WGCG
Hidden wonders in the landscape of Warwickshire
Warwickshire Geological Conservation Group

WGCG NEWSLETTER No. 50

WGCG members on the Shropshire field trip in June

Autumn 2025

Contents

WGCG ORGANISATION

i WGCG Aims and Objectives

WGCG is a charity operating under the rules of its constitution adopted 19th October 2011. It has two specific aims;

A. To advance the education of the public on the significance of geology: for the understanding and aesthetic appreciation of landscapes, for human settlements and economic activity, for recreation and leisure and for ecology.

B. To conserve the geological heritage of Warwickshire through identification and active conservation of geological sites and through fostering an interest in and knowledge of the geology and landscapes of Warwickshire.

We achieve these aims by:

- Holding educational meetings from September to April for members and non-members
- Holding field excursions of short, medium and long duration throughout April to September for the benefit of members and non-members.
- Monitor and maintain an LGS (local geological site) register and annually undertake geo-conservation of selected exposures within Warwickshire.
- Hold an annual educational workshop in February.
- Working with 3rd party organisations such as The Geology Trusts and participate in externally organised events e.g. "Ask a Geologist" quarterly event at Warwick Museum
- Installing and maintaining information panels at key geological exposures
- Producing information brochures of local geological walks and exposures
- Providing a point of contact for geological support in Warwickshire for other organisations such as schools, local planning, etc
- Through the funding of educational awards

ii Appeal to members - Please get involved

WGCG needs volunteers. We have a specific need for someone to volunteer to become a Trustee at the next AGM in November. This is a great way to discover all about the range of activities that take place within our organisation and a chance to influence decisions on the direction of the group. The trustees are the Management Committee. There are a broad range of skills within the management committee, thus having a degree in geology is not essential. The first year as a trustee is mostly learning the ropes. Committee meetings are held on Zoom 6 times a year. Your location is not an issue for this role. Please complete the form on the following page to apply.

Your time is a valuable resource. Volunteering for WGCG of course makes demands upon your time. However, the rewards are plentiful and varied. Please do carefully consider this opportunity to assist the Group.

iii Soapbox / Holiday geo snaps / Geo-Article

Got something to say? Send your contribution to the NEWSLETTER via email to warwickshiregcg@gmail.com

Warwickshire Geological Conservation Group
Election of Trustees 2025

Nominations must reach The Secretary by 30th October 2025.

I would like to nominate the following member to serve as a Trustee of the WGCG.

Name of nominee (print):

Address:

e-mail: Tel:

I, (name of Nominee) am willing to stand for election as a Trustee and, in accordance with **Charity Commission Rules, am not a disqualified person. *** see note 1

Signed (by Nominee)

Personal statement (optional):

Proposed by:

Name (print):
Address:

e-mail: Tel:

Signature: Date:

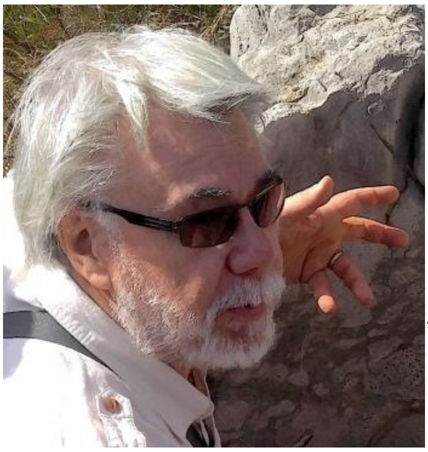
Note 1: The Nominee and Proposer must be paid up members of the Group. No-one under 18 can be a trustee of a charitable trust. For further information see *http://www.charitycommission.gov.uk/Library/guidance/cc30text.pdf*

Those disqualified from acting as Trustees (according to sections 178-180 of the Charities Act 2011) include:

A. anyone who has an unspent conviction involving deception or dishonesty
B. anyone who is an undischarged bankrupt
C. anyone who has been removed from trusteeship of a charity by the Court or Commission for misconduct or mismanagement, and
D. anyone under a disqualification order under the Company Directors Disqualification Act 1986
E. Anyone who has entered into a composition or arrangement with their creditors which includes an individual voluntary arrangement (IVA), and is currently on the Insolvency Register

Note 2: This form may be returned by e-mail to *warwickshiregcg@gmail.com.* Confirmation of receipt will be returned by e-mail .

FROM THE CHAIR (Stuart Burley)



The gales of last weekend appear to mark the end of the glorious summer of 2025 with a bluster. I hope you managed to make the most of this years' summer field programme to enjoy excellent geology and engaging tutorship under blue skies. If you did join some field visits, the many articles in this newsletter reporting the Group's field activities will provide fond memories. If you were unable to attend, read on with envy. We will have another engaging programme in 2026 – I hope to see you on some excursions.

As usual in this commentary I extend my sincere thanks to all those members who actively contribute to WGCG – your committees are very busy on behalf of the membership – please do feel welcome to participate wherever you feel you can. Given the bumper pack of field reports in this issue it is appropriate that I extend our collective thanks to Mike Allen, who steps down as Chair of the Education Committee (EdCom) at this year's AGM. Thank you Mike.

Mike needs no introduction. He has been a pillar of WGCG for more than a decade. He joined the EdCom in October 2014 and took over as chair in March 2016. Mike has chaired EdCom from the front with his gentle charm and huge geological insights. The winter lecture programme and summer trips we have all enjoyed are in large part down to his knowledge and vast network of contacts, supported by other members of the EdCom. It is not an overstatement to say 'WGCG would not be what it is without Mike'. We will be recognising Mike's contribution at the forthcoming AGM – please do come along in person to express your appreciation. Mike will of course continue to support WGCG and I'm sure he will enjoy many future talks and field visits. Ray Pratt will be taking over Chair of EdCom after the AGM, which will be enriched with a talk on the geology of the Warwick (now Helsby) Sandstone by a research student from Imperial College, Xiang Yan, who will be sharing new ideas on local exposures around Warwick.

EDITORIAL (Ray Pratt)

This October I shall be stepping down as a Trustee having spent six years, two full terms, in this role. As Secretary one of my duties was to stand in whenever an important role became vacant to ensure all key activities were covered. Nothing stands still so thankfully over the course of time others were found in due course to take over these roles. My role as Newsletter Editor is one of these temporary jobs which we are still waiting for someone to come forward.

Over the course of the last six years, we have become increasingly reliant on using technology and storing everything digitally. Whilst we haven't been hit for millions of pounds by a ransomware virus like many UK businesses, we have had some glitches.

You may have noticed that this newsletter has arrived a little later than would be expected for an Autumn edition. This is because I had a portable drive failure. Despite the WGCG folder being backed up about 4 weeks prior, the Newsletter file had not been. The disk was less than 1 year old. Fortunately, it was under warranty and the manufacturer was able to recover all the data.

My last disk failure was about 12 months prior to this. I was not able to recover any of the data. Thankfully most of it was backed up. Despite this it's still a major chore to go back into the backup files to reinstate and recreate your project databases. So, the lesson to be learned is make sure you back up your digital data frequently and don't trust a disk drive just because it is new. Interestingly enough I found an old portable drive in my desk drawer. It didn't work so I sent it off to have the data recovered. On return I found a number of files created in the 1990's in much earlier editions of software than on my PC today. Those files that did open appeared like wingdings or hieroglyphs. Sometimes there is something preferable in having hard copies – storage space allowing.

