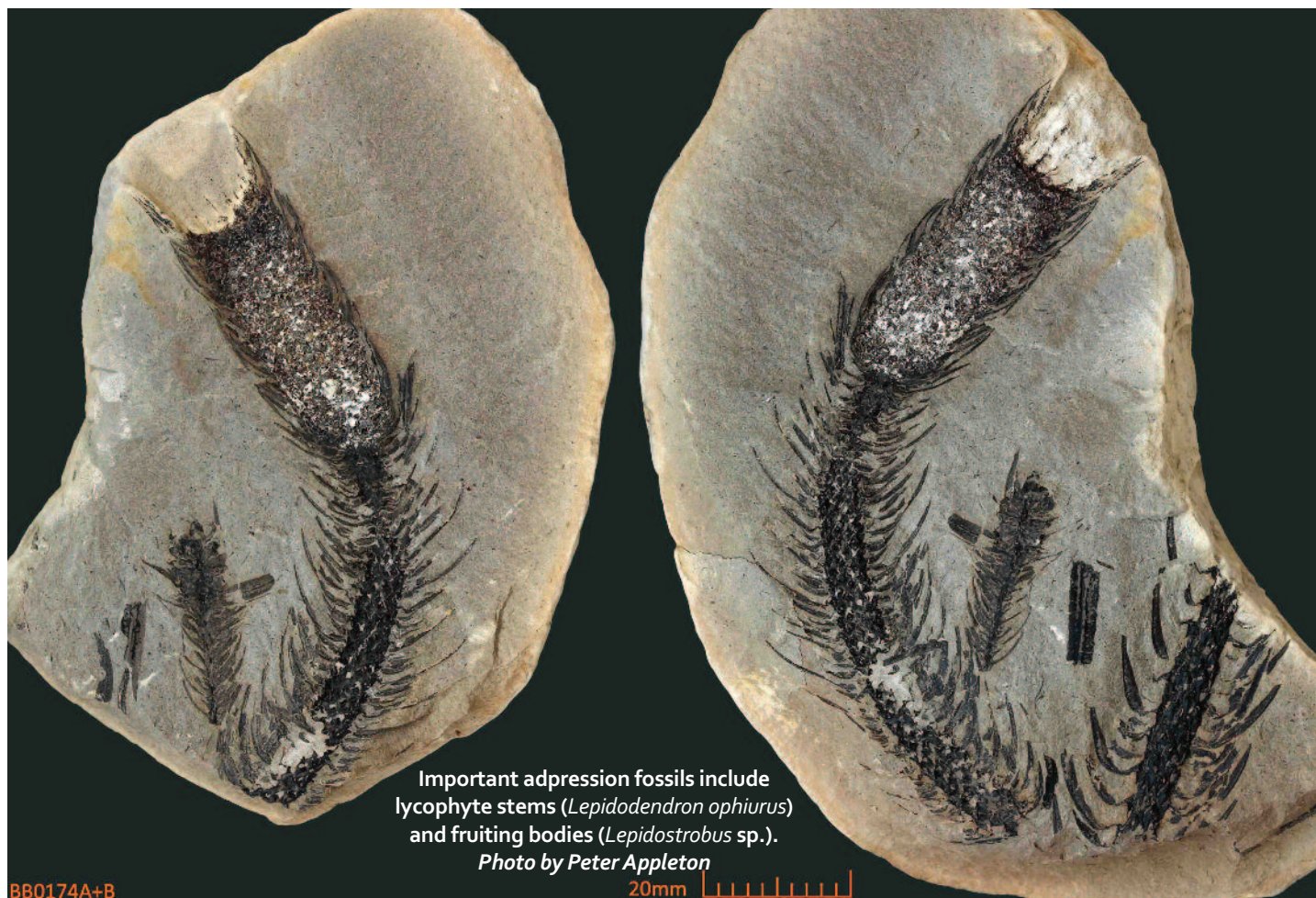


The Brymbo fossil collection includes many beautiful well-preserved ferns. *Sydneia* sp. (above) was only previously known from Cape Breton in Canada.  
*Photo by Peter Appleton*



Excavation work during reclamation of the former steelworks at Brymbo revealed coal seams and plant-rich horizons. A mechanical digger (seen centre) is dwarfed by the scale of the excavations.  
*Photo by Jason Parry, Brymbo Developments Limited*





## From previous page

The importance of the geoconservation and scientific interest of the site was realised very early on. Soon after its discovery the site was registered as a RIGS. To confirm its national importance, the Brymbo fossil forest was subsequently registered as a Geological Conservation Review site in 2012. It is planned to notify the site as a SSSI in the coming year.

A number of reasons dictated that a good home be found for the more important items. The storage at Brymbo was only suitable for the larger and more numerous fossil types. Smaller specimens, with rarity, display or research potential were housed in domestic premises; one of the authors being keen, after several years, to reclaim his kitchen, living room, garage and garden shed. This was a far from ideal situation where fossils, particularly those in a mudstone matrix, were deteriorating and one where there was no means of expert assessment of the content and value of the collection.

A permanent location had to be found for the rare or fragile specimens, including potential new species, in addition to a representative selection of fossils. Ideally this would be located in north-east Wales but no organisation there had the space or experience to deal with such a task. Thankfully Amgueddfa Cymru – National Museum Wales (AC-NMW) had the facilities and expertise.

A memorandum of understanding was drawn up between AC-NMW, Brymbo Heritage Group (BHG) and Brymbo Developments Limited (BDL), the latter being the site owners and hence the owners of the fossils. The result was a framework for co-operation and effective communication between the three groups, enabling them to work in partnership to preserve specimens for future enjoyment, research and general educational purposes.

