

# Earth Heritage

The Geological and Landscape Conservation Magazine

**Rum rocks for  
Mars mission**



**Celebrating  
Cumbria's  
Geodiversity**

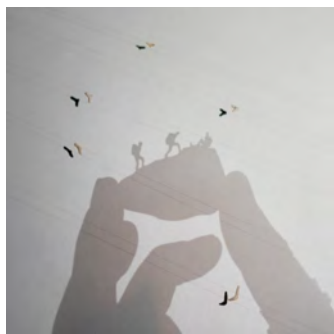
**ISSUE**  
**60**  
**Winter 2024**

**"Balancing Act"  
by Simon Armitage**

**Art Meets  
Palaeontology**



**11th International  
ProGEO  
Symposium**



Cover: A still image from the shadow puppetry, stop-frame animation, film Projections by Mary Grieve. Mary's projection animation is inspired by fieldwork, undertaken for palaeontological research, taking place on Skye. Find out more in the article on p.38.

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## EDITORS

**HANNAH TOWNLEY,**  
Natural England  
07780 688242  
[Hannah.Townley@naturalengland.org.uk](mailto:Hannah.Townley@naturalengland.org.uk)

**COLIN MACFADYEN,**  
NatureScot  
0131 316 2616  
[colin.macfadyen@nature.scot](mailto:colin.macfadyen@nature.scot)

**RAYMOND ROBERTS,**  
Natural Resources Wales  
0300 065 3896  
[raymond.roberts@cyfoethnaturiolcymru.gov.uk](mailto:raymond.roberts@cyfoethnaturiolcymru.gov.uk)

**DAVID BRIDGLAND,**  
Geologists' Association and Durham University  
[d.r.bridgland@durham.ac.uk](mailto:d.r.bridgland@durham.ac.uk)

**MICK STANLEY,**  
Geodiversity Consulting  
07747 863847  
[mick.stanley1@btinternet.com](mailto:mick.stanley1@btinternet.com)

**JULIE HARRALD,**  
The Geology Trusts & English Geodiversity Forum  
01509 558211  
[julieharrald@googlemail.com](mailto:julieharrald@googlemail.com)

**MICHAEL DEMPSTER**  
Quaternary Research Association  
[conservation@qra.org.uk](mailto:conservation@qra.org.uk)

**BARBARA SILVA**  
Production & Design  
07974 711525  
[bsilva.palaeo@gmail.com](mailto:bsilva.palaeo@gmail.com)

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## EDITORIAL

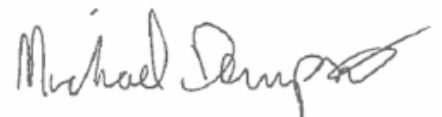
This issue of Earth Heritage is nothing if not wide ranging, covering as it does geology and landscapes the length of Britain all the way to Mars! To find out how the island of Rum will help us understand the 'Red Planet' see the article on pages 20-23 by Dr. Lydia Hallis of Glasgow University.

Moving back to Earth, we have an overview of the refreshed Scottish Fossil Code, news on a citizen science project for geosites in Scotland, and an article on a project that connects art and science through the palaeontology of Skye (our cover story). Bridging art and science could be described as a 'Balancing Act', which happens to be the title of Poet Laureate Simon Armitage's poem inspired by Brimham Rocks SSSI in north Yorkshire (pages 42-43).

Elsewhere in this issue we have reports on the 11<sup>th</sup> International ProGeo Symposium hosted by Charnwood Forest Aspiring UNESCO Global Geopark, England's new 'Super National Nature Reserve', putting geodiversity into the heart of protected landscapes in Cumbria and the new Building Stones Database for England.

We also have an obituary for Mike Harley. Mike was not only instrumental in shaping Earth Heritage magazine into its current form, but also crucially led in establishing the RIGS initiative. He is sadly missed by family, friends and colleagues.

The Earth Heritage Editorial Board has started to plan Issue 61 and will be happy to feature articles about both new and ongoing geological and landscape conservation projects. To contribute, please contact the most appropriate editor (list on left).



**Michael Dempster, Editor**

## Revalidation mission for the Black Country UNESCO Global Geopark

19<sup>th</sup> - 22<sup>nd</sup> July 2023, saw the first revalidation of the Black Country UNESCO Global Geopark take place with two re-validators, Helga Chulepin from Uruguay, and Gloria Garcia from Spain, enjoying a four-day tour of the Black Country's rich geoheritage, cultural heritage and wildlife. Although only designated in July 2020 and with Covid restrictions in full swing, there were plenty of projects to see, partners to meet and local volunteers to hear from. The urban character of this Geopark is always a surprise to first time visitors but the strong links between the area's geoheritage, industrial heritage, remaining greenspace and local communities immediately shone through. So too did the enthusiasm of the staff from the four Black Country local authorities, Canal and River Trust, Dudley Canal Trust, RSPB and Natural England amongst many partners who they

met. In particular, the commitment and knowledge of local volunteers who maintained and promoted many of the geosites impressed Helga and Gloria.

Of course, the primary aim of the revalidation is to assess whether Geopark work plans are being delivered, quality standards are being met, governance is in place and local communities are aware of, engaged with, and benefitting from the Geopark. The four-day mission included visits to the Geopark Headquarters, Wren's Nest and Saltwells geological NNRs, the Purple Horizons Nature Recovery Project, Walsall Arboretum, a canal boat trip into the underground limestone caverns, tea with the local mayors, and meetings to explore progress, challenges, and future opportunities.

The subsequent re-validators' report was extremely positive and informative, and the signs are that the Black Country will retain UNESCO Global Geopark status for the next four years, subject to ratification by UNESCO when they meet in Spring 2024.

There are currently 195 UNESCO Global Geoparks in 48 countries across the world, including nine in the UK.

**By Colin Prosser, Natural England**



**Above:** The revalidation mission takes a trip on a canal boat into the tunnels under Castle Hill. Photo by Colin Prosser

**Right:** The revalidation mission visits Doulton's Claypit SSSI (important for its Carboniferous strata) within Saltwells NNR. © Dudley MBC



# Alan Stubbs awarded MBE

The founder of nature conservation group Buglife, Alan Stubbs, has been awarded an MBE in the King's Birthday Honours List for his services to nature conservation.

Alan graduated from University College London with a BSc Geology in 1962 and then spent his entire working life and retirement in conservation. He started his career in geological conservation, joining the Nature Conservancy in their London office in 1962. Working under George Black, Head of Geology and Physiography, Alan spent thirteen years conserving, enhancing and promoting geological and geomorphological SSSIs, rising to Deputy Head of Geology and Physiography in the process. In 1975, taking advantage of the recruitment of some additional geological resource into the NCC, Alan took

the opportunity to follow another passion and joined the newly formed Chief Scientist's Team of the Nature Conservancy Council to develop the first invertebrate conservation policy for Britain.

Following early retirement, Alan became increasingly involved in invertebrate conservation, leading to the formation of the Invertebrate Conservation Trust in 2000, which was renamed Buglife in 2002. Alan was Chairman of Buglife from the mid 2000s until 2012. He helped Buglife expand to its current position by influencing policy and legislation, raising the profile of invertebrates and developing projects to raise the impact of the organisation. He is currently one of Buglife's Vice Presidents and acts as a volunteer offering training and support on invertebrate conservation.

By Hannah Townley, Natural England



<https://www.buglife.org.uk/>

Alan Stubbs (to the right of the pipe smoker) with colleagues in 1968 on the Jurassic exposures at Thrapston in Northamptonshire. © Natural England



# Whin wins!

Northumberland becomes the first British county to have a County Rock and a County Fossil, as voted by the general public.

The public's favourite rock is *dolerite*, the Whin Sill, the iconic rock that is the bedrock of the most dramatic and famous Northumberland locations: Hadrian's Wall, Bamburgh Castle and the Farne Islands. The 295-million-year-old dolerite of the Whin Sill came far ahead of the other candidate rocks: coal, sandstone, limestone and granite.

The County Fossil people voted for is the *crinoids*. You can find their remains all over the county, but especially at the coast. A relative of modern star fish and sea urchins, crinoids lived in warm coral seas 320 million years ago when Northumberland was close to the Equator.

Crinoids did very well to beat the predicted favourite: *Anthracosaurus*, or the coal lizard, a vicious swamp dwelling predator, and the other fossil contenders

of ancient trees, corals and sea shells, found in the rocks across the county.

Mike Pratt, Chief Executive of Northumberland Wildlife Trust, who organised the vote with The Natural History Society of Northumbria, Visit Northumberland, Northumberland and Newcastle Society and North Eastern Geological Society, said:

*"Rocks and fossils are a great way of engaging people, of getting them out in the countryside to enjoy and experience nature and the landscape. Ultimately, we believe that the more people really connect with nature, the more they'll act to protect it".*

If you want to see dolerite, the new Northumberland County Rock, head to Hadrian's Wall anywhere between Walltown and Limestone Corner. For the County Fossil, go to the coast, anywhere from Howick to Berwick, where you'll find crinoids in the limestone rocks on the foreshore.

**By Hannah Townley, Natural England**



**Above:** Whin Sill escarpment at Sycamore Gap, before the tree was felled.

**Right:** Crinoid fossil at the beach near Scremerston, to the south of Berwick-upon-Tweed, Northumberland

Photos by Ian Jackson



# Putting Scotland's Geosites on the Map

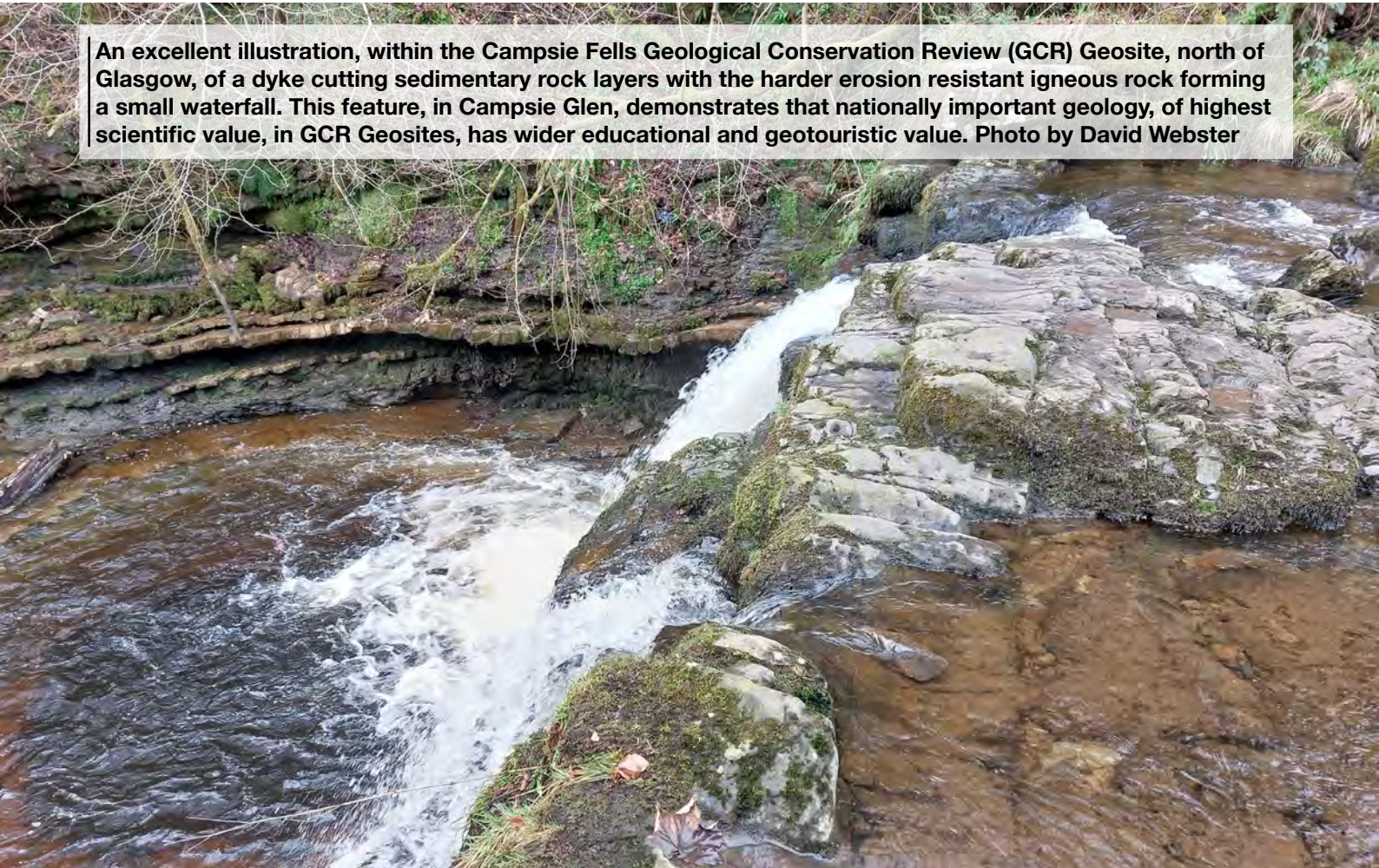
The Scottish Geology Trust's Geosites project was launched in June 2023. This ambitious new initiative intends to gather together and present data about all of Scotland's best and most representative Geosites. By creating an interactive, online, map this bold project will make it very much easier for anyone to identify, learn about and visit Geosites. So far the project has involved the services of almost 30 volunteers, who have visited over 100 Geological Conservation Review (GCR) Geosites. As work progresses, the project website <https://geosites.scottishgeologytrust.org/> is already developing rapidly into an incredibly useful resource.