This has been a very busy summer field season, as you will discover as you read through this packed newsletter. Many thanks to all those members who have been actively engaged and have written up an event for the website and this newsletter. Events that have taken place in September onwards will be covered in the 2026 Spring edition.

OFFICERS CORNER

The Management Committee generally holds 6 meetings a year, monitoring all activity and making action plans for future work. Here is a snippet of the work we undertake in the running of your society.

In **June** we held our interim financial meeting where we reviewed our investment activities and performance which were broadly in line with overall market performance. The Trustees unanimously agreed to continue with Canaccord Genuity to manage our investments.

Kathrin, our Treasurer, gave us an overview on our income and expenditure. There were no issues or concerns. The total spend is forecast to be about £21,000 and the estimated income is about £20,800.

The Trustee Folder, our governing document, requires regular monitoring to ensure it is up-to-date in conforming with the guidelines dictated by Charities Commission and the way we work. The following areas were updated;

- Holloway Awards: criteria
- Holloway Bursary reporting requirements
- Financial Control Procedures
- "Safeguarding Policy" statement (NEW)
- Bullying and Harassment Policy & Procedure *(NEW)*
- Social Media Policy & Procedure (NEW)
- Planning began for the Christmas Social and the Annual Workshop
- The summer field trip events program and Public Engagement activities were reviewed
- A building application has been put forward that impacts the Napton LGS 58 site. WGCG are in direct contact with the builder and planning authority to ensure the site LGS exposure remains accessible.

The **July** MC meeting primarily followed up on outstanding matters from the previous meeting;

- We reviewed progress on the planning for the Christmas Social and the February Workshop.
- The MC were updated on the progress of the Napton LGS planning activity.
- We discussed the possibility that we may need to relocate our WGCG office. In preparation for such a likelihood members of the MC planned to review the office contents in the coming months.
- The MC members agreed to have a stall at the GA conference in Keele.
- Following the AGM in October both the Secretary positions require a new volunteer to take over.

NEWS

Geoscience apprenticeship

A headline news item this summer is that Keele University has introduced a 5-year geoscience apprenticeship leading to the qualification of a BSc hons. Keele is the first university in the UK to offer such a course, despite Geoscience apprenticeships being a hot topic for a number of years. The learning and assessment options are tailored to the individual’s professional background. The tuition is delivered via a combination of online content and face to face block release weeks which include practical laboratory and field-based elements. Given the cost of pursuing a normal geoscience degree without any guarantee of a job at the end of the course competition for places is expected to be keen.

GA Conference

Keele will host the GA Annual Conference 3-5 October 2025. A full program of talks on Saturday focussing on the local geology plus and interesting variety of local excursions on the Sunday should be tempting to many GA members.

Walkabout

An interesting article in the summer 2025 edition of Geoscientist discusses the unprecedented rate of movement of the Earth's magnetic field of up to 55km per year in recent years. We have a strong reliance on the magnetic field, not only for protecting our planet from solar radiation but for day-to-day activity such as mobile phone navigation apps. These movements necessitate updating of maps every 5 years to ensure accuracy. Don't worry though, the current magnetic field is strong and a magnetic reversal is not imminent.

The colour of gas

You probably always thought that hydrogen gas was colourless (like most gasses) but apparently not so. A report in the January edition of AAPG Explorer explains the colour coding given to hydrogen. **White hydrogen** occurs naturally in hydrogen reservoirs, accumulating in traps like hydrocarbons. Just like hydrocarbons, it requires a source, migration pathway, reservoir, trap/seal, and timing. To create hydrogen requires water rock interaction in the upper part of the mantle. Its longevity is limited as it is consumed in the subsurface through both biotic and abiotic processes. The former will be prevalent below 120°C whereas the latter is active above 200°C, so between 100-200°C there is a window for hydrogen accumulations. For the record the other "colours" of hydrogen are;

Grey: manufactured as a by-product from methane steam reforming and coal gasification
Green: Produced by the electrolysis of water using green energy
Blue: combines the production of grey hydrogen with carbon capture utilisation and storage

Fracking with Nukes

Also in the January edition of the AAPG Explorer was an article on the Gasbuggy Project carried out in the USA in the 1960's and 1970's. In 1967 a nuclear bomb twice the size of the one that destroyed Hiroshima was used to fracture a well at 4200 ft depth. The team predicted gas would flow through the fractures created by the blast and the collapse chimney would become a down hole collection chamber. The overlying formations were considered competent enough to contain the explosion. Following the blast tremors were felt for miles around. The rubble filled chimney was estimated to be 330 ft high and 160 ft wide. The molten rock created by the explosion settled at the lower part of the chimney. The original well casing was damaged requiring a sidetrack to be drilled from 3812 ft in order to evaluate the results. Gas testing went on for 15 months with production rates 6-8 times improved. However, unsurprisingly, perhaps, the gas contained measurable levels of radiation and long-term production estimates were disappointing as the fracture effectiveness decreased away from the detonation centre. In addition, the gas had a significantly lower heating value due to dilation with CO_2 and other contaminants. The radioactivity of the gas made it undesirable for commercial use without complex expensive processing. The site was demobilised and remediated in 1978, dubiously deemed a scientific success but an economic failure.

Fracking is not the cause of earthquakes

In the January Explorer magazine an article explains the findings of induced seismicity in unconventional resources. The production of shale gas in the USA is big business. In order to produce gas from these tight rocks fracking is essential. During the production of gas from these wells a significant amount of formation water is also produced which is re-injected into the formations. Injecting these saline fluids into the subsurface pressurises the formations elevating the pore pressure which will take time to diffuse away.

Monitoring of seismicity has been ongoing in these areas for many years. In 2016 the re-injection rates declined in Oklahoma which corresponded with a reduction in the number of earthquakes in the area. Before the connection was made between re-injection and seismicity many thought the actual drilling or hydraulic fracturing was the cause of the earthquakes – which does happen sometimes. However, not all regions show the same trends and relationships. injection along major basement faults is likely to cause larger movement than in smaller faults and weaker rocks where movement is smaller. On a positive note, none of the cases of seismicity caused by such injections has resulted in the loss of life or significant structural damage. There was no mention of aquifer water contamination - just in case you were wondering.

Tourmaline in Essex

In the June 2025 GA Magazine an article explains how black tourmaline-rich rocks have found their way from Cornwall to Essex, a journey of 300 miles. Black tourmaline is found in post-Anglian gravel terraces across much of SE England. It's all to do with the glaciations and their impact on river systems.

Could climate change trigger a financial crisis? -

Extracts from Shares magazine 24-07-2025

Droughts, wildfires and floods are no longer one-in-a-hundred year or one-in-a thousand-year events, they are becoming more widespread, they are happening more regularly, and their effects are becoming more devastating. As the world warms up, some countries are rolling back policies to combat global warming and energy companies are abandoning their promises to invest in renewables.

Of all the long-term problems facing the planet, global warming is perhaps the largest and the most difficult to solve and it is already having a direct impact on the insurance industry and the real estate sector in the US. In June, the temperature topped 40^{o}C across a large swathe of the US as a 'heat dome' took hold across eastern and central US states affecting tens of millions of people. This led to power emergencies as extreme temperatures put a strain on the electricity grid.