*Continued on following page*



Large quantities of sediment-filled casts of *Calamites* stems in growth position are found at Brymbo. *In situ* *Calamites* pith casts have never been seen in such quantities in the UK. The example shows *Calamites suckowii* Brongniart in a loose block. Photo by Peter Appleton



# PRACTICAL GEOCONSERVATION

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Co-funded by the Museum and the Countryside Council for Wales (Natural Resources Wales' predecessor), material was unwrapped and painstakingly sorted into upwards of 350 items for an AC-NMW collection with 'duplicate' material to be returned for storage at Brymbo. Where appropriate the AC-NMW specimens were cleaned, sometimes trimmed and in a few cases repaired or impregnated where stability was compromised. All items were individually marked and photographed, the digital images having specimen number and millimetre scale added.

Data have been logged on an Excel spreadsheet allowing sorting by fossil type and by rock unit. High-resolution digital photographs can be accessed by clicking on the spreadsheet thumbnails relating to each specimen. Identification, most to species level, has been made by Chris Cleal of AC-NMW and Barry Thomas of Aberystwyth University.

In 2013 the transfer of title to the selected fossils was signed and ownership passed to the Museum, along with the logged data and photo files. The collection has been given an overall accession number and the specimens are being item registered. They are stored with the Museum's palaeobotanical collection, the material from Brymbo being located together and ordered by type. The store is air-conditioned and temperature- and humidity-controlled to minimise deterioration.

## Touring exhibition and digital resource

AC-NMW would like more people to be able to see this remarkable collection and plans to open a temporary touring exhibition in Wrexham Museum in 2016. In conjunction, it is planned to produce a digital resource of images and information about the specimens and the site at Brymbo for access worldwide.

In addition to the fossil forest, the 'heritage' area at Brymbo encompasses the 18th Century ironworks of John Wilkinson and the mid-19th Century colliery known as the Blast Pits. BHG aims to illuminate a story spanning 300 million years from life in the tropical forests, to the mining of coal and ironstone, and the 200-year industrial and social history of iron and steelmaking, all of which the geology made possible. In addition to the fossil rescue work, grants have been secured for a feasibility study and work to stabilise the ironworks structures, which include blast furnace and foundry from 1796. A heritage officer, funded by Heritage Lottery, is tasked with developing the Brymbo project for BHG in conjunction with partner organisations and local communities.

Proposals for the fossil area involve excavation to expose trees and *Calamites* standing where they grew, with a protected boardwalk system for visitor access, all enclosed within a single structure. With appropriate security and environmental conditions, AC-NMW will return specimens on loan for display. The practicalities of the venture are discussed at regular forums including the bodies mentioned above plus Wrexham County Borough Council, Wrexham Museum and Natural Resources Wales. Since the Brymbo Fossil Forest is a project without precedent, funding may be challenging; all offers gratefully received!



Brymbo fossils securely stored at AC-NMW Cardiff. Each fossil was given a specimen number, boxed individually (*above*) and stored within the Museum's palaeobotanical collection (*below*).  
*Photos by Caroline Buttler, AC-NMW*



# All spruced up after site management work

Holly Addis, Aberystwyth University  
Eleanor Brown, Natural England

**F**our Ashes Pit Site of Special Scientific Interest (SSSI), five miles north of Wolverhampton, has long been of geological interest. In the 1960s and 1970s it was a working sand and gravel quarry and supplied scientists with information concerning the extent of the last British and Irish Ice Sheet (BIIS) and ecological and climatic changes during the late Pleistocene.

However, 50 years on, most of the former quarry had been landfilled, was overgrown and affected by high water levels. Natural England assessed the small area of the former working faces that constituted the SSSI and found it to be in unfavourable condition, and much of its scientific interest was thought to have been lost.

When researchers expressed an interest in conducting fieldwork at Four Ashes, Natural England prioritised the site for a Conservation Enhancement Scheme (CES) grant, using advice on conservation measures provided by Keele University. With assistance from Natural England's Staffordshire Land Management Team, the landowner and farm manager put in place a number of management actions to return Four Ashes to favourable condition. As a result, researchers from the University of Liverpool working within the Natural Environment Research Council-funded BRITICE-CHRONO project ([britice-chrono.org/](http://britice-chrono.org/)) moved in to conduct their fieldwork to investigate the timing of the growth and decay of the last BIIS. The overall BRITICE-CHRONO project aims to use this research to inform models of ice-sheet change for current ice masses; principally land-ice retreat in Antarctica and Greenland. The work should also inform projections of future global sea-level change.

### Scientific importance

The original research on Four Ashes was conducted in the late 1960s and early 1970s by A.V. Morgan and A. Morgan. The gravel pit was subsequently chosen as the type site for the last (Devensian) glaciation in Britain and it became an important reference site for the British Quaternary. While much of the site was lost due to extraction of sand and gravel and subsequent landfill, deposits can still be found at the former pit margin, where the SSSI is located. The site was designated for its important sand and gravel deposits with underlying organic material thought to date to the last (Ipswichian) interglacial, and the overlying Irish Sea Till. Within the sand and gravel unit, there are further lenses of detrital peat and organic muds containing pollen and insect remains, which provide evidence of cooler climatic conditions at Four Ashes before the deposition of the Irish Sea Till.

The organic material has been radiocarbon dated with dates ranging from approximately 30,000 – 40,000 years before present. The presence of ice-wedges and frost-heave (cryoturbation) structures indicates that periglacial conditions both preceded and followed the deposition of glacial sediments, both diamict and outwash gravels associated with ice advancing south through the Cheshire, Shropshire and Staffordshire lowlands from the Irish Sea basin. Four Ashes has lost much of its original sediment sequence, yet it is an important geological site where research over 35 years has provided insight into the maximum extent and timing of this sector of the most recent BIIS, and earlier climatic and environmental variations during the late Quaternary.

*Continued on following page*



One of the sections excavated by researchers from the BRITICE-CHRONO project. The Irish Sea Till is visible with the sand and gravel beneath.