We intend to develop this project further over the coming years, creating a one-stop portal for finding out about all of Scotland's Geosites. Users of the online resource will be able to access sources of information about each Geosite including overviews and further details published in the Geological Conservation Review volumes and papers. People will also be able to find information about access, the best spots to visit and view recent photographs.

As well as realising and promoting the educational and touristic value of Scotland's Geosites, raising awareness of them will help secure support for their conservation. Additional conservation value stems from users of the interactive map being able to report any damage or deteriorating conditions they may come across and contribute their own reports to the portal. Several sites have already been reported as overgrown and difficult to access. However, it is heartening that thus far we have discovered no significant concerns from the geoconservation perspective.

The Trust would sincerely wish to get more people involved, as even if you aren't able to visit sites there is still a lot of desk-work to be undertaken. The Trust is also grateful for funding received to support this project from the Curry Fund of the Geologists' Association along with three smaller grants from other organisations. Please contact Angus Miller at [angus@scottishgeologytrust.org](mailto:angus@scottishgeologytrust.org) for further information on this exciting project and to get involved.

**By Angus Miller, Development Officer,  
Scottish Geology Trust**



**An excellent illustration, within the Campsie Fells Geological Conservation Review (GCR) Geosite, north of Glasgow, of a dyke cutting sedimentary rock layers with the harder erosion resistant igneous rock forming a small waterfall. This feature, in Campsie Glen, demonstrates that nationally important geology, of highest scientific value, in GCR Geosites, has wider educational and geotouristic value. Photo by David Webster**

**“Balancing Act”, a poem by the Poet Laureate Simon Armitage, commissioned by the National Trust and carved into Witton Fell Sandstone in celebration of Brimham Rocks, North Yorkshire. Find out more on p.42. Photo by Jonathan Larwood**

And the moor is something again —  
the sky's garden, turfed roof of the hill.  
Of course the horizon is only a trick of the light  
but here it is, rolled out  
and chamfered into the clouds at both sides, a snug fit.  
It's raining now and the paths are streaming or frothing  
or puddled with dark brew but so what:  
away from the manic circuitry of the world  
a person striding this off-grid weather-farm  
is laundered and reset by buffeting winds  
and sudden light; the jumbled mind  
can feel itself grounded, earthed.

Look, a micro-moth  
across the papery so



## Northumberland Rocks and Cumbria Rocks

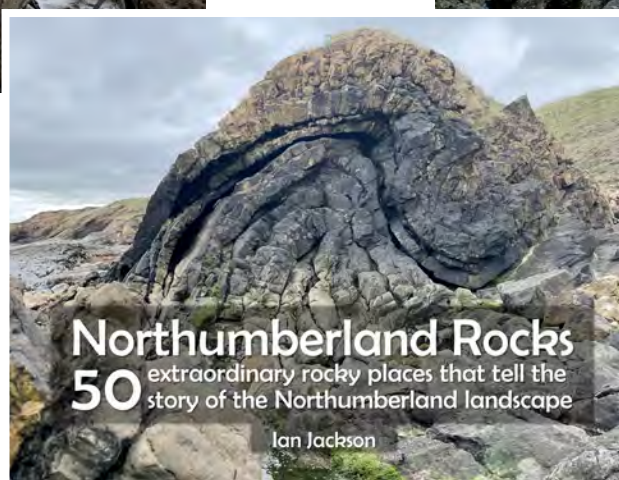
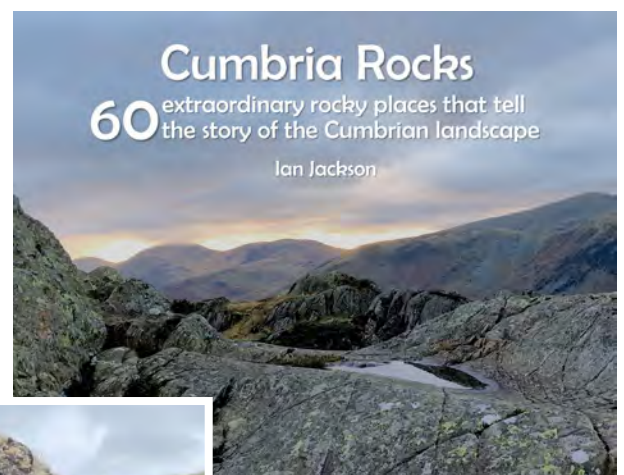
*Northumberland Rocks: 50 Extraordinary Rocky Places That Tell The Story of the Northumberland Landscape.* Ian Jackson. 2021. Northern Heritage Services. ISBN-10: 1916237673

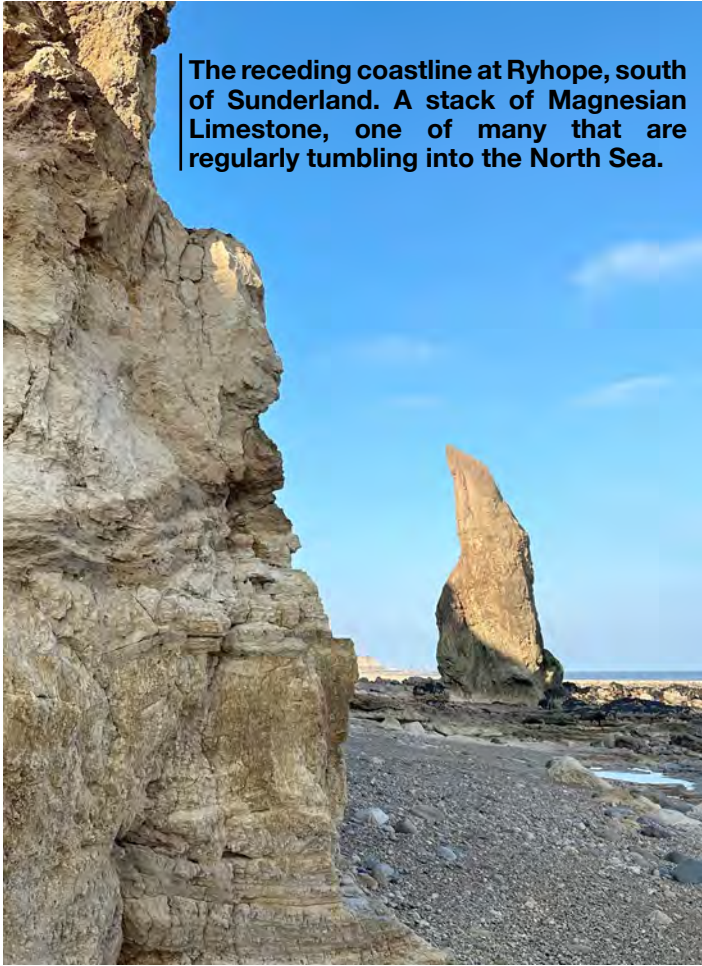
*Cumbria Rocks: 60 extraordinary rocky places that tell the story of the Cumbrian landscape.* Ian Jackson. 2022. Northern Heritage Services. ISBN-10: 91623768

*Durham Rocks - 50 Extraordinary Rocky Places That Tell The Story of the Durham Landscape.* Ian Jackson. 2023. Northern Heritage Services. ISBN-10: 191623769X

Northumberland Rocks and Cumbria Rocks are the first and second books of the Northern Rocks Trilogy, written by Cumbrian geologist Ian Jackson. Ian spent 18 years surveying the geology of parts of northern England for the British Geological Survey who, following retirement, decided to collate a personal selection of rocky places across the counties of Northumberland and Cumbria which tell the story of their landscape, history, heritage, culture, and wildlife. What started as a desire to engage his friends and non-geologist colleagues in the amazing stories that our rocks tell, morphed into a celebration of the 50- and 60-year anniversaries of the Northumberland and Cumbria Wildlife Trusts respectively, before culminating in these two richly illustrated books.

Both books comprise a collection of full colour, full page photographs which open a window into the Northumberland and Cumbria beneath our feet. Each double page is devoted to an individual site and the 110 sites are grouped into five themes based on their geological origins or their role in heritage and mining. Each site is accompanied by two or three short paragraphs which describe the special features of geological interest and how they help to explain the evolution of the landscape throughout Earth's history. The text is clear, jargon-free and is written in a way that is understandable to anyone curious about the geology and landscape. The photos are attractive and usually vary in scale often with one page showing a wide landscape shot and the other more cropped, focussing on the texture, structure, or composition of the rocks. Each site also includes a small map insert from OpenStreetMap, showing the location and





**The receding coastline at Ryhope, south of Sunderland. A stack of Magnesian Limestone, one of many that are regularly tumbling into the North Sea.**

Ordnance Survey grid reference of the geological feature in relation to nearby vehicle parking, making these books inspiring companions for those interested in walking or exploring the sites in person. Whilst the books predominantly focus on more remote geological sites, such as the Ennerdale granophytic microgranite in Cumbria or the concentric agates from the shingle banks of the River Coquet in Northumberland, it is also nice to see that easily accessible urban geology is often acknowledged, such as the red Triassic Sherwood Sandstone of Barrow in Furness Abbey or the famous Carboniferous sandstone ashlar used in the city centre of Newcastle Upon Tyne.

Ian's books are an excellent source of inspiration to get outside, explore some spectacular landscapes, ignite an interest about the rocks beneath our feet and help us understand why they are so important for our past, present, and future. His books also support a good cause, with all proceeds raising funds for the Northumberland and Cumbria Wildlife Trusts. Ian's third and final volume of the trilogy, titled 'Durham Rocks - 50 extraordinary rocky places in County Durham' will be published by Northern Heritage Services Ltd in the coming months.

**All photos by Ian Jackson**

**Jonathan Hall, Natural England**



**Claxheugh Rock, Sunderland. Desert conditions and the transgression of the Zechstein Sea; Permian Yellow Sands overlain by Magnesian Limestone.**



**Pavey Ark above the Langdale Valley in the Lake District. Explosive Ordovician volcanic rocks.**

Simonside, near Rothbury Northumberland. A prominent escarpment formed by the Carboniferous Fell Sandstone. Photo by Ian Jackson



## Preaching beyond the converted

For 38 years I lived in a geo-bubble. My colleagues were 800 geoscientists and other professionals who worked to further our geological mission. The people I met in the course of my job were from a plethora of other organisations that had connections to geoscience too – from scientists of other disciplines to local and central government planners, insurance assessors, or amateur geology groups. Friends from beyond my workplace would have a connection.....although I'm not sure it was always the one they wanted. Then in 2011 I retired from the British Geological Survey and moved back to the north, where I'd worked for many years as a field geologist.

In a few short years my intense connections with the geological and geo-cogniscent world were substantially diluted, partially out of choice; I did other things. I hiked in the Lake District, the Pennines and the Cheviots with friends from diverse (non-geological) backgrounds. I was invited to be a non-exec for three charities, all landscape and environment related, with boards full of professional people, but not a geoscientist amongst them. I trained as a volunteer guide on Hadrian's Wall and met archaeologists and a wonderful range of visitors. I started a small guiding business that took people on landscape walks in Cumbria and Northumberland and, as local organisations realised I was a geologist who understood a bit about their backyard, I increasingly got asked to do talks.

Why am I telling you all this? Because it's the reason for what I did next. It took these last 12 years and those eclectic and often candid contacts with the world beyond the geo-bubble for me to appreciate that most people really don't understand what geology is about and why it matters. And they have a limited appetite for it. That is not to say they are not curious about their landscape and their past. They are, but they don't have our voracious enthusiasm for it. The feedback I got from that extensive, but admittedly un-statistical, sampling was that despite our best efforts, an awful lot of the content we professional and amateur geologists turn out in the name of outreach is still too full of technical language and outfaces them. I probably bear more responsibility for that than most – for 7 years I was BGS Information Director and 'popular publications' were in my charge.

So, in 2021, following a web-based rock festival to celebrate 50 years of Northumberland Wildlife Trust, I decided to convert the content into a book – Northumberland Rocks. That was followed in 2022 by a second one to celebrate 60 years of Cumbria Wildlife Trust. This year will be the third and last of the trilogy – Durham Rocks. They all follow the same format; they are image heavy, text light coffee table books about the story of the landscape of the north of England told through 50 to 60 chosen "rocky" places in each county. About 300 words and two large photos on each place connect the rocks to wildlife, history, economy, and culture. They are written for the public at large, not for geologists, although it is gratifying to see that they are being bought and positively reviewed by them.