Take the example of Lytton, British Columbia, which in the summer of 2021 recorded temperatures as high as 49.6C before the town literally burned to the ground. 'When a team of climate scientists assembled days later to analyse the heat wave, they found the local historical weather data offered a paradox: their standard approach for estimating a heatwave rarity concluded the new records were too extreme to occur in the region where they did. They were, in a sense 'impossible', even though they actually occurred.'

insurance has not only become more expensive but fewer companies are willing to offer cover. Legendary investor Warren Buffett claimed that at some point the insurance industry would face an outsized loss due to global warming.
A study published in the journal Nature earlier this year forecast climate disasters could cost the global economy $38 trillion per year by 2050 compared with an estimated $417 billion in economic losses incurred by natural catastrophes last year. 'Without resilience strategies, especially increasing heat will cause $560 billion to $610 billion in annual fixed asset losses for listed companies, with telecommunications, utilities and energy companies most vulnerable,' warned the report.

Stalactites or Stalagmites?

We recently received a query from Andy Robinson, A UK expat living in Crete. He wrote,

"Hi there, I was hoping you may be able to help, I have a property in Crete and there were some quite interesting marble/stone structures on the site, and was hoping someone could help identify them and see if they are of any significant interest?"


His initial thoughts were that they could be Stalactites or Stalagmites.

Following examination of the photographs Stuart Burley was able to respond:

"Well, they are not stalagmites or stalactites. These have concentric growth structures rather like tree rings.

This specimen consists of stacked multiple crystal growths which in the photographs with Andy standing are arranged vertically. There are several phases of crystal growth recorded as marked by the change in colour and horizontal lines. Such structures can form in (i) large veins (as crystals growing into a cavity) or (ii) in very saline lakes as crystal cumulates on the shallow lake floor.

The context of where they occur in situ and whether they are calcite or gypsum (var. selenite) is important. It's not possible to say for sure what they are without this information. But during the Messinian (late Miocene, early Pliocene, 5 million years ago) the Mediterranean dried-up and huge evaporite lakes developed in and around the desiccated Mediterranean sea floor. There are thousands of square kilometres of gypsum deposits, including in Crete, Cyprus, Italy, Greece, Spain and elsewhere which are variously exposed and mined around the Mediterranean. Many cultures have used them for ornamentation and tiling.

So that's my guess. Selenite (a crystalline variety of gypsum, $CaSO_4.2H_2O$ – the same mineral as in plaster of Paris and plaster board, just more coarsely crystalline). Its water-soluble, so dissolves quite easily".

EDUCATION & STUDENT SECTION

We are pleased to announce that we have received a number of students applying for WGCG membership.

WGCG is one of a very few local groups that has the financial ability to support students through its WGCG Holloway Award scheme. We have traditionally assisted students by awarding grants to support their summer mapping or other projects. We are looking to expand the use of this scheme to assist students to participate in specific WGCG activities as summarised in the "Benefits of Student Membership" below.

Benefits of Student Membership

- Student membership is free
- Members can participate in our winter lecture program in person or via Zoom free of charge.
- Members can also participate in the Leicester Literary and Philosophical Society events (LLPS) free of charge thanks to our bi-lateral agreement (also broadcast on Zoom).
- Members receive a copy of Down-to-Earth and Down-to-Earth Extra delivered to their email address, free of charge.
- Members receive a copy of our bi-annual newsletter delivered to their email inbox.
- Members are encouraged to contribute articles to the newsletter – a chance to get your project or ideas published in a magazine with national readership
- Members receive email updates on geological activities from WGCG and a number of other societies around the country.
- Members can participate in our non-residential field trips free of charge.
- Members can take an active role in running and organising events.
- Member only events include our February workshop, the October AGM and the December Xmas social. There is normally a £15 charge to attend the workshop which is held for a full day on a

Saturday where geological training is given by our experts. **Students will be able to attend this free of charge.**

- WGCG organises 2 residential field trips annually. In 2024 we visited the Peak District and Charnwood Forest. In 2025 the first residential 2½ day weekend trip was to Shropshire. The second was in September where we spent 4 days in Northumberland. Member attendance charge is c. £25-£40 depending on the number of days. **Student members not only go free but are also able to claim support for their accommodation and travel costs via our Holloway fund.**

Making the most of your membership

Knowledge Transfer & Networking Opportunities: Local groups can usually benefit students through the depth of knowledge and wide variety expertise that exists within the group such as senior or retired university staff, professionals from energy, extractive industries, civil engineering firms and water resources etc with their links to firms and institutions. Many activities arranged by local groups draw on expert connections e.g. the leading of field trip or workshops. Participation in these can supplement or support student learnings from their course work. You will only be able to tap into these benefits if you get involved with some of our activities.

UK Geoscience benefits from local geological groups through:

- The maintenance and accessibility of inland geological exposures for the purpose of research and training is very dependent on local groups.
- Local groups monitor and help maintain Local Geological Sites (LGS) and Sites of Special Scientific Interest (SSSI) and are required to be consulted when any planning application is made that may affect such a location.
- WGCG is part of the Geology Trusts, through which we participate in government incentives and Natural England regarding the environment to ensure geology is taken into consideration in the drawing up of such plans
- Local groups are the core of Public Engagement efforts in schools and museums as well as engaging with the public during national events such a GeoWeek and Earth Science Week.
- Local groups support local museums and their geological collections.

We want to hear from our student members so please let us have your opinion

We understand that WGCG student members may spend very little of their time, if any, in Warwickshire and be mostly unavailable when we are running events. We hope that our use of Zoom for our talks programme, and the use of funding for specific activities will enable you to occasionally get involved.

If you have any suggestions on how we can improve our offering to you and other students we would love to hear from you. Please send your comments to warwickshiregcg@gmail.com with the heading STUDENTS

Students and researchers are invited to submit articles and field work reports for inclusion in our Newsletter, which they will be able to reference in their CV

Links

The Virtual Microscope (VM) for Earth Sciences is primarily an Open Educational Resource (OER). The VM project aims to make a step change in the teaching of Earth Sciences by broadening access to rock collections that are currently held in museums, universities and other institutions around the world. The Virtual Microscope allows users to examine and explore minerals and microscopic features of rocks, helping them to develop classification and identification skills without the need for high-cost microscopes and thin section preparation facilities.
https://www.virtualmicroscope.org/

Geology Bites: What moves the continents, creates mountains, swallows up the sea floor, makes volcanoes erupt, triggers earthquakes, and imprints ancient climates into the rocks? Oliver Strimpel, a former astrophysicist and museum director, asks leading researchers to divulge what they have discovered and how they did it. https://www.geologybites.com/

"The Shear Zone": Rob Butler, known for his talks on the geology of Scotland, created a YouTube channel during lockdown called "The Shear Zone" with well over 100 excellent, informative videos: https://www.youtube.com/channel/UCIUYjr1yPCZQWYl9cJCO1mA

"Geology from your Sofa": Content will remain accessible but embedded links may not work as they are no longer being maintained. https://geologistsassociation.org.uk/sofageology/

Holloway Awards 2024-25

Updated website to include an online application form

Award	Pledge	Note
Teacher Training and CPD		
ESTA Geoscience Summer School	£1500	
Student Individual Projects		
Birmingham University	£2000	Based on 5 students
CSM (Exeter University)	1200	Based on 3 students
Keele University	1600	Based on 4 students
Derby Postgraduate support	645	Equipment for 2 projects
Contingent	1500	
Total Pledges	**£8445**	

Student Award Reports:

Paleoenvironment, Glaciation, and Volcanism of the Tryfan-Pen yr ole wen locality, Snowdonia, Wales

Morgan Harris, Camborne School of Mines, University of Exeter

Summary

An extensive 24-day mapping project on the interconnected realms of volcanism, glaciation and paleoenvironment, focusing on an in-depth exploration of the Tryfan locality in Snowdonia, Wales.