*All photos by Eleanor Brown*



*From previous page*

## Conservation and management

Shallow Quaternary sediments are particularly vulnerable to tree-root penetration and damage from soil processes. At Four Ashes, vegetation had covered the former pit faces and the limited area of undug reserve behind the faces (*right*). Large trees had grown up around the site, and their roots were disrupting the upper part of the profile. Trees were felled with the roots left *in situ* to decay naturally. Stumps were then treated with herbicide to prevent re-growth. Some trees were left standing along the site margin to screen it from the adjacent road, but a number on the undug reserve were uprooted in the 2013-2014 winter storms, disrupting the topsoil and upper part of the sequence. This could lead to further damage so the remaining trees need assessing for the likelihood of wind throw in the future.



**Four Ashes Pit SSSI before clearance. The former pit faces are heavily wooded, impeding scientific access to the geological profile.**

Waterlogging is also an issue at Four Ashes, as it hinders access to the former pit faces and makes deep excavation beneath the faces problematic. Only the upper 2.2 m of the original profile is visible, so deeper excavations are needed to expose the lower parts. Site inspections in 2012 revealed that nearby drains were blocked and their clearance helped lower water levels by around 1.2 m. Brash from vegetation clearance was laid in the waterlogged areas (*right*) to help provide access for machinery, such as excavators.

After the clearance, the University of Liverpool researchers were able to carry out their fieldwork. Following an initial ground penetrating radar (GPR) survey along the length of the current exposures and remaining intact terrain, an excavator cleared five short (5 x 3 m) sections along the former pit face. This opened up the profile and revealed a surface Irish Sea diamict, sediments laid down by glacial ice, and the upper part of the sand and gravel sequence (*see photo on preceding page*). It also revealed the amount of damage from tree-root penetration. One of the hazards encountered during the excavation was root balls which occasionally caused the upper part of the profile to collapse soon after the section had been opened. As well as recording the excavated sections, the researchers from the University of Liverpool sampled the sections to assess the preservation of organic materials in cryoturbated units towards the top of the lower sand and gravel. They also collected samples from the upper diamict for optically stimulated luminescence (OSL) dating of grains of quartz in the sand, with the objective of constraining the timing of the last deglaciation.



**Four Ashes Pit SSSI after clearance works. Researchers from the BRITICE-CHRONO project are opening up sections for study. Note the waterlogging in the former pit floor – brash from the vegetation clearance was laid down to improve access.**

## The future for Four Ashes

A site visit in July 2014 showed that vegetation was already returning and water levels were rising slightly. Although the management at Four Ashes was a great success, maintaining favourable condition for the longer term will require vegetation growth to be controlled periodically and site drainage to be monitored. The development of a light coverage of herbaceous vegetation will help prevent erosion. The CES agreement is for five years, so vegetation clearance will continue until it expires. This, combined with regular monitoring, will help maintain Four Ashes in favourable condition for future research.

The return of Four Ashes Pit SSSI to favourable condition shows that research projects can help prioritise sites for conservation and management actions and funding. The Quaternary Research Association (QRA) is marking its 50th anniversary by creating a list of the 50 most significant Quaternary sites across Britain. Natural England has nominated Four Ashes, reiterating its importance for the British Quaternary and highlighting its recovery as a result of partnership working between the landowner and farm manager, Natural England and the academic community. The authors thank all those involved in achieving this great result.

## More information

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# Good geoconservation opens door to Lower Thames studies

Peter Allen, Essex Field Club

David Bridgland, Geologists' Association

A joint meeting between the Geologists' Association (GA), the Quaternary Research Association (QRA), the Essex Field Club (EFC) and the Fluvial Archives Group (FLAG) involved excursions to a number of Quaternary geoconservation sites. Of eight sites visited on two field days in October, six were GCR sites, five from the Thames Quaternary block (*GCR Vol. 7*) and one from the Quaternary of East Anglia (in press, *Proceedings of the Geologists' Association*). This serves to emphasize the value and importance of geoconservation, without which it would not be possible to operate meetings of this sort. The management of these and other geoconservation sites in the region was a topic debated both in the field and as part of the conference. In readiness for the meeting, cleaning operations were undertaken by hand at Marks Tey, Lion Pit (West Thurrock), Purfleet and Swanscombe, by volunteers from the EFC and the QRA.



### Marks Tey Brick Pit SSSI

**ABOVE**, the Day 1 excursion party inspected newly cleaned sections at Marks Tey Brick Pit Site of Special Scientific Interest. This is the para-type-locality of the Hoxnian Interglacial (~400,000 years ago), although the sediments representing that warm episode are below the quarry floor and these exposures are in overlying cold-climate lacustrine-turbidite beds. The pit is still used for the low-intensity extraction of sediment for use in specialist brick making, perhaps an ideal situation for a soft-sediment SSSI.

### Swanscombe Skull Site NNR

Hand-excavated sections at Swanscombe were opened a few days before the visit and then camouflaged with prickly brush from vegetation clearance. This was removed just before the visit. As is standard practice in managing the Swanscombe Skull Site

National Nature Reserve, all the sections were backfilled after the visit. There are plans, however, for a visit to sections here in summer 2015.



**ABOVE**, a small proportion of the Day 3 party inspected the sections in Lower Loam and Lower Gravel in the edges of the 1960s–1970s Waechter excavations. This area is criss-crossed by paths used by off-road cyclists and motorbikers, causing damage to the resource.

**LEFT**, a section in the Upper Middle Gravel shows the cross-bedded sand that makes up the majority of that unit; its basal gravelly layer was the source of the human skull fragments. The holes visible in the section (ringed yellow) had been excavated the previous day to collect material for Electron Spin Resonance dating for processing in France, demonstrating the level of international interest and collaboration that the Swanscombe site engenders.