For what publishers and booksellers call niche books they have sold well: Northumberland - 3400 copies in 18 months and Cumbria - 1400 in 7 months. People are using the books as inspirations for walks with a purpose. The feedback has been positive, especially about their accessibility. The Cumbria book came runner-up in Lakeland Book of the Year, a literary competition that ranged across fiction and non-fiction. That was reassuring as the books had public accessibility as their prime goal - keeping it short and simple and visually appealing...and ensuring rocks were leavened with topics that, rightly or wrongly, excite public interest more than geology does.

In the words of W B Yeats: *'think like a wise man but communicate in the language of the people'*. Put another way, if we include a glossary in a book we'd like to use to reach out to the wider public with, we shouldn't be disappointed if it doesn't reach its target audience very successfully.

Ian Jackson, Geologist and Author

Cumbria is one of the most geologically diverse areas in Europe, including as it does, an exceptionally wide range of rock types, geological features, and landforms such as the Triassic sandstone cliffs of the St Bees Heritage Coast between Whitehaven and St Bees. Find out more in the article on Cumbria's Geoconservation on p.27. Photo by Stuart Holmes



## 11th International ProGEO Symposium, Charnwood Forest

Hannah Townley, Natural England

The 11th International ProGEO (the International Association for the Conservation of Geological Heritage) Symposium was organised by the Charnwood Forest Aspiring UNESCO Global Geopark and took place in Loughborough from 9th to 11th October 2023.

Over the course of the three days, the symposium was attended by 120 geoheritage and geoconservation scientists, students, educators, and professionals from across the world. The meeting's aims were to promote communication and collaboration amongst attendees and provide a space to discuss new challenges and threats in geological conservation. It was the first face to face symposium since 2018, with the 10<sup>th</sup> symposium being held online in 2021 due to Covid-19 restrictions.

The indoor sessions of the meeting were held at Loughborough Town Hall, which also gave delegates an opportunity to view a temporary art exhibition in the balcony gallery, *First Imprints*, which tells the story of the rise of animal life, as told by the Oxford Printmakers Co-operative. Over the three days 47 talks and 39 posters were presented, split into 11 themed sessions. Talks covered different methods of identifying and evaluating sites; site management, monitoring and protection; the impacts of climate change on geodiversity; geo interpretation; geoparks and geotourism; and immersive experiences of geosites.

The pre-symposium field trip visited several sites in the Black Country UNESCO Global Geopark, including the Silurian limestones found at Saltwells NNR in Dudley. Photo by Colin Prosser






The formal part of the symposium closed with a declaration on geodiversity net gain, followed by dinner and drinks which showcased produce from Charnwood, including local venison, honey, and wine.

Throughout the symposium there were also plenty of opportunities to explore the geology of the Midlands through three field trips. The pre-symposium trip to the West Midlands introduced the geology, mining heritage and palaeontology of the Black Country UNESCO Global Geopark. It explored the Palaeozoic and Mesozoic highlights of the Geopark's geology, including visits to Wren's Nest and Saltwells National Nature Reserves (NNRs), and gave an insight into the area's important role in the Industrial Revolution. The intra-symposium trip to Bradgate Park explored the Precambrian rocks and fossils found in the rocky crags within the park.

The post-symposium trip explored several sites in Charwood Forest over three days, including visits to the British Geological Survey at Keyworth, Morley Quarry and Bardon Hill.

 Further information on ProGEO:  
<http://www.progeo.ngo/>  
Charnwood Forest Aspiring Geopark:  
<https://www.charnwoodforest.org/>



**XI<sup>th</sup> INTERNATIONAL  
ProGEO SYMPOSIUM**  
9-11<sup>th</sup> October 2023  
Charnwood Forest, UK  
Celebrating Geoheritage • Promoting Geoconservation

www.progeo2023.com  
#ProGeo2023

**YOU'RE INVITED TO CHARNWOOD FOREST**

On behalf of the Organising Committee, and the International Association for the Conservation of Geological Heritage (ProGEO), we are pleased to invite you to take part in the XIth International ProGEO Symposium. The meeting is being organised by the Charnwood Forest Geopark, and will take place in Loughborough, UK from 9th to 11th October 2023. Time to put it in your diary!

Charnwood Forest is an Aspiring UNESCO Global Geopark, and is home to some of the oldest animal fossils in the world. Among our crag-topped hills and forest-filled valleys, you can find communities shaped by their geology, and geology shaped by two thousand years of industry.

**AS SYMPOSIUM FOR EVERYONE**

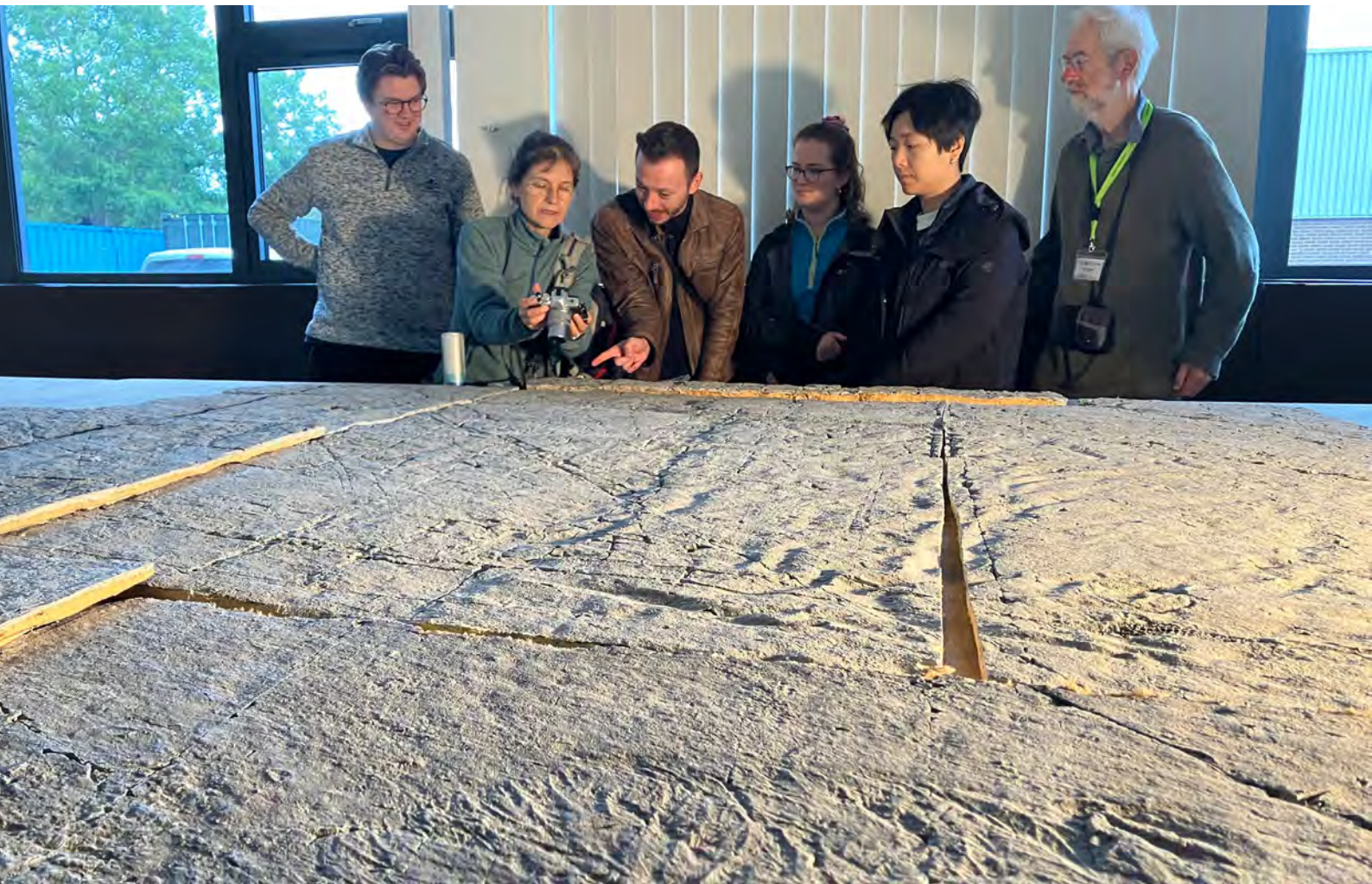
As always, the symposium is an international event open to scientists, students, educators, professionals, decision-makers, and anyone involved in geoheritage and geoconservation. The meeting will promote communication and collaboration amongst attendees from all over the world, and provide a space to discuss new challenges and threats in geological conservation. The symposium will feature a special session on the Conservation of Palaeontology, including a keynote on this topic, but we encourage attendance and presentations by all those interested in the varied topics of geoheritage, geoconservation, and geodiversity.



**Above: The 11th International ProGEO Symposium visit the Precambrian rocks of Bradgate Park in Charnwood Forest Aspiring UNESCO Global Geopark. View across Bradgate Park from Old John Tower looking southwards towards Leicester.**

**Photos by Jonathan Larwood**

**Below: Post symposium to the British Geological Survey at Keyworth, near Nottingham. Delegates examine casts of Precambrian fossils from Charnwood Forest Aspiring UNESCO Global Geopark**





# New Mendip National Nature Reserve announced by Natural England

Jonathan Hall, Natural England

In October 2023, Natural England launched their newest National Nature Reserve (NNR) on the Mendip Hills in Somerset. NNRs were originally established under the National Parks and Access to the Countryside Act of 1949 to protect some of our most important geology, habitats, and species, and to provide ‘outdoor laboratories’ for scientific research. The Mendip NNR is the second in the new King’s Series of NNRs to be declared by Natural England, following the declaration of the Lincolnshire Coronation Coast NNR earlier this year.

The Mendip NNR extends from Brean Down on the coast (south of Weston-Super-Mare) across the southern Mendip escarpment to the city of Wells (about 1410 hectares in total). It links an archipelago of geological and ecologically important sites along the Mendip Way Trail, many of which are Sites of Special Scientific Interest, and overlaps with the Mendip Hills National Landscape (formerly Area of Outstanding Natural Beauty).

The Mendip NNR is a vibrant landscape of craggy limestone slopes, species-rich calcareous grasslands and ancient wooded combes, alongside significant karstic cave systems, dry valleys and deep gorges carved by periglacial meltwaters during the last 1.2 million years. The geological

The Cheddar Complex, Somerset.  
©Natural England





landscape ranges in age from Devonian to Jurassic (approximately 372 to 161 million years old) in a relatively small area, making it one of the best places in the country to appreciate the relationships between geology, landscape, and biodiversity. The Mendip Hills were formed by late Carboniferous (Hercynian) mountain building; folded and faulted into a domed ‘periclinal’ structure. Devonian Portishead Sandstone at the core of the pericline forms the Blackdown Hills and the highest point in the Mendip NNR at 325 m. The Blackdown Hills are flanked by tilted tropical Carboniferous limestones, cut by deep, periglacial gorges. These gorges are among the geological highlights of the Mendip NNR and include Cheddar (England’s best known limestone gorge) and Ebbor Gorges on the southern side, and Burrington Coombe on the northern side. The associated cave systems contain a well-stratified sequence of Devensian sediments, preserving the remains of some of our most diverse and important small mammal faunas from the Last Ice Age as well as reindeer, mammoth and hyena which once roamed the landscape. The NNR reaches Brean Down in the west, a dramatic Carboniferous limestone promontory which extends over 2 km into the Bristol Channel. It is capped and flanked by a sequence of breccias, aeolian sands and palaeosols that are of critical importance for understanding Late Pleistocene environments in southwest England.

The Mendip NNR brings together the existing Ebbor Gorge and Rodney Stoke NNRs and declares additional land owned and managed by nine different partners, including Longleat Estates, National Trust, and Avon Wildlife Trust. This new, larger “super” NNR aims to enhance partnership and collaborative management across this landscape and will enable land managers to work together on nature recovery, to maximise the benefits for science and research, to improve access and to create more opportunities for people to connect with nature. The launch event was hosted in Cheddar

Speeches below High Rock.  
© Natural England



Gorge and was attended by Natural England Chair Tony Juniper and Lord Bath, owner of Longleat Estate, alongside key partners for the NNR. The event itself included speeches from across the partnership, a visit to Britain's tallest inland cliff (High Rock), presentations of declaration plaques, and the ceremonial cutting of a Cheddar cheese matured in the nearby Gough's Cave. Overall, this declaration shows Natural England's continued commitment to declare more geology as part of the NNR series, five major NNRs every year over the next five years as part of the King's Series, and to work in collaboration to deliver nature recovery.