The introduction of this dissertation establishes a comprehensive context for the reader, by synthesising already existing literature. Delving into the historical data and scholarly perspectives, sets the stage for a nuanced analysis. The methodology section elucidates the systematic approach that was employed to be able to capture the intricate details of Snowdonia's geological features. Which utilises on site surveys, satellite imagery and mapping tools. This hopes to provide a holistic understanding of the region's evolution. Findings during the 24-days highlight paleoenvironmental conditions, unveiling insights into the historical climates that existed. Along with impacts of glaciation and vegetation patterns. Examining the landscape morphology due to the history of volcanism reveal geological events that shaped Tryfan.

The geology comprised ignimbrites, shale, volcaniclastics and tuff. These formed in a shallow marine setting with volcanic eruptions within the area. It was then deformed by the Caledonian orogeny which produced

Tryfans Anticline and cleavage. This research will contribute to the academic discourse surrounding the history of Tryfan and
Pen yr ole wen, while holding those aspects of understanding the paleoenvironmental changes in similar settings. A comprehensive examination is provided by this paper, and this study advances our understanding of the geological dynamics.

Palaeoclimate reconstruction from mapping and microclimate monitoring or Cretan Caves

By Faatimah Hossain, Morgan Jarvie, Oliver Baker and Harry Leake. University of Birmingham

Summary
This study aims to improve the resolution of palaeoclimate records in Crete by assessing the suitability of speleothems from four Cretan caves for palaeoclimate reconstruction, with a focus on understanding Minoan climate-societal relationships. Fieldwork conducted in June 2023 involved mapping and monitoring the caves of Chainospilios, Skortini, Levantaka, and Karamaki. Cave microclimate data, including temperature, humidity, and CO2 levels, was collected and compared to external climate patterns to assess environmental connectivity and identify ideal sampling sites. Among the caves, ***Chainospilios Cave***, particularly a newly discovered chamber deep within the cave, was identified as the most promising location for palaeoclimate studies. This chamber exhibited stable microclimate conditions, including minimal ventilation, high humidity, and high pCO2, which are ideal for speleothem growth in quasi-equilibrium. These conditions suggest that speleothems from this site are likely to preserve a more accurate palaeoclimate signal, making it a prime location for future studies. In contrast, other sites showed less favourable conditions due to factors such as human disturbance, floodwater, and prior calcite precipitation, which can alter speleothem records. This research highlights the archaeological importance of Chainospilios Cave, particularly due to its proximity to the Minoan settlement of Knossos, and underscores the need for focused studies on active, unbroken stalagmites from the newly discovered chamber. The findings offer significant potential for enhancing the resolution of Crete's palaeoclimate records, contributing to a deeper understanding of how the Minoans responded to past climatic events.

The emplacement and volcanology of Palaeogene vents in the Cretaceous Ulster White Limestone Formation, Whitesands Bay, Northern Ireland.

By Gregor O'Keef, Isaac Finran, Max Horner, Louis Hays and Lucas Richards. University of Birmingham

Abstract:
This project investigates the geological complexities of a White rocks Beach vent on the Antrim coast of Northern Ireland, associated within the Palaeogene basaltic volcanism of the North Atlantic Igneous Province. Fieldwork involved advanced digital mapping using the FieldMOVE Clino app, LiDAR scans for precise clast analysis, and direct examination of geological features, providing a comprehensive foundation for the study of the White rocks Beach vent. Contrary to initial assumptions suggesting the early explosive phase ~62Ma was associated with the formation of the vent, the study challenges existing theories by proposing that the vent's activity occurred post the emplacement of the Lower Basalt Formation ~61Ma. The agglomerate composition, primarily comprising Lower Basalt Formation and the absence of juvenile magma strongly support the hypothesis of a magmatic phreatic hydrothermal eruption associated with the Portrush Sill. A model of the vent describes stages of evolution, involving gas-driven eruptions and seismic activity-induced pulses. This unique process contributes to the vent's distinct characteristics. The relationship with the intrusion of Portrush Sill dates the vent at least 5 Ma younger than initially proposed. Although associated with the Portrush Sill, the study concludes that the vent's eruptions releasing greenhouse gases were likely insufficient to significantly impact or trigger the Palaeocene-Eocene Thermal Maximum.

ESTA/EGU Geoscience Education Summer School 2025 – Organisers report for sponsors

Once again, the ESTA-EGU Geoscience Summer School was held at Aquinas College Stockport at the beginning of the summer break (28th July – 1st August).

This year 14 delegates were trained to teach up to A level standard. All but one had geoscience related degrees and all were qualified teachers of science or geography from all parts of the country; mostly recently qualified with two already established in the profession. Of these, seven are expecting to be teaching exam classes in geology at their school/college within the next 3 years, with 4 starting or continuing to teach geology A level this September. A snapshot of the responses is seen in Figure 1 which shows a pleasing proportion intending to start a geoscience/physical geography club as an extracurricular activity.

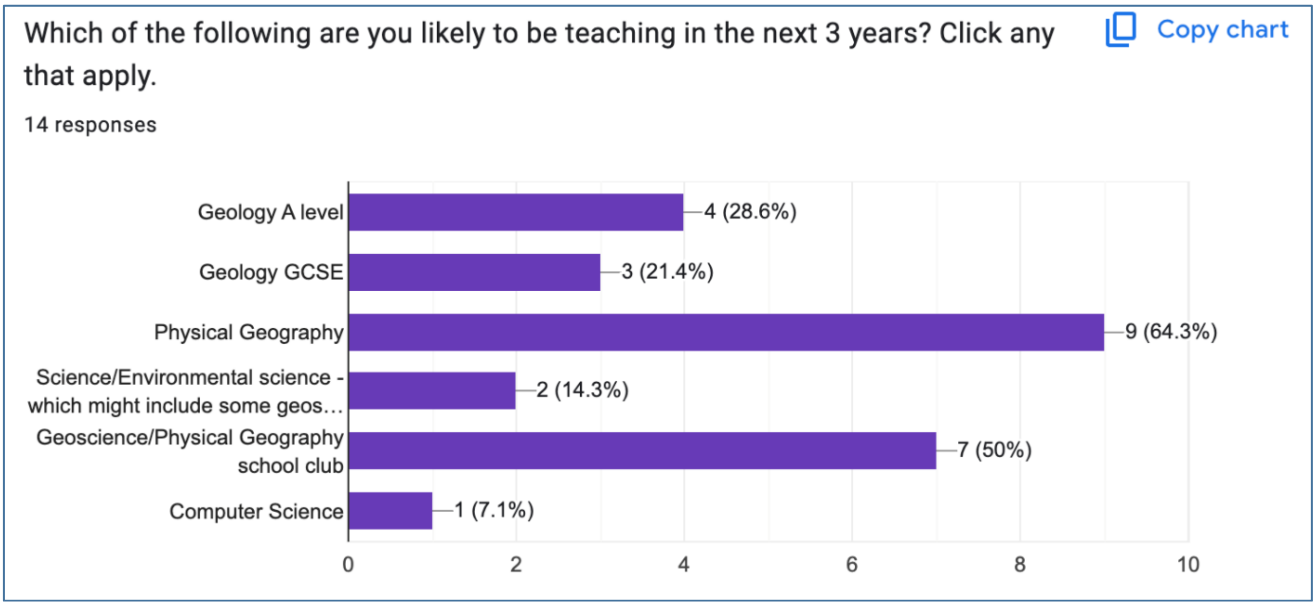


Figure 1.