### Baker's Hole SSSI & Scheduled Ancient Monument

**BELOW**, The excursion party inspected one of the surviving sediment remnants that form the Baker's Hole SSSI, which is only around 100 m from Ebbsfleet International Station. These sediment remnants, surrounded by landfill, have been de-vegetated, and are now being surveyed by the University of Southampton. They are thin and vulnerable, having little or no soil cover. Their long-term conservation is thus an issue of concern, but is part of ongoing discussions between Natural England, English Heritage and the landowner, Lafarge Tarmac.





## GSL acts to curtail unethical sampling

**Rob Butler, Geological Society of London Geoconservation Committee**

Readers of *Earth Heritage* will be aware of some of the appalling geo-vandalism caused by indiscriminate rock coring in some of our really important geological sites, especially around Scotland.

Rock coring is a specialist sampling technique used exclusively by research scientists. Although rock magnetists are the chief exponents, the method is also used by geochemists and rock physicists who decide to sample smooth rock exposures. You'd think that appeals to members of these communities who act irresponsibly would yield results – and most researchers are indeed highly responsible. But a few are not – even following the devastations of outcrops such as the minor intrusions on Ardnamurchan. The catch is, some of these groups are based overseas. In some cases, when confronted, the more brazen will argue that their science is more important than conservation. But this is an ethical issue – and never, not even in medical science where it is a matter of life and death, does the scientific benefit trump ethical considerations.

We are making real efforts to change the minority bad behaviour within Earth science. In the past few months the Geological Society of London has incorporated statements on appropriate rock sampling into its Publications Code of Ethics. This is broader than just rock coring. Authors have to confirm that all samples used in a submitted article have been collected ethically, wherever in the world, and peer-reviewers should assess whether this is so. Of course it requires honourable behaviour. But given the reputational damage caused to scientists who don't live up to other ethical standards (plagiarism, parallel publication, falsification of results etc.), not to mention the attitudes of their employers and the funders of the research, the risks of false declarations will hopefully outweigh any perceived benefits. Other publishers are considering adopting similar codes. Let's hope a unified approach can be in place very quickly.

Of course this is not to say that all rock sampling, or even coring, is unethical. It can be done sensitively – that is, it should be invisible to casual visitors to the sites – an approach advised in the Scottish Core Code ([tinyurl.com/kyerp96](http://tinyurl.com/kyerp96)). Samples for geochemical study have been collected of course from national archaeological monuments – even Stonehenge. But not by drilling holes in the middle of the most obvious faces! We should demand the same duty of care for all outcrops, within SSSIs or not. All research sampling should have the written permission of landowners and, if required, the statutory bodies charged with protecting our most important sites. Working together, perhaps we Earth scientists can finally get our house in order.

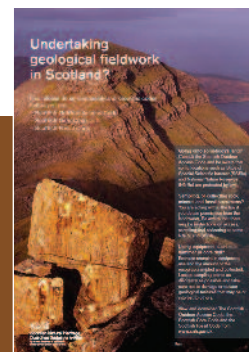


One of the casualties of the 2014 rock coring campaign in North West Scotland, the classic outcrop of the sub-Torridonian unconformity in Assynt. This is one of the most visited outcrops in Britain, in the heart of the NW Highlands Geopark, and one of the 100 Great Geosites listed by the Geological Society. Although not within a notified SSSI, it is on land owned by the John Muir Trust, one of the world's foremost conservation landowners. Vandalism like this, in the name of research, causes serious reputational damage to the science of geology in general. *Photo by Rob Butler*

### Posters flag up good-behaviour expectations

Early in 2014, Scottish Natural Heritage (SNH) staff on Rum National Nature Reserve, were alerted to plans by a geoscience researcher from abroad, to post home tens of kilograms of rock samples. Fair enough, laboratory investigation of rock samples is a key element of geoscience research. However, the incident highlighted the worrying issue that geoscience researchers undertaking fieldwork in the UK can be unaware that certain procedures concerning access to sites and removal of samples must be followed and that best-practice codes should be observed. As a result, SNH has produced seven posters setting out the Codes that apply to researchers accessing land in various parts of Scotland for geoscience fieldwork. The posters will be available for download from the SNH website, with printed versions available to university geoscience departments. Efforts will also be made to display the posters in hostels and other venues accommodating fieldworkers. Spreading the message will remain challenging.

*Colin MacFadyen, Scottish Natural Heritage*



# Fossil smash and grab: bad news and good...

Colin MacFadyen, Scottish Natural Heritage

**I**n June 2014, the internationally significant stromatolite fossil bed at Yesnaby on Mainland Orkney, was subjected to reckless collecting. With disregard for the Scottish Fossil Code, collectors damaged several square metres of rock in an effort to extract slabs and smaller specimens. Hand tools were used, with some of the fossil material being removed from the site. The incident was reported to the police, who investigated. In an effort to prevent further instances of damage to, and theft from, the site a sign will be installed near the stromatolite exposure.

*Earth Heritage* issue 36 reported reckless collecting that took place a few years ago at South Threave Site of Special Scientific Interest (SSSI) in Ayrshire, when the geological feature of the SSSI was partially destroyed, ostensibly for scientific gain. Instead of clearing debris from historic sections to reveal exposure, tonnes of fresh rock were excavated in an apparent fossil hunt, with the removal of trilobite and other material from the site. This took place without permission from the landowner or regard for the Scottish Fossil Code. The good news is that over three years after the incident, SNH was able to track down the fossils and they were returned to Scotland in October 2014 from a university in the USA. It is hoped the owner will agree to donate the scientifically useful material to an accredited museum in Scotland.

Police involvement in these cases underscores that reckless damage to fossil localities is taken seriously in Scotland. On Skye, where industrial-scale collecting was an issue in 2012, the resulting police investigation appears to be deterring reckless collecting.