### ***Further information:***

King's Series NNRs

<https://www.gov.uk/government/news/kings-nature-reserves-to-leave-lasting-legacy-for-people-and-nature>

Mendip NNR

<https://www.gov.uk/government/news/mendip-hills-to-be-declared-a-super-national-nature-reserve>

Geology of the Mendip Hills

<https://www2.bgs.ac.uk/mendips/geology/geology.html>

# Rum rocks for Mars mission

Dr Lydia Hallis, University of Glasgow

During the summer of 2023 a team of geologists from the Universities of Glasgow, Cambridge, Leicester, and Brock University in Canada, collected hundreds of kilograms of igneous rock from the Isle of Rum. The aim of this collection was to support the Earth-based preparation for Mars Sample Return (MSR) in the coming decade. Rum wehrlite rock provides a suitable analogue for rock sampled by the Perseverance Rover on Mars allowing the establishment of procedures that will be applied to the Martian rock on its arrival on Earth in the 2030s.

## *Life on Mars?*

The current environment on Mars is cold and desert-like, a chilly version of the Antarctic without the friendly oxygen-rich atmosphere. However, there is evidence that in the past Mars was once much warmer and wetter, with a thicker atmosphere that may even have produced rain. In fact, there may have been an ocean covering the northern hemisphere. Ancient Mars was thus potentially a habitable place, and the question of whether life evolved on Mars is key to the Mars Sample Return (MSR) mission currently being led by NASA and the European Space Agency (ESA). Key to sampling rock on Mars and the return of samples to Earth is the car-sized Perseverance Rover - in effect a mobile robotic geological laboratory. Perseverance landed inside Jezero Crater in 2020, just north of the Martian equator at the western edge of a Martian plain called Isidis Planitia. The Rover's mission is to collect data that will enable study of the geological development of the landing area and to seek out signs of past life. The rover is also collecting samples of Martian soil and rock that might harbour these signs. Jezero crater was chosen as a landing site because it once contained a river delta,

Dr Lydia Hallis (left) and the rest of the international team of geologists on the Rum-Mars sample analogue team at the wehrlite sampling site on the Isle of Rum National Nature Reserve. In the foreground are the samples of wehrlite collected from loose blocks that will provide the test bed for procedures to be undertaken on a sample of the Martian Séítah formation due to arrive on Earth in the early 2030s. ©Luke Daly/University of Glasgow



Loch Maclvor and the Rum Cuillin from the main track on the Isle of Rum. The empty and rugged nature of the Isle of Rum could have been problematic for sampling hundreds of kilograms of wehrlite rock to be used as an analogue for Martian rock from Jezero Crater. Thankfully and conveniently ideal samples of the wehrlite were found right by the side of the island's main unsurfaced road that had been excavated during the road's construction. © John MacPherson/NatureScot



which fed into a large lake. The presence of abundant water in Jezero may have made this one of the most habitable places on the red planet during Mars' early history.

### ***Sampling Mars***

Geological data gathered at Jezero Crater has included use of Perseverance's rotary percussive corer drill that takes test tube-sized cores. The samples taken by Perseverance are due to land on Earth in the early 2030s. Given the considerable investment in the samples being brought to Earth, there has to be appropriate preparation for their treatment. Analogues for the samples on Earth are required to trial methodologies and to test-run our scientific procedures until they are perfected, ahead of analysing the Martian rock samples. Preparation is very important, as once the Mars samples arrive on Earth we will only get one shot at some of the scientific tests. Test runs will thus help maximize the knowledge gained from each Martian sample.

### ***Rum's geological link with Mars***

Rum is one of the Small Isles, in the Inner Hebrides, off Scotland's west coast. The island that we see today is the exposed remains of the interior of a Paleogene volcano. The volcano was one of several, along Scotland's west coast, that erupted around 60 million years ago, when Europe slipped from North America. Millions of years of erosion, most recently during several glaciations, has scoured away the surface rock to reveal the internal working, or plumbing system as it were, of the volcano. The endlessly fascinating and complex nature of these rocks and the insight the worn volcanic edifice provides into volcanic processes globally, has had geologists flocking to Rum for over a century. Wehrlite, an ultrabasic rock that is a mixture of olivine and clinopyroxene, is one of the lithologies on Rum that has been identified during many years of intensive research on the island and was formed as part of a large magma intrusion within the sub-surface crust.

On Mars, between 55 and 400 million kilometers away from Rum, Séítah (meaning ‘amidst the sand’ in Navajo) is one of the basement formations that underlays the sedimentary delta-front rocks at Jezero Crater. It is one of the oldest rock formations to be sampled within the crater, hence could give us an insight into the environmental conditions during Mars’ warmer and wetter early history. One test-tube sized core of Séítah has been drilled and sampled by Perseverance, and is due for return to Earth. In advance of its arrival and study an analogue was required for this very special sample. Studies of the published literature pinpointed a few locations on Earth that could have rock similar to that of the Séítah igneous formation. As luck would have it, wehrlite exposed on Rum has a very similar mineral and chemical composition to the Séítah formation. This has provided an outstanding opportunity of using the Rum wehrlite as the required analogue rock to test how best to study the precious Martian rock sample upon its arrival on Earth.

### ***Sampling the perfect Martian analogue rock on Rum***

Sampling and transporting hundreds of kilograms of rock on Rum comes with logistical issues, as the interior of the island is largely uninhabited due to the Scottish highland clearances of the 19th century. Today, less than 50 people live on Rum, with only one unsurfaced road that bisects the rugged island. Luckily, after much reconnaissance of the areas that offer exposed wehrlite, the Rum-Mars sample analogue team found the ideal sampling site by the side of the road. In fact, the sampling utilized loose rock that had been pulled from the wehrlite exposure during the road’s construction. This meant that *in situ* rock was not affected by the sampling at this globally significant geosite. All that was required was to break some of these roadside blocks down into manageable sized pieces, and with assistance from NatureScot’s National Nature Reserve staff, to transport the rocks back to the ferry port.

### ***Rum rock off to the test bed***

The samples of Rum wehrlite are now at the University of Oslo in Norway, to be classified along with the other analogue materials already collected in Iceland and California, and due to be collected in Oregon later this year. Once the classification is complete, these analogue rocks will all be stored in a central collection, and made available for scientists to begin testing the analysis methods ahead of the Mars sample arriving on Earth.

To learn more about the Mars Sample Return mission, visit: <https://mars.nasa.gov/msr/>

NASA's Perseverance Rover as it appeared on 22<sup>nd</sup> of January 2023, which corresponds to the 684th Martian day, or sol, of the car-sized robotic laboratory's mission in Jezero Crater on Mars. The image was taken by the WATSON camera mounted on the rover's robotic arm and shows a sample tube, deposited by Perseverance on the ground surface. This and other samples, of the area's rocks and soils, are destined for examination on Earth in the 2030s. Rum wehrlite will provide the testing ground for procedures that will be used in the analysis of a sample of the Jezero Crater's Séítah igneous formation. Image credit: NASA/JPL-Caltech/MSSS



### ***Conserving and celebrating Rum and Martian geology***

It was 1949, in the context of a report of listing potential nature reserves in Scotland, that mention was first made of the conservation value of the igneous geology of Rum. Now declared a National Nature Reserve (NNR) and designated a Site of Special Scientific Interest, the nature of the island, including its geology, enjoys a high level of statutory safeguard. NNR status means the island is one of Scotland's best sites set aside for nature, including its globally significant geodiversity, to be promoted, conserved and enjoyed. Securing recognition of the conservation value of Rum's outstanding igneous geology, its value to geoscientific research and importance for education, would have driven the activities of early geoconservationists. So it is diverting to contemplate, for a moment, the reaction these workers would have had if they knew that the geology of Rum they were endeavoring to safeguard and champion would, many decades later, be helping to unlock the geology and development of life on another world. Looking ahead, it may be envisaged that sometime in the 22<sup>nd</sup> or 23<sup>rd</sup> centuries the locations visited by Perseverance, in Jezero Crater, will be included in an inventory of geosites of high conservation value, meriting special protection, appearing in a Martian analogue of the Geological Conservation Review.

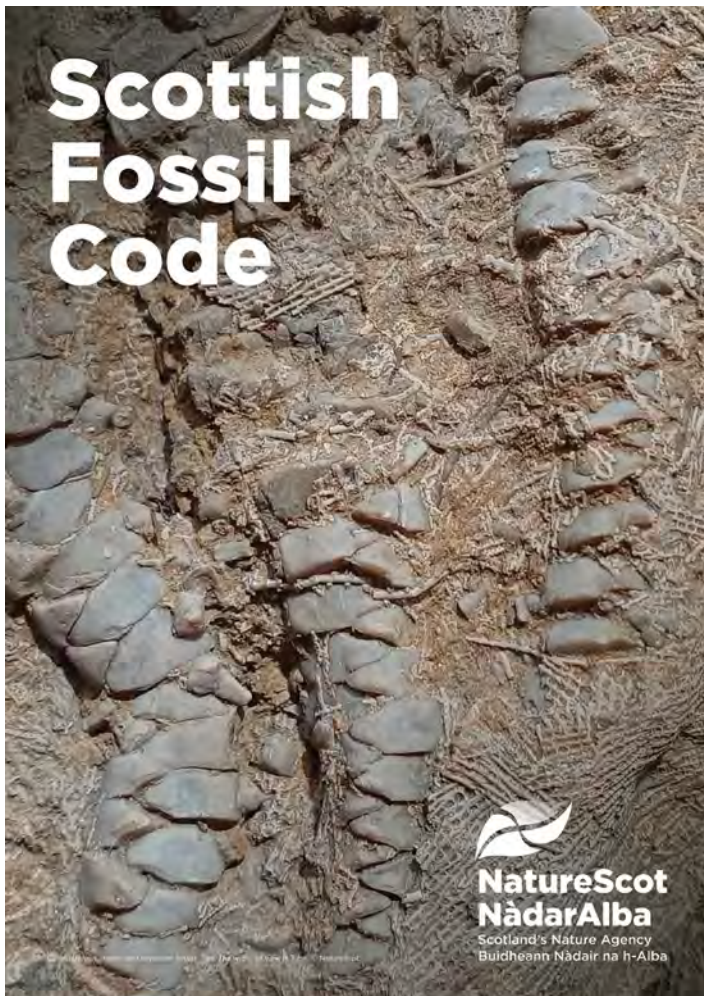
Colin MacFadyen, NatureScot

# A refreshed Scottish Fossil Code

*Guidance for fossil collectors, and the owners of fossil localities, on the responsible collection and care of Scotland's fossil heritage.*

Colin MacFadyen, NatureScot

First published in 2008, the 'Scottish Fossil Code', was relaunched in August 2023 after consultation-driven updates and improvements. Refreshing the Code was necessary in the light of experience gained in palaeontological site management, since it's original publication, and to accommodate comment from users of the Code's best practice guidance. With clearer messaging the Code is now considered more impactful, balanced and pragmatic and is accompanied by the 'must-read' 'Scottish Fossil Code Guidance' summary version. It is hoped the Code will prove to be 'can do' guidance that will be supported by all that have an interest in the collection and care of Scotland's fossil resources.



## *The challenge of irresponsible collecting*

Early issues of *Earth Heritage*, and its predecessor publications, documented the difficult challenges, faced in Scotland, of large-scale irresponsible fossil collecting. Despite the evolving, and increasingly strengthening protection afforded to fossil locations designated as Sites of Special Scientific Interest (SSSI), irresponsible collecting, especially in remote areas by collectors was, and continues to be, difficult to manage. Lamentably, damaging collecting has affected some fossil localities for decades with most of the high profile instances negatively impacting on globally significant Devonian fossil fish localities. Silurian fish localities, that also yielded eurypterids and other arthropods, have also suffered from decades of reckless exploitation. Such was the concern at the loss and destruction at particular sites that when nature conservation legislation was being drafted, in the early noughties, a ban on fossil collecting, was actively considered.

The front cover of the refreshed Scottish Fossil Code published in August 2023 and available as a downloadable pdf. At 54 pages it is a lengthy document but fulfils the duty given in the Nature Conservation (Scotland) Act 2004. Taking into account comments and experiences of users of the Code, as well as evidence of disengagement with the original Code, the refreshed Code takes a balanced and pragmatic approach to fossil collecting. The short Scottish Fossil Code Guidance document, available as a fully accessible HTML page on NatureScot's website, represents the summary 'must-read', or companion, version to the Code. All photos © Colin MacFadyen/NatureScot unless otherwise stated.





### **Not a ban but legislative backing for a Code of best practice**

Luckily, an alternative route was adopted and a ban was set aside on the grounds that it would be detrimental to the amateur collecting tradition, that has a significant role in scientific discovery, and would also diminish public interest in geology. In 2004 the *Nature Conservation (Scotland) Act*, hereafter referred to as the '2004 Act' gave Scottish Natural Heritage, now known as NatureScot, the duty of preparing the Fossil Code. The Code, the first national Code of its type, was to comprise recommendations, advice and information relating to fossils describing, *inter alia*, activities likely to damage fossils, circumstances in which fossils should not be removed and how collected fossils should be treated.