The course covered all the pedagogical aspects of teaching geology as a school subject including practical work, integrated fieldwork (a half day was devoted to geology fieldwork and how to run a successful trip), 3D spatial thinking skills and an understanding of the many misconceptions that are passed onto students by non-specialists and the media. Sessions were also provided in 'thinking like a geoscientist', updates on plate tectonic theory and teaching strategies based on Earth Learning Idea activities. The full programme can be found in the Delegates Handbook alongside a bio of each of this year's sponsors.

We were also delighted that Ben Lepley (ESTA President and mining consultant) was able to give a keynote address entitled "Why do we need to teach Geology".

Many of the activities were documented on social media (LinkedIn) and a selection of photos is available here and on the Earth Learning website. The delegates have formed their own What's app group to enable them to keep in touch with each other and the course tutors and each received a free year's membership to ESTA, along with a 50% reduction in the ESTA Conference fee for 2025.

Our grateful thanks to all our sponsors without whom the 2025 Geoscience Education Summer School would not have been possible. The following logos were included on all resources and the course formally endorsed by the Geological Society of London. We were also pleased that Simon Baxter (Soil Engineering) was able to join us again for a brief spell to share with us his firm's rationale for supporting the Summer School and to outline career opportunities in his sector. We offer this invitation to all our sponsors and would love for you to join us at some point at future events.

Endorsed by the
Geological Society of London

Many thanks to our current sponsors and supporters

During the evaluation of the course delegates were asked *"Do you have a particular message you would like to forward onto your sponsors?"* A selection of their responses are as follows:

Thank you for such an incredible opportunity. The course has been challenging, fun, educational, and such an amazing opportunity to connect with colleagues in our field that we wouldn't have normally encountered. It has been so amazing to truly learn from the best in earth science education!

Thank you so much for this experience! I wouldn't be able to afford to do this if it wasn't for sponsors and my classroom would suffer without my newfound knowledge.

Thank you for a brilliant opportunity to attend this course and to learn so much.

I really enjoyed the week. I made lots of new contacts and have become more confident as a geology teacher.

It was a great opportunity - and I can't wait to incorporate what I have learnt here into my teaching and try to enhance the amount of geology in my geography lessons.

A full analysis of the delegate evaluation sheets is available on request.

Pete Loader
(EGU Geoscience Field Officer - UK), August 2025

PAST EVENTS

Outreach (School visits)

3 primary school visits were undertaken by Peter Hawksworth, Kathrin Schutrumpf and Chris Vincett.

Public Engagement Events (Kathrin & Peter Hawksworth)

5th July 2025 Ask a Geologist', Market Hall Museum Warwick

by Kathrin Schutrumpf

On 5 July 2025, the Market Hall Museum in Warwick came alive with scientific discovery as families, students, and curious minds gathered for the latest **"Ask a Geologist"** event. Organised by the **Warwickshire Geological Conservation Group (WGCG)**, this free, drop-in session offered visitors a hands-on opportunity to explore the fascinating world beneath our feet.

Geology is more than just rocks — it's the science that helps us understand the Earth's history, the forces that shape the landscape, and the resources we rely on every day. Events like *Ask a Geologist* aim to bring this science to life, connecting everyday people with experts who can decode the story behind a pebble, fossil, or crystal.

Visitors had the chance to:

- Examine real fossils, rocks, and minerals from Warwickshire and beyond
- Use the microscope to explore hidden textures and crystal structures
- Bring in their own finds for expert identification

All set up awaiting visitors

Activities get underway

There was a particularly strong turnout from younger visitors, many of whom brought in their own rock and fossil finds. Their curiosity and enthusiasm created a real buzz in the room — and it was especially exciting for us to see so much young interest in geology and the natural sciences.

By learning about rocks and landscapes, we also learn about Earth’s deep time — its 4.6-billion-year history, marked by dramatic changes and extinctions, but also by the resilience of life.
The success of the July session continues a strong tradition of public science outreach in Warwickshire. These events not only encourage curiosity in children but also empower adults to think differently about the landscapes they live in and walk through daily.

The WGCG and Market Hall Museum plan to continue hosting *Ask a Geologist* events throughout the year, inviting more people to explore how Earth science shapes the world — and their place within it.

Ask a Geologist', with Dippy the Dinosaur and Friends. Herbert Art Gallery and Museum

31st May 2025 by Gareth Jenkins

The team at hand over: Marketa Kicmerova, Jill Mayes, Brian Ellis, Gareth Jenkins, Peter Hawksworth, Joe Mazgajczyk

Dippy the Dinosaur at Herbert Art Gallery and Museum

Back in December 2024 Gareth approached the Herbert Art Gallery and Museum in Coventry about doing an event to celebrate Geo Week 2025 GeoWeek - Earth Science. This was following the ongoing success of WGCGs 'Ask a Geologist' event at Market Hall Museum in Warwick. Following discussions with the museum a date of the 31st May 2025 was set to mark this week. You can read more about the Warwick event in Geoconservation Research: View of 'Ask a Geologist' at Market Hall Museum, Warwick | Geoconservation Research. The event at the Herbert ran from 10am to 4pm, somewhat longer than what had been done before at Warwick. As such, two teams of volunteers were recruited to cover and morning and afternoon shifts. Peter and Gareth attended for the entire time to provide support throughout the day.

The team set up shop opposite the Jurassic Seas exhibition Warwickshire's Jurassic Sea - The Herbert Art Gallery & Museum and under the tail of the iconic Dippy the Dinosaur Dippy in Coventry: The Nation's Favourite Dinosaur - The Herbert Art Gallery & Museum. Surely, nowhere better could be better placed for a team ready to talk about geology.

'Ask a Geologist' events allow the public to discuss geology in our everyday lives, geological careers, and geological science in general. We always have rocks, minerals and fossils on hand which the public can view and discuss. Additionally, a number of posters, geological references and free brochures of nearby geology trails are made available. A WiFi microscope on our stall allowed the specimens to be viewed on a tablet screen.

Brian demonstrates the properties of magnetite

Jill demonstrates the WiFi microscope

And what a great day it was! From the moment the doors to the museum opened a steady stream of people who already had an interest in things geological. The day coincided with the beginning of a new exhibition Brick Dinos Brick Dinos - The Herbert Art Gallery & Museum and there some life size dinosaurs roaming the space next to the WGCG team.

Anna the Ankylosaurus comes to say hello to the team

Gareth and Peter watch on as Ralph the Raptor strolls past

Joe and Marketa get to know new friend Bruce.

What is your favourite shell?

Gareth and family take a closer look at an ichthyosaur skull belonging to Finn

It was a great pleasure to be part of a wonderful day with the museum. Everyone enjoyed themselves and the museum have invited WGCG back in October 2025.

If you are interested in volunteering for exciting events like this and others then please get in touch at WarwickshireGCG@gmail.com and keep an eye on our website and mailing list.