The publicity surrounding these events will act as a reminder that when collecting fossil material in Scotland, the Scottish Fossil Code applies and that reckless damage may result in prosecution. However, the dearly held aspiration remains, that whilst efforts are made to deter criminal activity, responsible collecting will continue with all the benefits and rewards that can have for science, education and recreational collection.



The stromatolite bed at Yesnaby within the Stromness Heaths & Coast Site of Special Scientific Interest, illustrating one of the areas targeted by collectors. Hand-held tools including a hammer with a pick point and a chisel have been used to extract about a tonne in total of stromatolite-bearing rock with a large proportion of the material having been smashed up and discarded.

*Photo by Colin MacFadyen,  
Scottish Natural Heritage*



# Island poses a multi-interest conservation challenge

Colin MacFadyen, Scottish Natural Heritage

**T**he extermination of rats from Ailsa Craig in the Firth of Clyde and the recovery of the ground-nesting seabird populations have made it an outstanding international exemplar in bird colony management and restoration. However, this success may have unintended implications for geodiversity and other features of interest.

Ailsa Craig lies in the Clyde estuary 20 km south of Arran off the Ayrshire coast and is a Site of Special Scientific Interest for both biological and geological features and a European Special Protection Area for breeding seabirds. From the summit of this 339 m conical island there are spectacular views, on a clear day to the south and south-west the Isle of Man and Ireland, to the north-west, Jura.

The island is composed of the internationally famous Ailsa Craig microgranite and forms part of the Hebridean Igneous Province. It is a boss of rock that was intruded around 60 million years ago into Triassic sediments and has an unusual and distinctive peralkaline composition. The microgranite shows remarkable heterogeneity with grey, bluish and even pink varieties in evidence. Its unusual mineralogy is defined by riebeckitic arfvedsonite, which gives the rock a distinctive speckled appearance. As well as providing an unusual contribution to the Hebridean Igneous Province, the rock has helped elucidate the movement of ice sheets during glaciation, with the discovery of erratics from Ailsa Craig found in Cumbria, the Isle of Man and Wales. Two quarries on the island provide excellent, albeit limited, opportunities to sample fresh rock and relatively clear faces for scientific examination.

### Source of curling stones

Recognised as one of the largest gannet colonies in Britain, arguably Ailsa Craig is better known as the source of rock used in curling stones by an Ayrshire company for an international market. Currently stone – in the forms of loose blocks dislodged by blasting in the last century – is removed from the two quarries in batches, with considerable periods elapsing between each visit. Agreements are in place to ensure stone removal is undertaken in a manner and at a time that has minimum impact upon the bird population. The island's stone quarry industrial heritage dates back to the 19<sup>th</sup> Century. The quarrymen's cottages and a narrow-gauge tramway to transport the rock to a jetty, dating from this period, are still in evidence. The island also boasts a 16<sup>th</sup> Century castle and a late 19<sup>th</sup> Century lighthouse complete with gas-powered fog sirens, now silent.



The rocky faces of Ailsa Craig composed of columnar-jointed microgranite provide ideal nesting sites for thousands of breeding seabirds. Gannets represent most of the birds in this field of view.

The quarried area in the north-east of Ailsa Craig provides a variety of the microgranite known as Blue Hone, utilised to manufacture the cores of curling stones. The Blue Hone comes into direct contact with the ice on the curling rink. Highlighted on the right of the image is one of the now redundant 7 m-high gas-powered fog sirens.



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# CONSERVATION PRINCIPLES

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All of these features have value as cultural, industrial heritage and aesthetic assets, together providing tourism potential.

In the late 19<sup>th</sup> Century the brown rat was accidentally introduced to the island. The rats killed and ate young puffins, ultimately eliminating the island's puffin breeding population, and they preyed upon the young of other species such as fulmar and gulls. It took five tonnes of Warfarin rodenticide in the early 1990s to eradicate the rats, and seabirds have since made a welcome comeback. However, a monitoring visit to Ailsa Craig in summer 2014 to establish the impact of recent stone removal, revealed a rather challenging conservation issue. With the eradication of the rats, it is clear that the disturbed ground and spoil heaps in the quarries are becoming nesting grounds for seabirds such as fulmars and gulls, and burrow-nesting bird species such as puffin and manx shearwater.

## Geoconservation concern

The geoconservation concern is that as the quarries become increasingly regarded as established seabird breeding grounds, those tiny areas that provide access to relatively fresh faces of rare rock to provide insights into the origin and formation of the microgranite, may gradually become out of bounds. There are also the health and safety issues of undertaking geological research in a nesting location.

It is hoped that when discussions take place on the longer-term management of the island an holistic approach will ensure that the other interests on the island, namely the mediaeval castle; the industrial archaeological heritage; the lighthouse infrastructure; the source of raw material for curling stones and geoscience research are all carefully considered and catered for alongside those of the seabirds.

**The puffin is an unmistakable bird that is one of the world's favourites. These hardy little migrants can travel thousands of miles to breed on coastal cliffs and on offshore islands such as Ailsa Craig, burrowing or utilising hollows and crevices in the ground to nest.**

*All photos by Colin MacFadyen, Scottish Natural Heritage, except puffins, Matthias Meckel CC-BY-SA-3.0*



**One aspect of the industrial archaeological features of interest on the island is the pile of quarried microgranite from which cylinders of rock for manufacturing curling stones have been cut.**

**Below, the narrow-gauge tramway that transported quarried microgranite to the jetty near the island's lighthouse. The track is a significant element of Ailsa Craig's industrial heritage.**





## A valuable Europe-wide summary

Cynthia Burek, University of Chester

*Geoheritage in Europe and its conservation* (2012), W.A.P Wimbledon, S. Meyer-Smith (Eds), ProGEO, 405 pp. Hardback. € 40.00, ISBN 9788242624765

**T**here are few books specifically on Geoconservation. *The History of Geoconservation* by Burek and Prosser, published by the Geological Society in 2010, is one that springs to mind, and this publication is a welcome addition. It is a snapshot in time (2011-12) of geoconservation across 37 countries in Europe. It places the UK within a European context and is therefore a first. It is in full colour and very reasonably priced.