**Left:** The internal mould of a Lower Carboniferous gastropod from a South Lanarkshire river bank. The choice of using images of unprepared and generally common fossils, to adorn the pages of the Code, is intended to illustrate the finds that recreational collectors are likely to come across when collecting in Scotland. The fossil is 3 cm in length. M. Sword Collection.

Recreational collectors at Achanarras Quarry, Caithness, an SSSI and former National Nature Reserve, which is owned by NatureScot. The refreshed Scottish Fossil Code defines approaches to collecting and levels at which it is undertaken to help collectors understand their responsibilities. The Code also recognises that seeking permission to access and collect fossils is difficult. However, the Code states that those undertaking significant, large-scale or commercial collecting are expected to adhere to the Code's highest standards. There is also the expectation that owners of fossil localities, particularly of localities designated as SSSI, take appropriate action if they suspect that their site is the subject of irresponsible collecting as defined in the Code.

© Iain Sarjeant/NatureScot





**Above:** A trilobite emerges from the substrate, an image used on the back cover of the Scottish Fossil Code. Inclusion of such an iconic and much loved fossil is intended to stimulate an interest in Scotland's rich, diverse and globally significant, fossil heritage and help encourage its responsible utilisation through engagement with the Code. M. Sword Collection.

**Below:** A fossil mollusc shell in Jurassic siltstone, pictured on the intertidal platform on the south coast of Mull. This image is one of those used to illustrate the Scottish Fossil Code. Being an *in situ* fossil it demonstrates the idea of "find and observe 'collecting'" as an alternative to the actual removal of fossil material. The fossil is approximately 10 cm across.



### **The 2008 'Fossil Code'**

A Working Group, chaired by Professor Nigel Trewin, consisting of a wide range of organisations and individuals with an interest in Scotland's fossil resources, advised upon and assisted in development of the Code. *Earth Heritage* charted important stages in the preparation of the Scottish Fossil Code including the Code's launch by a Scottish Government Minister, in 2008, at Cromarty the birthplace of the famous geologist and author Hugh Miller. As directed by statute, the published Code contained information concerning Scotland's fossil heritage and best practice guidance concerning its collection and care. Significantly, the Code applied to all fossil-bearing localities across the length and breadth of Scotland regardless of designation status.

Into the 2010s, the Code was widely promoted to try and effect a change in collector behaviour, with encouragement for responsible collecting activity. A review of the Code in 2012 provided an encouraging indication that the Code, and its promotion of responsible collecting, had resulted in fewer instances of large-scale damaging collecting. However, towards the end of 2010s it was becoming clear that despite efforts to promote the Code there were signs of collector disengagement with the guidance. There was also evidence of irresponsible collecting activity resuming at the usual much-targeted localities. In this context it became clear that revision of the Code, as catered for in the legislative steer in the *2004 Act*, was required.

### **Issues with the original Code**

In similarity with the process of preparing the original Code a Fossil Code Working Group was convened in 2020, to assist refreshing and improving the guidance, with Professor Stuart Monro as Chair. The process began with a period of consultation that highlighted various issues with the Code. Accessibility to key information was one of the key bugbears with the Code being described as too long; "there has to be a shorter version" being a ubiquitous comment. Further and wider consultation established

## Setting aside the term ‘amateur’

The original 2008 ‘Fossil Code’ made use of the word ‘amateur’ to describe collecting undertaken by those other than professional research collectors. However, a significant number of so-called amateur collectors undertake important fossil collecting, specimen preparation and research work, at a professional level often working in partnership with professional researchers, contributing to the advancement of palaeontological science. In the refreshed Code, setting aside ‘amateur’ and replacing it with ‘recreational’ better reflected the work of an indispensable cohort of unpaid paleontological research workers. ‘Recreational’ also appropriately covers the collecting activities of other collecting groups including children and family groups.

that, worryingly, some collectors were unclear as to the Code’s legal status with confusion over which elements of the Code were mandatory and which represented guidance. The Code was also regarded as being “too hard-line” and “off-putting” to recreational collectors to the point that it risked being ignored altogether. Users of the Code also felt there was ambiguity in messaging concerning the various approaches to, and levels of, collection and what constituted damaging and irresponsible collecting activity. Regrettably, some of these concerns have been there for a good while but neither fully realised nor expressed.

### Refreshing the Code

Refreshing the Code was undertaken during the pandemic years. Work focussed on addressing the length, accessibility and messaging issues and aimed to produce impactful best practice guidance that was both pragmatic and proportionate. The overarching challenge was to achieve a Code that on the one hand discouraged irresponsible collecting whilst encouraging responsible research and recreational activity on the other. All that had to be achieved whilst working within the context of the law as every rock and fossil lying on the ground or *in situ*, in Scotland, is owned property and there has to be careful consideration of collecting in protected sites. On legal matters, pertaining to collecting, redrafting the text had to take into account and address challenging perceptions held by some collectors.

The end result of the refresh is a full length *Scottish Fossil Code*, available as a downloadable pdf document and a distilled, companion, version termed the *Scottish Fossil Code Guidance* presented as an accessible HTML page. At 54 pages the full Code is still a lengthy document but it was felt that was required to fully satisfy the steer in the *2004 Act*. In particular, some lengthy sections, on the responsible collection and subsequent care and storage of fossil specimens, are essential and irreducible information and best practice. The companion *Scottish Fossil Code Guidance* gathers all the essential guidance presented in the full Code. Already being termed the ‘must-read’ version, the companion guidance addresses the requirement for a shorter and more accessible code document.

### Improved messaging and adherence expectations

The messaging is now clearer on the legal status of the Code and the legalities of land and fossil ownership. There is the statement that although the Code has national legislation backing the document is not a law just best practice guidance. Crucially, however, areas of the law are highlighted, relating particularly to property ownership and SSSI regulations, that should not be ignored. The Code now defines the different approaches and levels of collecting, namely: casual; minor; significant; large-scale; and commercial, in order that collectors are better able to appreciate how their collecting compares with others and what may reasonably be expected of them. In recognition that seeking permission to access, and collect fossils is difficult, there is the stated expectation that those undertaking significant, large-scale and commercial collecting are expected to adhere to the Code’s highest standards. For those that are minded to set aside the Code and persist to collect without heed, for the consequences of their actions, there is clear messaging that “due

regard of compliance or otherwise, with the Code, may be given in the consideration of any offences and associated prosecution”.

In defining approaches to collecting and the levels at which it is undertaken, the refreshed Code defines irresponsible collecting as: “an approach that is inappropriate for the characteristics of a fossil resource, including the circumstances in which it occurs, that causes unjustifiable damage and loss”. The Code also presents “find and observe ‘collecting’” as an alternative to the actual removal of fossil material. This approach involves looking for undiscovered, or already known about, fossils to appreciate and learn from them. Find and observe collecting can involve taking photographs, making drawings and recording other information of what a collector observes and can extend to reporting new finds.

### **A role for fossil locality owners**

Prominence is given in the Code to the important role that owners of *in situ* fossil resources have in the management and safeguard of this important aspect of Scotland’s nature. The role of fossil locality owners and land managers can extend beyond ensuring that fossil collecting best practice guidance is followed, to finding out about the fossil-bearing resource on their land and how best to conserve it through appropriate management.

### **Relaunch and promotion of the Code**

The refreshed *Scottish Fossil Code* was published in August 2023. A social media campaign, that celebrated the role of women pioneers in Scottish palaeontology from the nineteenth century to the present day, formed the backdrop to the Code’s relaunch. To an extent, refreshing and relaunching the Code has probably been the simpler of the duties set out in the *2004 Act*. Perhaps the more challenging task, going forward, will be the continual promotion of the best practice guidance and encouraging adherence to the messaging. Part of that promotional effort will be to target, persistently, the particular collector cohort whose irresponsible collecting activities gave rise to the *2004 Act* legislative steer in the first place. Ideally the Code will be viewed as a ‘can do’ document that will not only stimulate and enable responsible discovery but will also lead to enhanced public interest in Scotland’s fossil heritage. Hopefully, it will be supported by collectors, fossil locality owners and everyone else that has an interest in the collection and care of Scotland’s fossil resources.

The *Scottish Fossil Code Guidance*, is available as an accessible HTML page at: <https://www.nature.scot/doc/scottish-fossil-code-1>, the full ‘*Fossil Code*’ being available as a downloadable pdf.

#### ***Link to the Code and social media posts that supported the Code’s relaunch:***

The Scottish Fossil Code Guidance:

<https://www.nature.scot/doc/scottish-fossil-code-and-guidance>

NatureScot news item:

<https://www.nature.scot/refreshed-fossil-code-celebrates-scotlands-female-fossil-pioneers>

Podcast - “Unearthing the Past - Exploring Scotland’s Fossil Code with Dr Elsa Panciroli by Elsa Panciroli”:

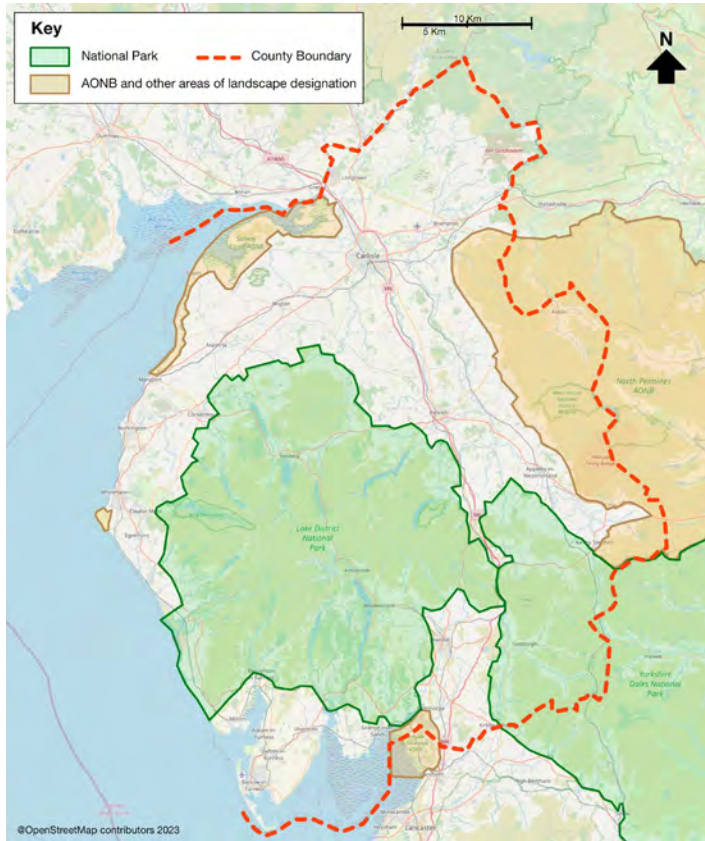
<https://www.nature.scot/unearthing-past-exploring-scotlands-fossil-code-dr-elsa-panciroli>

Scotland’s Nature Blog - “Unravelling the origins of life: fossil hunting with Dr Katie Strang”:

<https://wordpress.com/post/scotlandsnature.blog/20974>

# Celebrating Cumbria's Geodiversity

Ian Francis and Carolina Goodship, Cumbria GeoConservation



Cumbria is one of the most geologically diverse areas in Europe, including as it does, an exceptionally wide range of rock types, geological features, and landforms. The geodiversity of the county also underpins its rich biodiversity, many of its economic resources, and, of course, its iconic scenery. It is a key reason why over half of Cumbria lies within landscapes designated for their national or international importance, and why Cumbria has more geological Sites of Special Scientific Interest (including combined geological/biological SSSIs) than any other county in England.

As well as celebrating Cumbrian geodiversity, this article describes the impetus behind the new *Geodiversity Statement and Action Plan* for the county which has been produced by Cumbria GeoConservation (CGC), a volunteer organisation that champions the cause of geoconservation in Cumbria, and works to identify, promote, and conserve the county's Locally Important Geological Sites (LGSs).