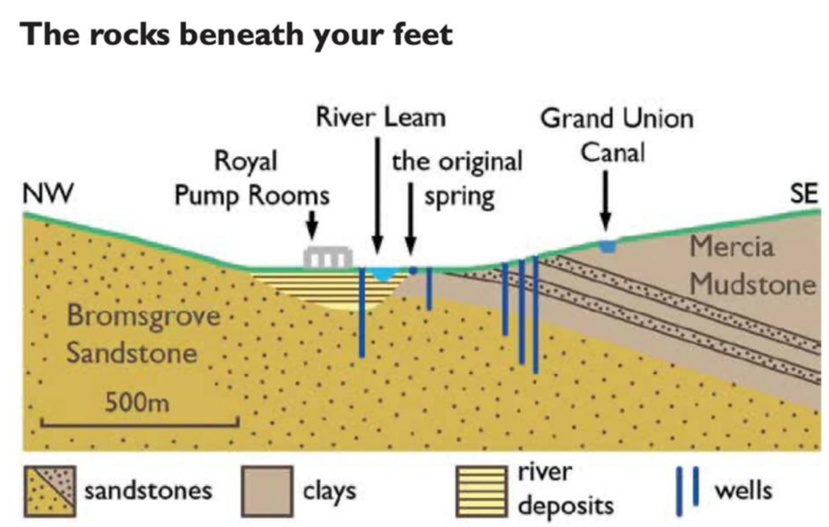
GeoWeek Event: Geo Walk in Leamington Spa: Reading the Rocks of Our Town

25 May 2025 | Guided by Jane Allum and Mihaela Bokor. Attendance: 15
Report by Jane Allum

On Sunday 25 May, a group of 18 intrepid budding and professional geologists gathered in Royal Leamington Spa for an eye-opening Geo Walk, led by geologists Jane and Mihaela. This wasn't just any urban stroll—it was a guided exploration through time, where building stones became storytellers, whispering tales of ancient seas, fiery magmas, and shifting continents.

Over the course of the morning, the group journeyed through the town centre, using a digital microscope to examine the fine textures, minerals, and fossils hidden in plain sight on building façades, paving stones, and decorative columns. Each stop along the route uncovered a different rock type, as Jane and Mihaela explained their origins, mineral compositions, and the environments in which they formed—often hundreds of millions of years ago.

First there was a bit of background provided by Jane about the geological origin of the springs that lead to the 'Spa' in Leamington Spa, the springs essentially forming at the interface of the Bromsgrove Sandstone (now Helsby Sandstone) or the Triassic and the also Triassic Mercia Mudstone Group. Many of the buildings in Leamington Spa are not constructed of load bearing decorative stones but rather from bricks made from clays mined from the local Mercia Mudstone which is then rendered to look like Portland Limestone.



The Geology of Leamington Spa

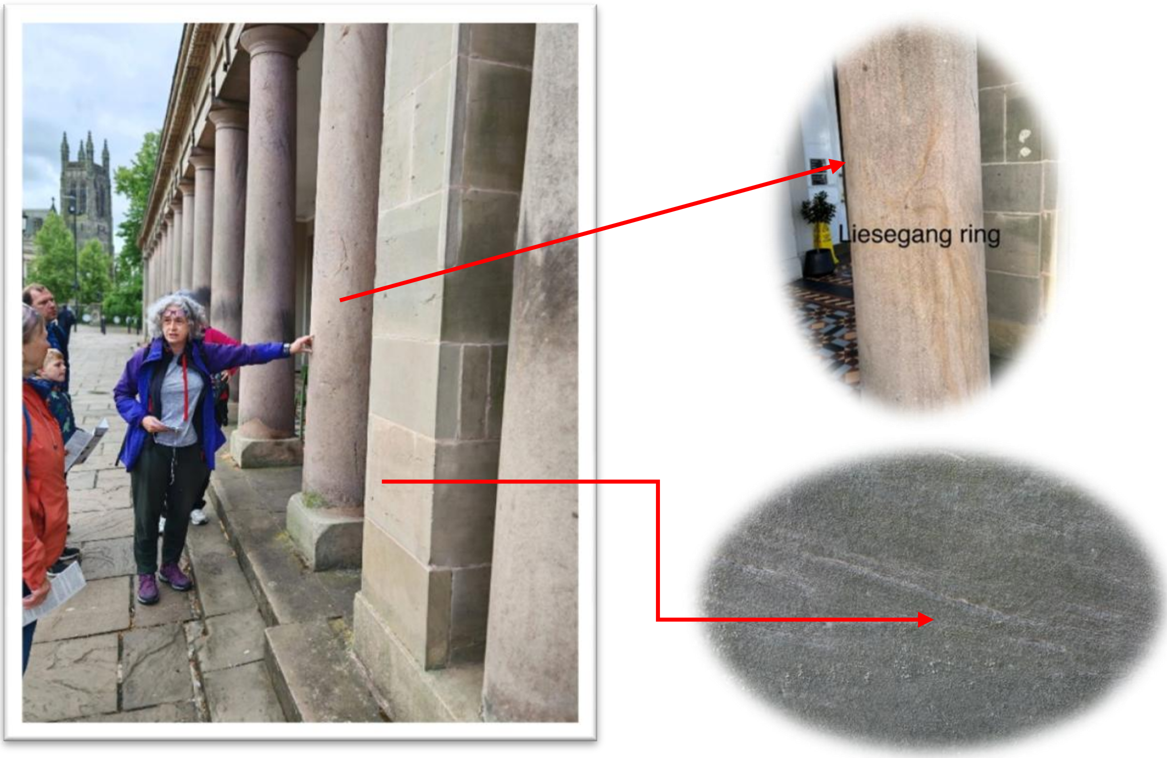
The tour included in depth observations and discussions on:

Sedimentary Rocks: Layered Histories

The first chapter of our walk began with sedimentary rocks, formed by the gradual accumulation of sediments laid down in ancient rivers, deserts, and seas.

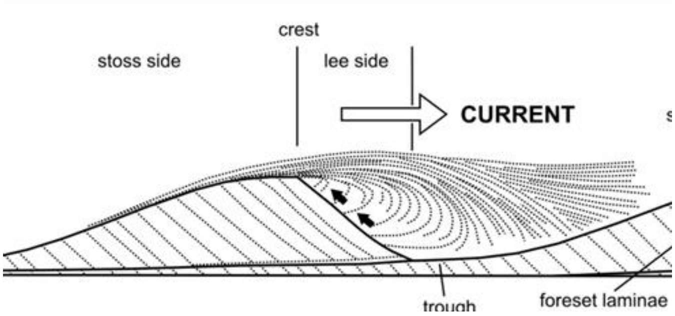
• *Feldspathic Sandstone Columns* (The Pump Rooms) with distinct Liesegang rings were an early highlight. These rings, formed by rhythmic precipitation of iron oxide during diagenesis (the rock's formation process), offered beautiful concentric patterns—almost like tree rings frozen in stone.

The sandstone's high feldspar content indicates limited chemical weathering and proximity to granitic source areas (Blatt et al., 1980).



Feldspathic

• Helsby Sandstone, a Triassic red-bed sandstone (~240 million years old), featured prominent cross-bedding structures, hinting at ancient dune or river environments. These sedimentary layers told of shifting currents and wind-blown sands in what was once a semi-arid desert landscape.