The ProGEO (the European Association for the Conservation of Geological Heritage) book was the brainchild of Gerard Gonggrijp from The Netherlands in 1990 and has taken years to come to fruition. Its publication is a tribute to the perseverance of ProGEO and the editors in collating information from many different regimes, in different languages and under different political systems.

The preface, written by a former president of ProGEO, is thought provoking and in some cases critical of the efforts of people, governments and institutions. He points to four prerequisites for successful geoheritage survival:

- Identification of each country's nationally valuable areas (*i.e.* a geodiversity inventory)
- Recognition/acceptance of the responsibility to protect these (*i.e.* geoconservation) by both the government and the national conservation agency
- Active conservation and monitoring of sites (*i.e.* geodiversity management)
- Using the geosite (geodiversity) resource sustainably and appropriately

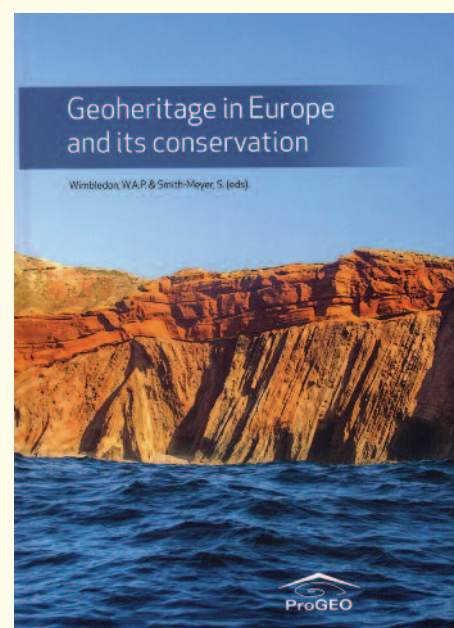
While the prerequisites don't refer to geodiversity, I have inserted it since the conditions can be applied more widely than geosites.

The protocol section – Conserving our shared Geoheritage – deals with geoconservation principles, sustainable site use, management of fieldwork, and fossil and mineral collecting. It covers policies for sustainable management and geosite use. Definitions of geoheritage, geoconservation, geosite, geopark and geodiversity follow, but there are no references to where they come from and they would have been useful.

Each country receives a full-colour frontispiece of an iconic piece of its landscape: a taste of its geodiversity. However this word is neither defined in the introduction nor discussed by the editors. A missed opportunity. Individual chapters follow a uniform pattern detailing the background to the geodiversity. If we look at Austria we find an introduction followed by a section dedicated to protection and then on management followed by education and tourism. The conclusion highlights the importance of tourism to the economy and states that the word geotourism is not known, although geoparks are recognised. References follow for further reading with contact details. However a holistic list of references at the end for further wider reading such as the book first edition at that time by Murray Gray is missing (Gray 2004; 2<sup>nd</sup> edition 2013). Another big omission is an index.

The chapter on the UK is unfortunately now severely out of date as events move forward, but it is a valuable snapshot in time. A detailed history and discussion is made of the Geological Conservation Review, including reference to statutory Sites of Special Scientific Interest and Northern Ireland's ASSIs as well as the non-statutory Regionally Important Geodiversity Sites (now called Local Geological Sites, except in Wales). World Heritage Sites and Global Geoparks are mentioned. However the Scottish and English Geodiversity forums are omitted although they were ongoing at the time and there is no mention of the UKGAP. These are national initiatives and should have been part of the UK story.

To summarise, this book is a valiant attempt to bring together a wealth of information in English. It lacks the useful key features of index and holistic reference list. However, this is definitely a book to dip into, and published at an affordable price.



***"This book is a valiant attempt to bring together a wealth of information in English"***

Cynthia Burek  
[c.burek@chester.ac.uk](mailto:c.burek@chester.ac.uk)

# Curry Fund boosts Jurassic Coast

Chris Green, Geologists' Association

**T**he Jurassic Coast of Dorset and East Devon was designated as a World Heritage Site in 2001, reflecting a long history of geological enquiry along the 155 km of coast between Exmouth and Old Harry Rocks near Swanage. At the heart of the Jurassic Coast is Lyme Regis, famously associated with the fossil collector Mary Anning, and field excursions to this coast were among the earliest organised by the Geologists' Association – to Weymouth and Portland in 1879 and to Weymouth and Lyme Regis in 1889. It is hardly surprising therefore that when the Curry Fund was established in 1986, it was soon involved in the funding of geological enquiry and conservation in this part of the West Country.

The first grant was in 1989 to the Dorset County Museum in Dorchester for £350 towards a tarpaulin to protect dinosaur footprints prior to their conservation. Since then the Curry Fund has made nearly 40 grants totalling more than £30,000 to groups active within the World Heritage Site.

More than a third of this funding has gone towards the acquisition, conservation and display of fossil specimens, for which the Jurassic Coast is justly famous – a plesiosaur acquired by the Dorset County Museum and the conservation there of an ichthyosaur, and, recently, the modelling of a spectacular life-size head of a plesiosaur. The Fund has also made grants for the display of fossils at the Charmouth Heritage Coast Centre and in museums at Beaminster and Sherborne Castle. As well as supporting the care of fossils, the Fund has helped the Museum of Jurassic Marine Life at Kimmeridge with the preparation of a catalogue of the Etches Collection of over 2,000 specimens from the Kimmeridge Clay.