## What makes Cumbria so geodiverse?

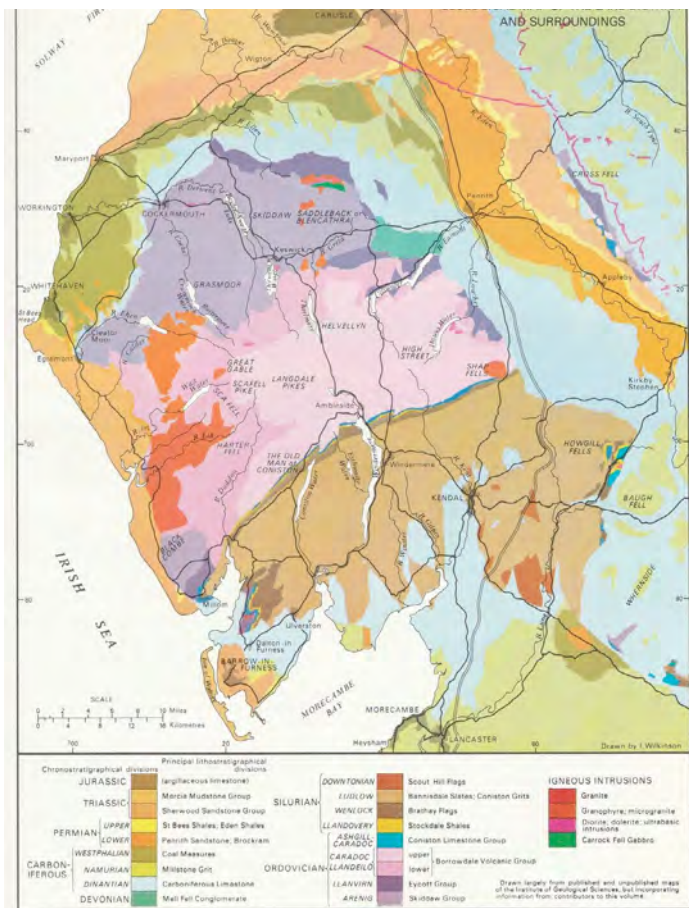
The contrasting landscape character of the different parts of county owes a great deal to the underlying geology.

The rugged mountainous scenery of the Lake District which occupies the centre of Cumbria is quite distinct from all the surrounding parts of northern England, something that was recognised by Adam Sedgwick in the mid-nineteenth century.

Top: Designated landscape areas in Cumbria.

Bottom: Geological map of Cumbria. Image courtesy of The Yorkshire Geological Society.

All photos by Stuart Holmes unless otherwise stated.



Lower Palaeozoic basement metasediments, granites and volcanic rocks produce the mountainous terrain of the Lake District fells. Here looking northwards from Great End towards Great Gable in the middle distance.



He wrote in Wordsworth's 1853 *Guide to the Lakes*:

*"By whatever line a good observer enters the region ... he must be struck with the great contrast between the hills and mountains that are arranged on its outskirts, and those which rise up towards its centre. On the outskirts, the mountains have a dull outline, and a continual tendency to a tabular form: but those in the interior have a much more varied figure, and sometimes present outlines which are peaked, jagged, or serrated."*

The distinctive mountainous character of the Lake District is generally thought to be the result of localised post-Cretaceous uplift, which led to the removal of several kilometres of Carboniferous and Mesozoic strata, exposing a core of Ordovician to Devonian metasediments, volcanic rocks, and granites. Around the circumference of the Lake District National Park, these ancient rocks dive beneath Carboniferous and Permo-Triassic strata.

Carboniferous limestones form hill country surrounding the southern, eastern and northern edges of the Lake District as well as the high moorlands of the Pennines in the east. Coal Measures form a belt of windswept moorland and rough pastureland in West Cumbria, whilst the succeeding Permo-Triassic sandstones underlie the rich dairy country of the northern Cumbrian plain, parts of West Cumbria, and the Eden Valley. They also give rise to the dramatic cliff scenery of the St Bees Heritage Coast.

Acadian and post-Acadian faulting has produced large-scale landscape features such as the Eskdale Fault which runs east-northeast through the Lake District, from Ravenglass on the coast, through Eskdale, into Langdale. It separates the central fells to its northwest, from the Coniston and Ulpha

**Carboniferous limestone karst on Whitbarrow Scar, southern Cumbria.**



**Triassic sandstone cliffs of the St Bees Heritage Coast between Whitehaven and St Bees.**



falls to its southeast, and forms a natural access route from the coast into the heart of Lakeland. It is the line taken by the Hardknott and Wrynose passes - used by the Romans 2000 years ago, and almost certainly by the earlier inhabitants of Lakeland. In the east of the county a major fault system of Permian age, the Pennine Boundary fault, separates the half-graben of the Eden valley from the Carboniferous escarpment of the Pennine massif to the east.

Cumbria's many different rocks have weathered to give diverse soil types, which in turn affect natural ecosystems and agriculture. The region's abundant mineral resources, such as roofing slates, building stones, metal ores, and coal, have strongly influenced the economic history of the region, as well as local settlement patterns and architectural styles. Remains of 19<sup>th</sup> century mining and quarrying activity still abound throughout Cumbria, and are now valued as an important part of the region's geoheritage.

Over the millennia, ice, wind and water have worked on the geology to produce a stunning variety of different landforms. Particularly noteworthy are the karst terrains of the Pennines and southern Cumbria, the dune fields of the Cumbrian coast, the raised peat-bogs of the Solway Plain, and best-known of all, the glacially eroded U-shaped valleys, cirques, tarns, ribbon lakes and hanging valleys of the Lake District.

### ***The need for a new geodiversity statement for Cumbria***

Most of Cumbria's most treasured landscapes lie in the following designated areas:

- the Lake District National Park, which also enjoys UNESCO World Heritage status,
- the western part of the Yorkshire Dales National Park,
- the St Bees Heritage Coast, and
- three Areas of National Landscapes (formerly Areas of Outstanding Natural Beauty) including the western half of the North Pennines UNESCO Global Geopark.

Each of these six areas has its own distinctive landscape, reflecting the county's diverse geology described above. Geoconservation is recognised as an important component in the conservation strategies of some of these protected landscape areas, but not all. The Lake District National Park is host to half of the county's LGSs and almost half of the geological conservation review (GCR) sites, which underpin geological SSSI designations. The UNESCO World Heritage citation refers extensively to the region's natural landscape of mountains, valleys and lakes of glacial origin, and



**Above:** Hardknott Pass, guarded by the Roman Fort, follows the line of the Eskdale Fault.

**Below:** Cathedral Cave Quarry, Little Langdale. Relics of Cumbria's extractive industries are an important part of the county's geoheritage.



yet the National Park's 2020-2025 Management Plan makes no mention of the region's geoheritage. This omission may stem from a lack of understanding of the risks to landforms and their robustness in the face of human activity and natural threats. When coupled with a low awareness of the role of geodiversity in supporting biodiversity, this can lead to the mistaken view that important geological sites do not need special measures for their conservation.

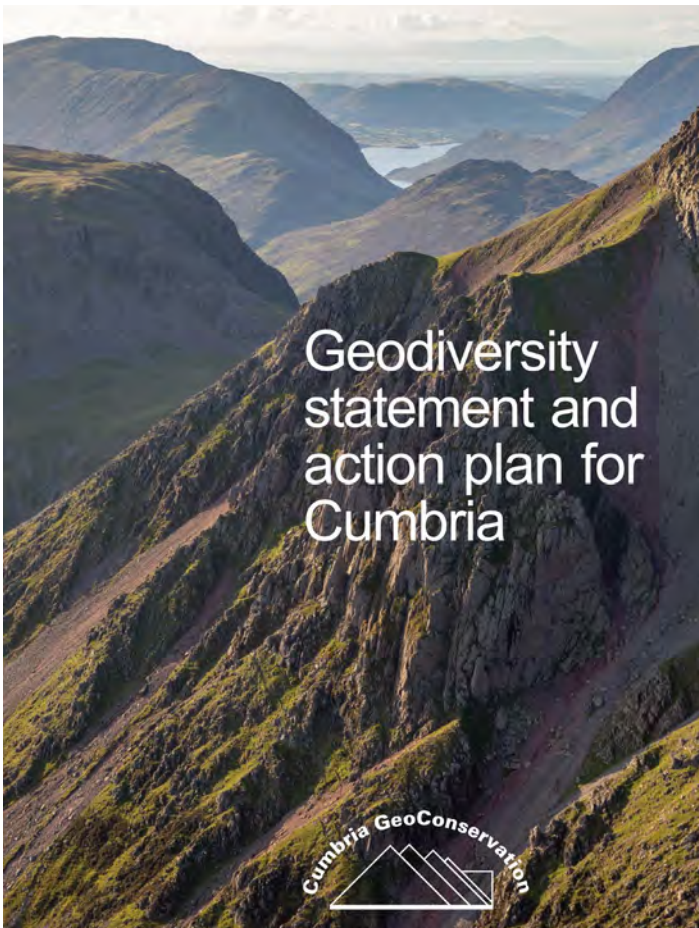
In an effort to raise awareness of the county's rich geoheritage, CGC has recently published a *Geodiversity Statement and Action Plan for Cumbria*. The document explains why geoconservation matters, and why geoheritage is a vital component in conservation planning and management. The document also provides an assessment of the geoconservation threats Cumbria is likely to face, in particular from climate change, which is anticipated to pose a significant challenge in our county. The CGC is about to embark on a desk-based review of all its LGSs to assess and categorise their degree of climate-change vulnerability. The publication also highlights a number of CGC's recent geoconservation projects including its involvement in the Westmorland Dales Landscape Partnership Scheme. The Westmorland Dales covers 200 km<sup>2</sup> of mainly limestone country east of Tebay and north of the Howgills, and was incorporated into the Yorkshire Dales National Park in 2016. CGC was the lead partner in the *Revealing the Foundations* project which focused on explaining the area's geology and its importance in understanding the region's landscape, and its natural and built heritage. It's an excellent example of a holistic approach to nature conservation, connecting people, landscape, and heritage. The findings of our geological research have helped to update the Yorkshire Dales National Park's dedicated geology website, [www.dalesrocks.org.uk](http://www.dalesrocks.org.uk), and the details of the new LGS and geotrails are also on the CGC website, [www.cumbriageoconservation.org.uk](http://www.cumbriageoconservation.org.uk).



Glacial cirques on the east side of the Helvellyn range, looking northwest towards Thirlmere



The Geodiversity Statement can be downloaded from our website, [www.cumbriageoconservation.org.uk/geodiversity](http://www.cumbriageoconservation.org.uk/geodiversity)



### Further Reading

Crofts, R., et. al. (2020) *Guidelines for Geoconservation in Protected and Conserved Areas* IUCN WCPA's Best Practice Protected Area Guidelines Series No.31.

Francis, I., Holmes, S., Yardley, B. (2022) *The Lake District: Landscape and Geology*, Crowood Press

Jackson, I. (2022) *Cumbria Rocks: 60 extraordinary rocky places that tell the story of the Cumbrian Landscape*, Northern Heritage Services Ltd

World Heritage Inscription for The English Lake District:

<https://whc.unesco.org/en/list/422/>

# Identifying and Sourcing Stone: The Building Stone Database for England, and how this should help safeguard historic sources for future use

Clara Willett, Historic England

Sourcing the right stone to conserve historic buildings can be extremely challenging. Lack of an appropriate supply is not only a matter of aesthetics but also of technical compatibility, because any new replacement stone should match the original in its mineral composition and physical properties; in particular porosity and permeability. An inappropriate new stone can accelerate the decay of the older adjacent stone and is likely to weather differentially. In addition, many new buildings and extensions, particularly those in conservation areas, will have to be constructed using materials which match those of the buildings around them. Whether the requirement is new or replacement stone; an available source for it is needed.

The rich diversity of England's geology means that thousands of different stones have been used over the centuries for building. Accurate information on the original quarries and the number and distribution of buildings constructed from these stones has been elusive to date.