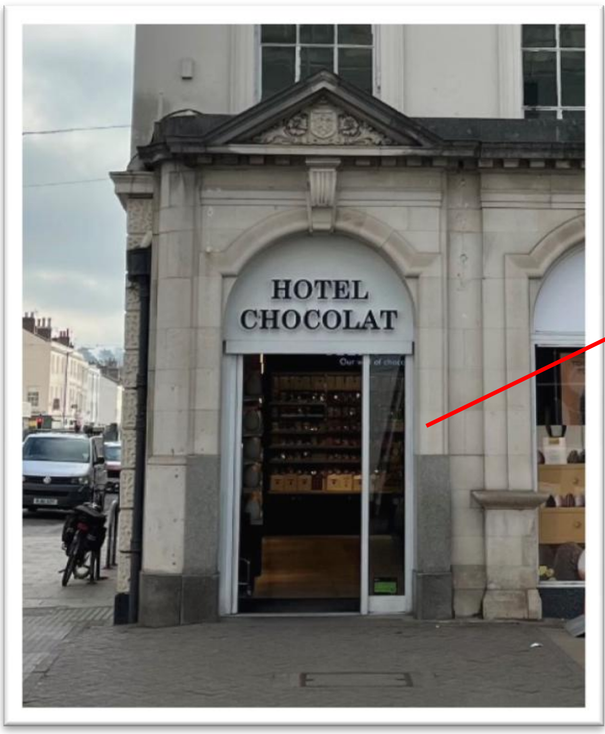
• Pennine Sandstone paving slabs, coarse-grained and durable, represented ancient deltaic deposits. These stones, quarried from the Pennines, Yorkshire, are commonly used in northern architecture and give towns like Leamington their robust streetscape. A Carboniferous-aged sandstone laid down in deltaic to coastal settings. Common in building and paving across the UK (British Geological Survey, 2021).

• Several iron-stained sandstones were also noted, their warm orange and reddish hues created by oxidation of iron minerals—a common but striking transformation over geological time.

• The group examined two classic ***oolitic limestones***:

• *Cotswold Limestone*, formed during the Jurassic (~170 million years ago) in warm, shallow seas, composed almost entirely of ooids—tiny spherical grains formed by rolling in calcium-rich waters. (Town Hall).

Portland Limestone from Dorset (Hotel Chocolat), also oolitic but often packed with fossilised oyster shells, giving glimpses of marine life that once thrived in the Jurassic seas. This stone is famously used in buildings such as St Paul's Cathedral.



Portland limestone naked eye

Portland limestone under microscope

- Travertine, a banded, porous limestone formed from calcium carbonate precipitated by spring waters, was seen in some decorative claddings, often associated with geothermal or CO_2-rich springs (Pentecost, 2005). Its formation is still happening today in places like Italy's hot springs—making it a living counterpart to other rocks examined.

Metamorphic Rocks: Recrystallised Beauty
As the walk continued, we moved from sedimentary to metamorphic rocks—those transformed by heat, pressure, or chemical fluids deep within the Earth.

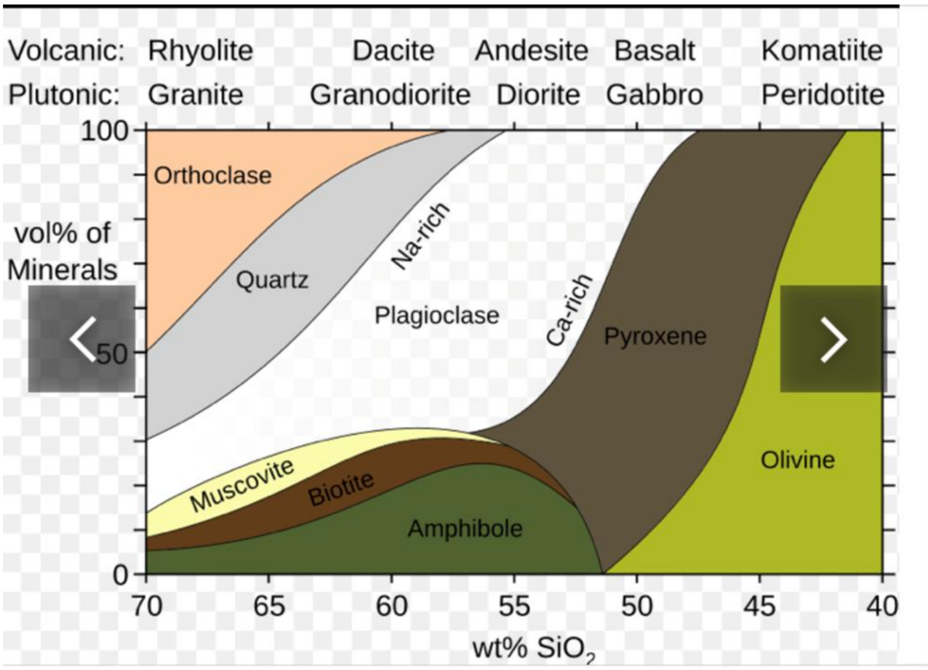
• *Carrara Marble*, used in many decorative building features, was admired for its clean, crystalline texture. Originating from limestone metamorphosed in the Italian Alps, this rock has been prized since Roman times for sculpture and architecture.

(Queen Victoria Statue)

• Vein Marble, with its intricate, swirling patterns, told the story of mineral-rich fluids infiltrating cracks in existing rocks, then crystallising under pressure to form visually striking veins—often composed of calcite or quartz.

These rocks reminded us that metamorphism not only changes structure but often enhances a stone's visual appeal—making it a favourite for high-end finishes.

Were we saving the best until last? Probably, because before we finished at Jephson Gardens we examined some beautiful igneous rocks. Mihaela explained that the size of the crystals in the rocks is dependent on a number of factors such as: crystallization time, stable conditions at depth (cooling rate), ample chemical components (crystal size) of the magma. Using the chart below we moved through Granite to Granodiorite and Gabbro rocks with the associated minerals.

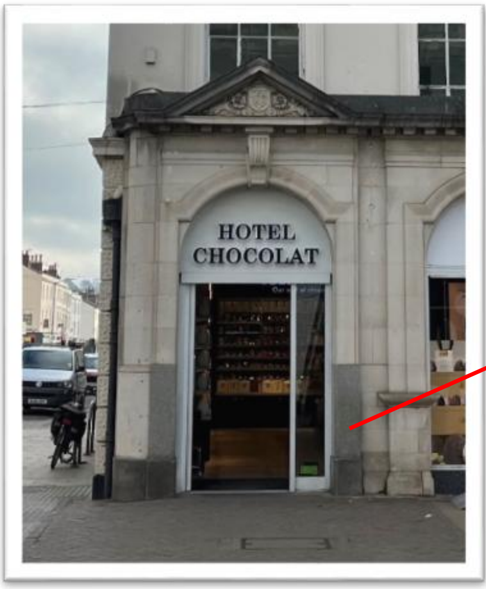


Igneous Rocks: Crystallised from "Fire" (plutonic rocks)

The tour culminated with a closer look at igneous rocks, born of molten magma and shaped by the rates and depths at which they cooled.

• The group examined several types of granite:

• A warm-hued ***pink Scottish granite from Aberdeen***, with large, visible crystals of feldspar, quartz, and mica.



• Equigranular granite, where all mineral grains are roughly the same size, indicating slow and uniform cooling deep underground.

• A striking porphyritic granite, containing large feldspar phenocrysts embedded in a finer matrix. These phenocrysts displayed a perthitic texture, where exsolution of potassium and sodium feldspar creates distinctive stripy intergrowths—visible under the digital microscope

• The granodiorite seen on building offered a contrast: light- coloured matrix (plagioclase feldspar dominant) the ground mass appears mostly white to light grey, because of the glassy grey, irregular clasts of quartz lesser amounts in granodiorite

We also looked to a ***gabbro*** underneath of the travertine in front of the McDonalds and the first inspection showed to us that is a mafic intrusive igneous rock, forms when mafic magma cools slowly deep in the Earth’s crust. Contains less silica than the other igneous rocks we have been looking and are rich in magnesium and iron rather than the feldspar and quartz (as you can see on the chart)

.