## Generous support for Lyme Regis

Before the establishment of the World Heritage Site, but now even more so, the promotion of interest in geology has been actively developed by local councils, museums and amateur groups and all of them at one time or another have turned to the Curry Fund for financial support. Weymouth and Portland District Council received a grant in 1995 towards developing the Chesil Beach Centre and when the Dorset County Museum mounted an exhibition celebrating the life of Mary Anning, it was supported by the Fund. Unsurprisingly, Lyme Regis, the home of Mary Anning, has a lively interest in geology.



The Curry Fund has helped the Museum of Jurassic Marine Life at Kimmeridge with the preparation of a catalogue of the Etches Collection of over 2,000 specimens from the Kimmeridge Clay. This is a fossil ray from the Collection.

*All photos by Alan Holiday*



Visitors to Portesham Quarry benefit from an explanation of what they are looking at, thanks to an interpretation board part-funded by the Curry Fund.

*Continued on following page*



# FUNDING

## *From previous page*

The Curry Fund has been generous in supporting the Lyme Regis Development Trust, making grants towards the cost of its very popular annual Fossil Festival and, behind the scenes, towards the setting up of the Festival's website. The Friends of Lyme Regis Museum also had a grant to assist with the creation of a website and with the acquisition of a computer.

The Charmouth Heritage Coast Centre is another 'hands-on' group that the Curry Fund has been happy to support with grants for an interpretative board, towards the preparation of a CD and for the purchase of microscopes. DIGS, the Dorset's Important Geological Sites Group has also had funding for an interpretative board – at Portesham Quarry. DIGS began as the Dorset Regionally Important Geological Sites Group in 1993 when RIGS groups were first being established. The Curry Fund provided 'start-up' grants to many of these groups including Dorset, and has provided further support for the publication of the group's guide to the geology of the Poxwell Anticline. It also supported the publication by the Dorset Environmental Records Centre of a couple of geological leaflets, listing Dorset RIGS and describing the Minerals of Dorset.

Support for geological publication is one of the main aims of the Curry Fund and support has been given generously to the Geologists' Association itself and to its local groups. The Dorset Local Group has received funding for several field guides including a bilingual guide prepared for a visit to Dorset by French geologists; and the GA itself has twice looked to the Curry Fund to cover the cost of publishing that perennial best-seller, the Dorset Guide.



Curry Fund support has been given to a publication on the Poxwell Anticline (above) and for the conservation of dinosaur footprints, a magnet for geologists on the Isle of Purbeck (below).





# Geopark aims for new income

**Mike Goodwin, North West Highlands Geopark**

**N**orth West Highlands Geopark spans 2,000 km<sup>2</sup> in the remote north-west corner of Scotland and is home to just 2,000 people. Beginning at The Summer Isles in Wester Ross, near Ullapool, the area encompasses mountains, peat-land, beach, forest and coastline across west Sutherland and on to the north coast beyond the settlement of Durness and Loch Eriboll. The eastern boundary of the Geopark follows the Moine Thrust Zone, an internationally significant geological structure that helped 19<sup>th</sup> Century geologists work out how the world's great mountain ranges were formed.

Having recently been voted the UK's favourite landscape in a public poll organised by the Geological Society of London (see page 14) its assets are well known among those interested in geology. The challenge for this Geopark is to broaden the appeal of the spectacular landscape to help bring prosperity to the area.

Geoparks are set up and managed by local communities and there are more than 150 geoparks worldwide. Every community is different but they share a common aim – to tell the story of the local landscape and make it accessible to visitors. This helps draw resources into sensitive rural areas, creating jobs and supporting small businesses. North West Highlands Geopark was set up by the five community councils. It seeks to encourage adventures for everyone to help people connect with the land and feel responsible for maintaining its beauty, wildlife and resources.

The geopark team has developed a social enterprise model to establish financial security for the future, building revenue streams from advertising and sponsorship to complement grants and funding from more traditional sources. At the core of the geopark is the concept 'Explore Deep Time', a tribute to James Hutton, the father of modern geology. An exciting new geo-centre exhibition opens early in 2015 to complement a range of geo-routes (see page 16), geo-tours, geo-pods and geo-adventures aimed at engaging all ages and a wide range of interests in the science, nature and history of the landscape.

The new geo-centre sited at Unapool commands spectacular views over Loch Glencoul. Sited on the main north-south road through the geopark, it is perfectly located for those exploring the rock route, a driving trail established by Scottish Natural Heritage to link key sites. The geo-centre will house a café, a shop and an exhibition telling the story of the landscape using educational tools spanning two centuries with mechanical mountain-building machines from the 19<sup>th</sup> Century to a 21<sup>st</sup> Century 3D computer model of the Assynt geology. As a hub for the geopark team, the geo-centre will promote guided and self-guided tours.

A conventional approach to securing funding for projects such as these has been one-off grants or social responsibility budgets of corporate sponsors. North West Highlands Geopark believes however that the area's unique qualities command a value which corporations will seek to secure for their brands. The Geopark will develop opportunities for advertising and sponsorship of geo-themed events and festivals. Initial feedback for this business-focussed model for a geopark has been very encouraging.

More information on the North West Highlands Geopark at [www.nwhgeopark.com](http://www.nwhgeopark.com)