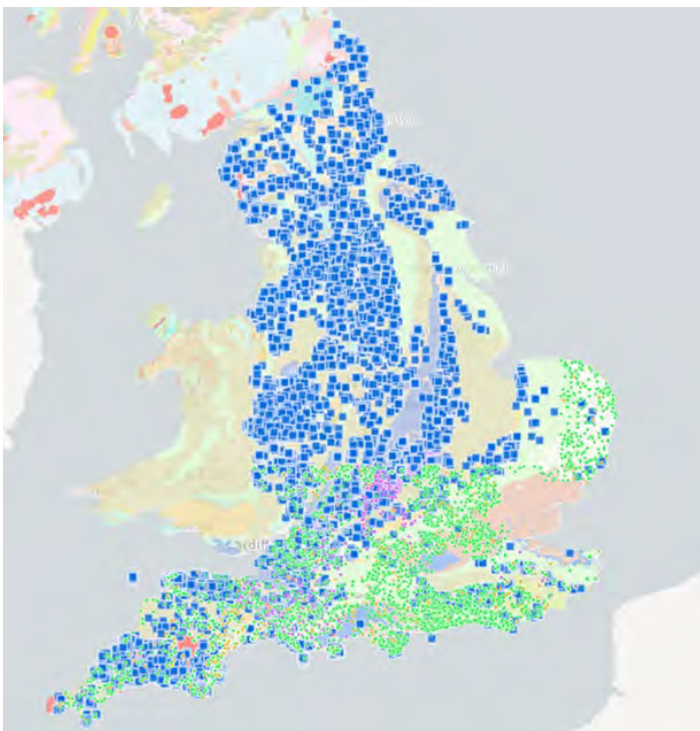
Elsdon Bridge, Northumberland constructed from Tyne Limestone.  
All images © Historic England





**Above: Kingsand Institute and clock tower, Cornwall. Constructed from Kingsand rhyolite and sandstone with Devon Limestone dressings**

**Below: Screenshot of BSDE map explorer with data points of building stone sources and representative stone buildings.**



The Symonds Report, *Planning for the Supply of Natural Building and Roofing Stone in England and Wales (2004)* identified the problems of sourcing appropriate stone to repair historic buildings, recommending that a national database of the building and roofing stones be established and that Mineral Planning Authorities should identify and protect ‘heritage quarries’. In response to this the then Department of Communities and Local Government produced guidance for Mineral Planning Authorities and others by publishing Minerals Policy Statement 1 (MPS1). Annex 3 Natural Building and Roofing Stone recommended that: “*English Heritage and the industry are encouraged to make Mineral Planning Authorities (MPAs) aware of important sources of building and roofing stone that they consider should be safeguarded from other forms of development.*”

The current National Planning Policy Framework (2023) also encourages safeguarding of natural stone resources. Paragraph 210c states that local planning authorities should: “*safeguard mineral resources by defining Mineral Safeguarding Areas and Mineral Consultation Areas and adopt appropriate policies so that known locations of specific minerals resources of local and national importance are not sterilised by non-mineral development where this should be avoided (whilst not creating a presumption that the resources defined will be worked).*” Paragraph 211 states that when considering proposals for mineral extraction, minerals planning authorities should: “*consider how to meet any demand for the extraction of building stone needed for the repair of heritage assets, taking account of the need to protect designated sites*” and to “*recognise the small-scale nature and impact of building and roofing stone quarries, and the need for a flexible approach to the duration of planning permissions reflecting the intermittent or low rate of working at many sites*”.

Historic England’s (HE) Strategic Stone Study was set up to address these issues by undertaking a county by county, nationwide survey to identify the building stones used, map their sources (active, dormant and historic quarries within England) and record representative buildings and structures and collating them in one online resource as the



characteristics and common uses of the stone, known or likely sources, as well as representative buildings. The sources data set includes each quarry location, the stones quarried from it and its status (active/inactive/ceased). Each representative building and structure entry in the buildings data set lists the building stones used to construct it and citations for further reference.

- individual county guides which summarises and richly illustrates the use of the building stones (organised by geological chronology) within an historic context.

The information from the BSDE should help Mineral Planning Authorities (MPAs) identify quarries of importance to the built heritage, whether disused or active, which they consider should be safeguarded from needless sterilisation by non-mineral development. Counties are already using information from the BSDE to guide their Local Minerals Plans (e.g. West Sussex, Somerset and Derbyshire). Furthermore local authorities are encouraged to recognise existing and potential quarry sites and include suitable policies within their development plans so that the needs of building conservation can be considered equally alongside other competing uses or designations. This information could also provide valuable support for a planning application or appeal.

The BSDE also helps new build and historic building professionals, seeking information for specific building projects. Indeed, it is of use to anyone wishing to find out about building stones; their sources and usage.

[The National Heritage List for England](#) (NHLE) is now online, making its 400,000 entries easily accessible. Data from the BSDE about the types of building stones used in designated buildings and structures has been returned to be integrated in the NHLE entry which not only enhances the individual entry but defines the original stone for matching purposes for any additional or replacement stone. Anyone can also add information about buildings stones as part of the [Missing Pieces project](#).

It is important to remember that it is not the intention of the BSDE to override or replace professional advice from experts in the stone conservation field, when undertaking a particular conservation or new build project.

Please follow this [link](#) to explore the BSDE. We'd welcome any comments on the BSDE. If you'd like to get in touch, please contact [Clara Willett](#).



A fossil limb bone from a small vertebrate in the Kilmaluag Formation, Skye. These and other incredibly rare and important fossils are the focus of palaeontological research on Middle Jurassic vertebrates. Such delicate, and intricate, fossils have intrigued and fascinated the work of Orkney-based puppeteer animator and model maker Mary Grieve, inspiring their work. Photo by Elsa Panciroli

## Art Meets Palaeontology on Skye

**Dr Elsa Panciroli** (Associate Researcher, National Museums Scotland) with contributions from **Mary Grieve** and **Lauren Gault**

**In the last few years I've been working with artists on projects that integrate palaeontological themes with visual arts. This work came about for two reasons: firstly, because I am, like many other scientists, someone who straddles the borders that traditionally delimit the arts from the sciences. I originally pursued humanities subjects, only 'switching sides' to begin a career as a scientist later, as a mature student. Being a visual learner, my study notes took the form of myriad outlandish drawings, and while numbers and specific details slipped frustratingly quickly from my mind (chemistry remains my arch nemesis), the stories behind scientific discoveries, and the wonder they evoked, were unforgettable. I now combine my research with creative non-fiction writing and poetry, and have even dabbled in palaeoart.**

My second reason for exploring art-science collaborations, came as a direct result of the ambiguous experience of conducting fieldwork on the Isle of Skye. My team has been prospecting for fossils on the island over a decade. I joined the work as a PhD student, and now co-lead the team. It was a joyful surprise to discover there were vertebrate fossils so close to my childhood home on the north-west coast of Scotland, and I feel lucky to have been able to dedicate my research to them. But from the beginning, I had mixed feelings about the experience.

Each day we trekked a hair-thin coastal path to our fossil localities; the Cuillin our backdrop, seaweed popping beneath our bent knees as we scoured the bruised blue limestones for flecks of shining black bone. Bliss, you might think, and so it was. Until it came to extracting our fossil discoveries, which had to be cut from their carbonate slumber. As our petrol rock saws were tugged into life, they rattled the rock doves from their cliff roosts, slicing through the calm. Refreshing salt spray was obliterated by a clawing plume of oily fumes. The screaming of the engine reverberated for miles, fracturing the peace so intrinsic to this incredible landscape.

**Right:** Artist Lauren Gault on the shore at Duntulm, Skye, a key location in the global context for Middle Jurassic dinosaur trace fossils. Lauren undertook a research residency on the Isle of Skye exploring the relationship Skye fossil heritage has in land working, folklore and identity. Photo by Elsa Panciroli

**Below:** Mary Grieve on the cliff path at Elgol, Skye. Their inclusion in a palaeontological research party, to discover fossil material, allowed imagining of past environments and ancient lives and the connection with “today’s beautiful beasts”. Photo by Dave Grieve



As Sorley MacLean wrote in his masterpiece, *An Cuilithionn*: ‘leanadh sgrìachail a’ Chuilithinn / ri mo chluasan ‘na dhuilighinn’ (the screeching of the Cuillin would follow / my ears with its anguish).

These mixed emotions led me to set up the *Skye Fossils Art/Science Residency* in 2019. The project sought to bring together artists, writers, and musicians with professional researchers, to explore the relationship between palaeontology, art, and cultural and natural heritage. The resulting work aimed to inspire new conversations and ideas about how we view our living landscape in deep time. I began work with the first resident artist, Mary Grieve in 2020, but lockdown inevitably hindered our progress. In August 2021 Mary secured funding from Creative Scotland for their project, *Projections: Shining Light on Ancient Worlds*, which they completed in 2022.

Mary Grieve is a puppeteer, animator and model maker, based on the mainland of Orkney. At the time the residency commenced, they were living on Raasay – touching distance from An t-Eilean Sgitheanach (the Isle of Skye). Mary shared their progress with the project online, through social media and a series of blogs on the residency website:

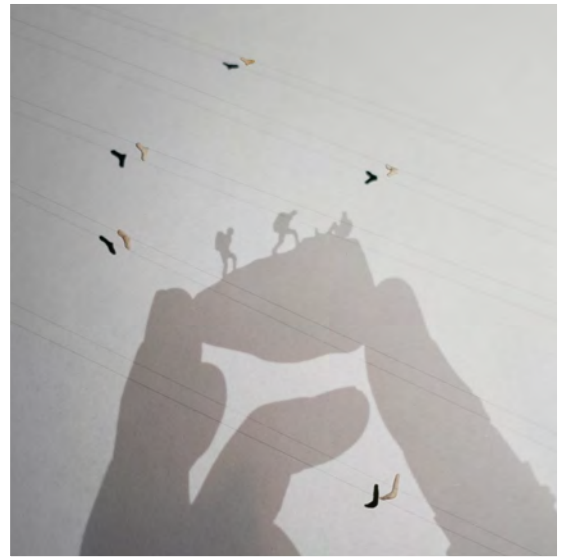
*I was interested in this residency because I had the idea of bringing an object to life and having it tell its own story through the use of movement and light. I was also intrigued by the relationship between the past and the present, between the ancient ecosystem that is being uncovered and the lives and culture of the communities now living on that same land.*

*‘...we clambered over the massive sandstone boulders like ants on sugar cubes.’ It was when I read this sentence, a short way into Elsa’s book, *Beasts Before Us*, that I could see an image of what my sculptures might look like for the first time. I could picture the palaeontologists as just as much a part of the story as the fossils, and I decided to embrace my place as an observer. This image became my first pebble sculpture.*

*Something that struck me early on was the scale of the fossils being found on Skye, not the big dwarfing dinosaur foot prints that I had previously heard about, but minute skeletons of tiny mammals and reptiles.*

**Right:** A still image from the shadow puppetry, stop-frame animation, film *Projections* by Mary Grieve. Mary's projection animation is inspired by fieldwork, undertaken for palaeontological research, taking place on Skye. Both photos by Mary Grieve

**Below:** A pebble sculpture by Mary Grieve, part of their project, *Projections: Shining Light on Ancient Worlds* undertaken during their Skye Fossils Art/Science Residency. Inspired by fossil discoveries on the Isle of Skye. This is a collaborative project, producing new work and stimulating discussion and exchange, about how we view our living landscape in deep time. It is also about the place of palaeontological science today in rural communities, such as Skye, and beyond.



*I am a sucker for tiny things. The more delicate, the more intricate, the more fragile something is, the more it intrigues and fascinates me. Their size however, is in contrast to their importance and the stories they tell. They are small objects casting big shadows, shadows of creatures we never knew existed, shadows that fill gaps in the origin story of today's beautiful beasts.*

As part of the project, Mary joined our team for fieldwork, both as an observer and participant. They spoke with the researchers, and found out about the techniques we employed.

*The name of this project is a nod to the micro CT scanning process. A 'projection', in this context, is the ghostly shadow-like image that is cast when x-rays are passed through an object, in this case a fossil! As the fossil is turned through 360°, thousands of these projections are recorded to build up a single CT scan. With this information scientists are then able to piece together a three-dimensional object, and to see and study the tiny fragments of bone without ever removing them from the rock. This is the concept that first sparked off my work – this fascinating process and the connections between it and shadow puppetry, both shining a light on an object, both casting a shadow that tells a story.*

Working with Mary was invigorating for our research team, as we got to see our work afresh from their perspective. As palaeontologists, we think in cycles of millions of years, the turnover of eons and entire evolutionary lineages. Mary linked us back to local seasonal cycles, by comparing the experience visiting our site at different times of the year, and drawing connection between change on micro and macro scales. Mary's final piece was a shadow puppetry stop-frame animation, which was streamed live during an event hosted by the Palaeontological Association. It has since been screened at multiple venues, including the Raasay climate Festival in 2022, and both the film and interactive sculptures were part of 'The Stone Speaks' exhibition at Stromness Museum from November 2022 - March 2023..



*I hope that my film gives the viewer a quiet contemplative space to think of the environment and its fragility, to realise in searching for knowledge and evidence of the past the necessity of being aware of our impact on the future. I would like to convey an appreciation of natural change in my film and hope that those watching it might begin to think of themselves as part of the environment, rather than owning or controlling it.*

The Skye Fossils Art/Science Residency is currently in hiatus (hopefully to relaunch soon). In late 2022 however, I was contacted by another visual artist named Lauren Gault. She was looking to collaborate on her new project based on Skye and supported by ATLAS Arts in Portree, and Creative Scotland:

*When I was invited to undertake a research residency on the Isle of Skye, I was immediately struck by the wealth of paleontological finds on (in!) the island. I'm interested in the ways objects and sculpture can provide a type of connectivity, or 'uncanny' encounter, not possible through other non-physical means. Fossil finds as 'objects' do this through providing a tangible connection in our 'present' to vast timelines.*

*Within the project, which is named Samhla (Gaelic for symbol, shape, likeness or apparition), I was keen to explore the relationship that fossils in Skye have to land working, folklore and identities, as well as having a role in informing contemporary discussions around imminent landscape decisions.*

I joined Lauren for a very different kind of 'fieldwork' on Skye. She took me to the clearance village above Romesdal, which is one of the key sites in her project. I took her to fossil-bearing localities, and shared my knowledge of deep time. We spent hours in discussion and discovery. It was an incredibly valuable experience for me. Lauren's natural interdisciplinarity is expansive, as she draws together threads from geology, archaeology, literature and visual arts.

*We completed fieldwork and public talks in Skye, expanding these thoughts and posing further questions around how fossils function in communities as their object biography evolves. Elsa's knowledge and the ways in which she thinks, writes and talks about this field have added much to the way I now think about and relate to the world. I also learned about the various techniques used within palaeontology, and plan to use them to produce new sculpture as one of the public outcomes from this joint work - an application of geoscience technology to art making.*

*I hugely value the ways in which arts and geosciences can inform each other symbiotically, and working this way has opened exciting new ground - not just across this project but I suspect across future works and collaborations.*

There is now widespread recognition that the disciplines of science and art have much to gain from one another. Science inspires art, but art makes enormous contributions to scientific advancement, particularly in encouraging creative thinking and innovation. As Segal and Meroz (2023) noted, 'one of the most significant outcomes is something that cannot be planned for in advance: serendipitous events'.

### **Links, further information and reading**

Find out more about the Skye Fossil Art Science Residency, and watch Mary's film, *Projections: Shining Light on Ancient Worlds*, on the website: <https://skyefossilsresidency.wordpress.com/>

Mary Greive's website: [www.marygrieve.com](http://www.marygrieve.com)

Lauren Gault's website: [www.laurengault.co.uk/](http://www.laurengault.co.uk/)

MacLean, Sorley. (1939) *An Cuilithionn / The Cuillin 1939 & Unpublished Poems*. Edited by Christopher Whyte, Glasgow: ASLS, 2011.

Segal, L. and Meroz, Y. 2023. Art–science collaborations: Generators of new ideas and serendipitous events. *Quantitative Plant Biology*, 4, p.e9.

# “Balancing Act” by Simon Armitage, Poet Laureate

Jonathan Larwood, Natural England

In June (2023) I joined the National Trust, Simon Armitage – Poet Laureate, the Mayor of Pateley Bridge and the National Trust at Brimham Rocks near Harrogate in North Yorkshire to unveil and celebrate Simon Armitage’s “Balancing Act”. This poem was commissioned by the NT as a celebration the curious place that the iconic Brimham Rocks has in the landscape of Nidderdale National Landscape (formerly Area of Outstanding Natural Beauty).

Brimham Rocks Site of Special Scientific Interest (SSSI) is notified for its ice age weathered gritstone tors and rounded balanced boulders, and associated open heath and woodland. In Balancing Act Simon Armitage reflects on his experiences of Brimham Rocks. From childhood recollection of an other-worldly place and today as a landscape that intimately connects between nature and people, the poem closes ‘...look, a micro-moth carries both rocks and moor across the papery scales of its wings’.

Inscribed into two free-standing sandstone pillars (see page 8) by NT mason Richard Dawson, Balancing Act is rooted in the landscape which it describes and will now take its own shape over time and become a new surprise for visitors and curious scratching post for the Belted Galloways that graze the heath.

You can read the poem overleaf but I would also encourage you to hear Simon reading Balancing Act and reflecting on his own experiences of Brimham Rocks using the link below:

<https://www.nationaltrust.org.uk/visit/yorkshire/brimham-rocks/simon-armitage-at-brimham-rocks>



Simon Armitage at Brimham Rocks. Photo by National Trust

# Balancing Act

The rocks are something else, grandstanding here  
with their temple chic and their stage names,  
flaunting their alien shapes.

Fluted manhattans, melted castles, monster fossils,  
one gyroscopes on a stone spur,  
others trumpet their warped anvils and weird mushrooms  
over the valleys below and as far as the coast.  
Of course the horizon doesn't exist but here it is,  
a scattered henge, massive chunks of ballast  
holding the centuries down, keeping the planet in place.  
Counterweights to the mad contraptions  
of cities and towns, a jittery mind  
can lean into these blocks  
and sense the still centre of things thinking solidly back.  
The afternoon sunbathes on south-facing slabs.

And the moor is something again -  
the sky's garden, turfed roof of the hill.  
Of course the horizon is only a trick of the light  
but here it is, rolled out  
and chamfered into the clouds at both sides, a snug fit.  
It's raining now and the paths are streaming or frothing  
or puddled with dark brew but so what;  
away from the manic circuitry of the world  
a person striding this off-grid weather-farm  
is laundered and reset by buffeting winds  
and sudden light; the jumbled mind  
can feel itself grounded, earthed.

Look, a micro-moth carries both rocks and moor  
across the papery scales of its wings.

Simon Armitage

## Mike Harley Obituary: Earth Heritage and RIGS

Readers of Earth Heritage, and those of us who knew or worked with Mike Harley will have been saddened to learn of Mike's death back in May 2023. Especially so, as Mike was Managing Editor of Earth Heritage for its first 5 issues. Mike took over the Managing Editor role for the inter-agency magazine Earth Science Conservation from Des O'Halloran in January 1992, initiating a series of changes to increase reader participation and external contributions, noting that these changes were to shift the magazine from a 'twice-yearly report of the conservation agencies' to an 'organ of the Earth Science community as a whole'. Mike oversaw progressive changes to Earth Science Conservation for 4 issues, before the magazine was re-launched in January 1994 as Earth Heritage. By that time, and with the help of an editorial board backed by the fine graphic-design and production skills of Seabury Salmon & Associates, Mike had helped to transform the magazine into a much more accessible, attractive, and effective forum for the geoconservation community; a tool that is still our mouthpiece today.



Mike in 2002, after his change in role at English Nature to focus on climate change.

All photos © Natural England

Mike's contribution to geoconservation was much wider than just Earth Heritage. His early roles at the Nature Conservancy Council (NCC) involved overseeing site clearance and enhancement work to improve the condition of geological sites and the production of field guides to support educational activities. For example, Mike was an editor of *New Sites for Old – a student's guide to the geology of the east Mendips* (1985) and the author of *Wenlock Edge geology teaching trail* (1988). The 1990 landmark geoconservation publication, *Earth Science Conservation in Great Britain – a Strategy*, identified 'expanding the RIGS network' as one of its major themes. Mike took on the task of spearheading the RIGS initiative on behalf of the NCC and later for English Nature, the successor to the NCC in England. Throughout the 1990s, Mike used his affable yet persuasive nature to stimulate interest in the emerging RIGS scheme at the grass-roots level, enthusing and encouraging personnel from wildlife trusts, local geological societies and museums, and many others, to conserve their local geological and geomorphological heritage by setting up RIGS groups, undertaking audits and establishing RIGS (Regionally Important Geological/Geomorphological Sites) in their areas. Mike must take considerable credit as a catalyst for the extensive network of RIGS groups which now exists.

Mike also played a key role in the Malvern International Conference of 1993, the first major international geoconservation conference in the UK. He was a member of the organising committee and an editor of the proceedings, *Geological and*



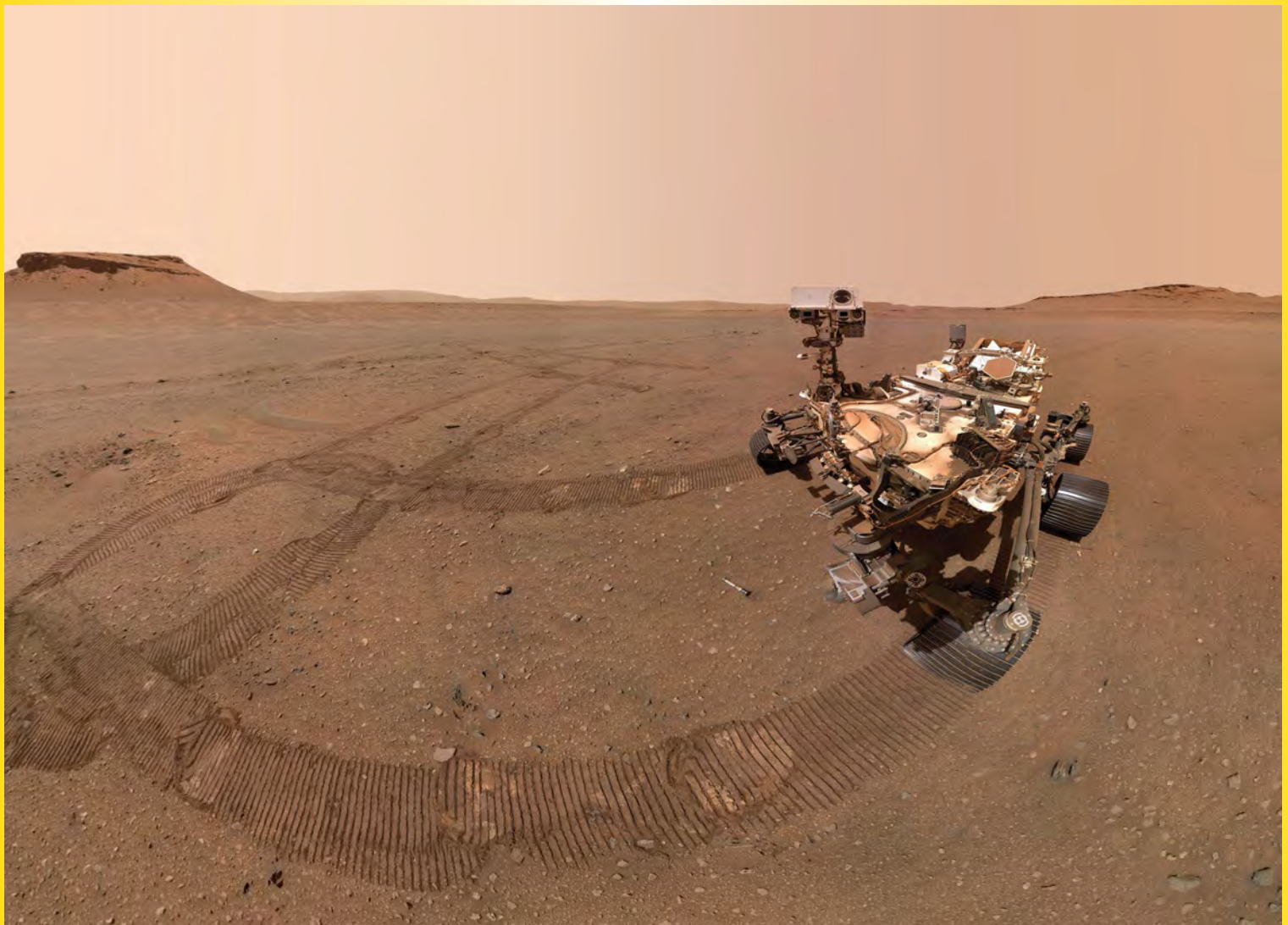
Mike at Hughley Brook SSSI in 1984.  
© Natural England

*Landscape Conservation – Proceedings of the Malvern International Conference 1993 (1994)*, as well as contributing a paper on RIGS.

Mike's career increasingly focused on engaging the voluntary conservation sector before he changed direction to work on the impacts of climate change on nature and the role of nature in adapting to and mitigating climate change. After leaving Natural England, the successor to English Nature, Mike continued to work in the field of climate change adaptation and mitigation in a consultancy role.

Mike was cheerful, down-to-earth, amiable, determined, well organised, and had the ability to enthuse and motivate others. He was always willing to do things differently and *Earth Heritage* magazine and the RIGS/ Local Geological Sites coverage would certainly not be what they are today without Mike's vision and influence.

**Stewart Campbell, Natural Resources Wales & Colin Prosser, Natural England**



# Earth Heritage in print

*Earth Heritage* is produced twice-yearly by the Geologists' Association, Natural England, Natural Resources Wales, NatureScot and the Quaternary Research Association.

It can be downloaded free as a pdf file from [www.earthheritage.org.uk](http://www.earthheritage.org.uk). You can also purchase a hard copy of any issue via [www.geologistsassociation.org.uk/earthheritage](http://www.geologistsassociation.org.uk/earthheritage). Subscribe to notifications of new issues at [www.earthheritage.org.uk/subscribe](http://www.earthheritage.org.uk/subscribe).

We thank all those who have assisted in preparing the publication, including the voluntary geoconservation sector who are major contributors. The opinions expressed by contributors are not necessarily those of the above organisations.

***Rum rocks for Mars mission* by NASA/JPL-Caltech/MSSS.**

**NASA's Perseverance Rover has collected samples of Martian rocks and soils which will return to Earth in the 2030s. Meanwhile, a team of geologists have collected hundreds of kilograms of igneous rock from the Isle of Rum to support the Earth-based preparation for Mars Sample Return (MSR) in the coming decade. Rum wehrlite rock provides a suitable analogue for the Martian rocks so the procedures that will be applied to the Martian rocks on arrival to Earth can be developed. Find out more in the article on p20.**