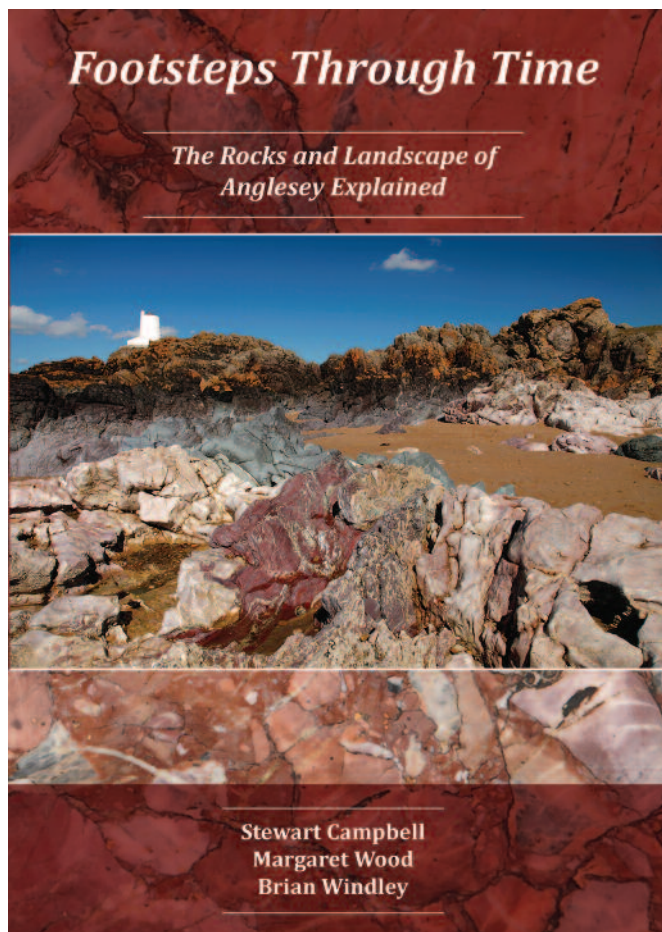
The view from Unapool across Loch Glencoul to the Stack of Glencoul is impressive both for its beauty and its international importance as a geo-site where the Moine Thrust is exposed.

*Photo by  
Lorne Gill, Scottish Natural Heritage*

*Mike Goodwin, Marketing Manager,  
North West Highlands Geopark  
[mike@nwhgeopark.com](mailto:mike@nwhgeopark.com)*



# Insights into Anglesey geology



Campbell, S., Wood, M. & Windley, B.F. (2014). *Footsteps Through Time. The Rocks and Landscape of Anglesey Explained*. GeoMôn, Isle of Anglesey County Council, 193pp.

*Footsteps Through Time – The Rocks and Landscape of Anglesey Explained* has been written to stimulate interest in the island's geology and to help visitors and inhabitants alike understand how the vast array of different rocks types was assembled over a billion-year time span. The book provides essential background information and context for geoboards and trails that have been developed by the GeoMôn geopark and its partners over the last four years (see *Earth Heritage Issues* 41 & 42). For those who will find difficulty in visiting the geosites and seeing the geoboards, the photographs and explanatory text in the book provide an alternative 'virtual' study tour. A pdf version in Welsh will be available from the GeoMôn website [www.geomon.co.uk](http://www.geomon.co.uk).

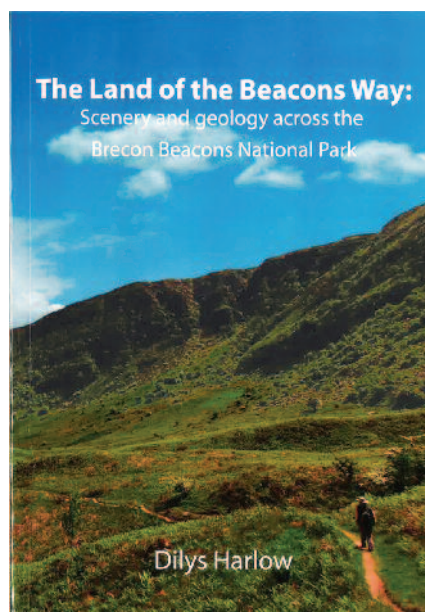
The book opens with an introduction to 'Planet Earth and the Wandering Continents'. It describes the global plate tectonic forces that have shaped the island's geology and introduces the concept of 'accretionary prisms' and 'ocean plate stratigraphy', which underpins

the book's early chapters. Chapters 2-8 describe the island's rocks chronologically, starting with the Precambrian and ending with an overview of Anglesey's Quaternary history and geomorphology. The geological highlights of each period are profusely illustrated with some 400 photographs and many chapters contain trails developed to showcase the best geology and associated cultural and archaeological features.

For more information, visit the Anglesey geopark website [www.geomon.co.uk](http://www.geomon.co.uk).



Right, intensely folded Cambrian rocks on Holy Island, one of the iconic geological sites featured in *Footsteps Through Time*.  
Photo by Stewart Campbell



## Lighting up the Beacons

*The Land of the Beacons Way* is a new, fully illustrated, 124-page book describing the landscape and geology across the Brecon Beacons National Park as seen from the Beacons Way, a long-distance walking route from Ysgyryd Fawr in the east to Bethlehem in the west.

Priced at £7.95, it is available from the Geologists' Association South Wales Group, Department of Geology, National Museum of Wales, Cardiff CF10 3NP. Cheques should be made payable to the Geologists' Association South Wales Group. More details at [www.swga.org.uk/pubs.html](http://www.swga.org.uk/pubs.html)



**Earth Heritage** magazine promotes geological and landscape conservation.

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or order a printed version – see below.



The dramatic peaks which form Quinag in the North West Highlands Geopark are typical of Assynt, recently voted the UK's favourite landscape in a poll organised by the Geological Society of London. The Geopark is optimistic that it can use the spectacular vistas to persuade major companies to part with some of their promotional budgets in order to affiliate their brands to the scenery. See page 34.

*Photo by Iain Sarjeant,  
The Sutherland Partnership*

### *Earth Heritage in print*

If you prefer to read *Earth Heritage* on paper, you can order this publication as a full-colour, laser-printed A4 hard copy via [www.earthheritage.org.uk](http://www.earthheritage.org.uk). Clicking on the Print link will take you to the ordering and payment facility provided by the Geologists' Association.

*Issue 43* or any back issue\* displayed on the website can be ordered online with individual copies and delivery costing £7.00, payable (online) to the Geologists' Association. There is a discount for GA members.

\* Early issues may not be reproduced in print to the standard of more recent ones, because production technology has improved over time.