• Particularly eye-catching were the Larvikites, two varieties of this Norwegian igneous rock were on display within a short distance.

Blue Larvikite (Marks and Spencer) is an intrusive igneous rock; is predominantly composed of feldspar minerals, particularly ternary feldspars (alkali, anorthoclase, perthitic) and with a dazzling Schiller effect caused by light reflecting from aligned feldspar crystals.

• Emerald Pearl Larvikite, dark with shimmering flecks of green and silver, often used in polished countertops and upscale exteriors.(Stone the Crows).

These rocks not only reflect geological processes but show how aesthetics and durability influence architectural stone choices.

After inspecting more limestones and sandstone in Jephson Gardens we finished on the bridge with the cross bedded Helsby Sandstone. This Geo Walk showcased how urban architecture acts as a geological museum – each rock block in the wall or pavement can be a window into ancient environments. Cross-bedding in sandstones hinted at past wind-blown dunes or river channels, while the sparkle of feldspar crystals connected modern structures to magmatic processes deep within the Earth.

Learning Beyond the Surface

Throughout the tour, Jane and Mihaela shared not just facts, but enthusiasm—encouraging participants to ***observe***, ***touch,*** and ***question***. With the help of digital microscope, textures normally overlooked—oolitic grains, feldspar twins, fossil shell fragments—were revealed in fascinating detail.
Participants were often surprised to realise how diverse and ancient the rocks around them are. Stones used in ordinary building façades may have formed hundreds of millions of years ago in environments as varied as tropical seas, or deep underground magma chambers.

Final Thoughts

The Geo Walk offered more than just geological facts—it invited people to see their town in a new light. Leamington Spa, like many urban environments, is a living geology museum, where stones from across the UK and the world come together in a built landscape.

A massive thanks to Ray for all his support during this tour (Geo walk) and his time before to help us to do a good prepare and understanding. Another thank you goes to Kathrin for joining us during the tour and taking lovely photos you will see them below.

Time for a well-earned ice cream then!

- ***References :***

- *used the excellent Warwickshire Geological Conservation Group leaflet as a guide to our walk;*
- *BGS - https://webapps.bgs.ac.uk/Memoirs/docs/B01616.html*
- *Blatt, H., Middleton, G., & Murray, R. (1980). Origin of Sedimentary Rocks (2nd ed.). Prentice Hall.*
- *Ian Sanders(2018)- Introducing metamorphism;*
- *John Mason (2015)– Introducing mineralogy;*
- *Pentecost, A. (2005). Travertine. Springer.*

Geoconservation of the Kenilworth Sandstone in Castle Hill Quarry 17th May 2025

Report by Jane Allum. Attendance 12

A group of 12[1] keen and spritely volunteers, led by Jane Allum, met at the Castle car park and walked down the private road to the access Castle Hill quarry just off Grounds Farm Lane, a short distance beyond the castle visitor centre. A beautiful 21^{o}C sunny day had unfolded and the conservation party was ready to get started. The preferred access into the quarry is very steep but Larry cleared the entrance path and dug a handy step for us to enter safely (Figure 1). Ian Fenwick joined the group later in the afternoon and braved the barbed wire access point at the eastern end of the quarry, which we do not recommend. Stuart Burley had arrived earlier in the day to clear some of the nettles that had overgrown the quarry since the February recce so that once the party was in the quarry movement was relatively easy. Jane had consulted with the Warwickshire Wildlife Trust to assess the environmental impact of our geoconservation.

Figure 1. The cleared entrance into Castle Quarry and the path through nettles.

[1] Mel Dearing, Gill Chant, Andrew Sanderson, Mihaela Bokor, Tony Smith, Brenda Watts, Larry Wooding, Lousie Grew, Trevor Howard, Ian Fenwick, Stuart Burley and Peter Hawksworth.

Castle Hill Quarry is located close to the western extent of the Kenilworth Sandstone, a short distance from the Western Boundary Fault of the Coventry Horst (Figure 2), although the fault has no topographic surface expression. The quarry was worked into the uppermost part of the Kenilworth Sandstone Formation sequence – immediately to the south, basal mudstones of the Ashow Formation are mapped by the BGS (Figure 2).

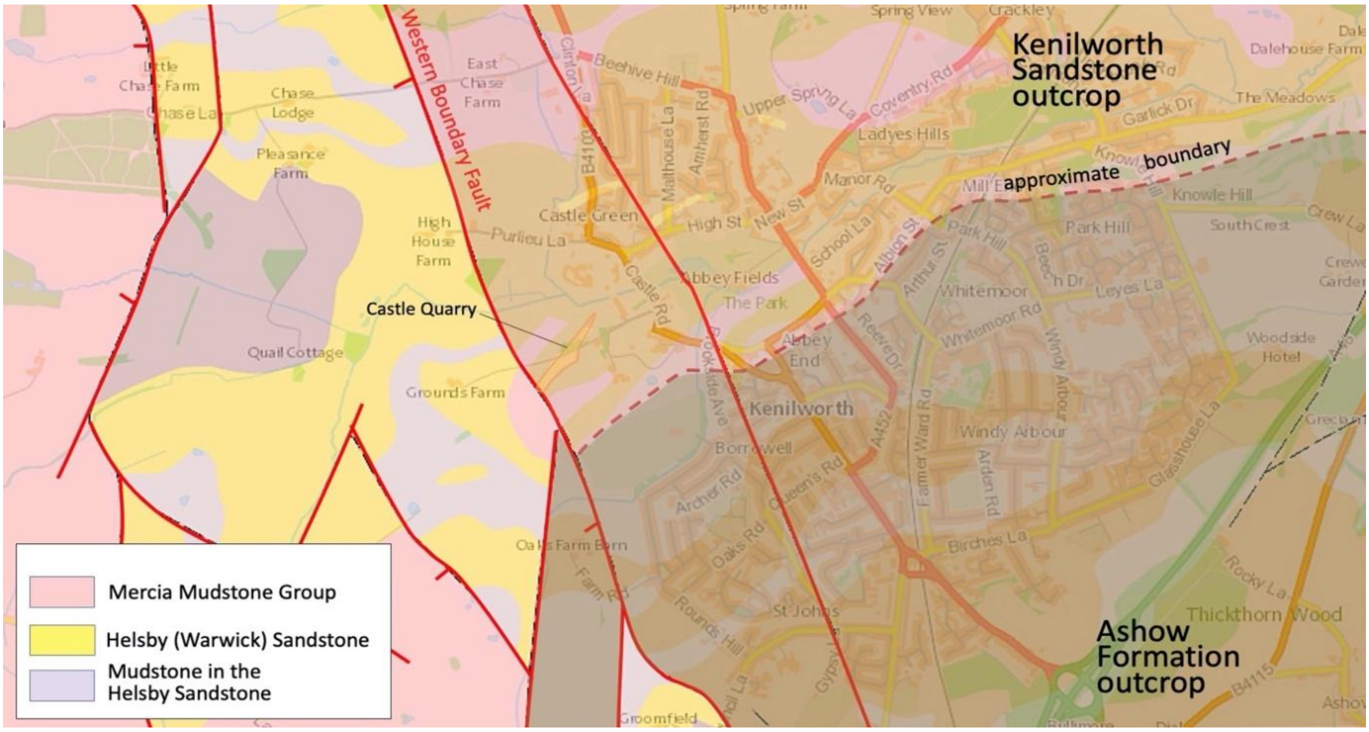


Figure 2. Location of Castle Quarry on the BGS geological map from GeoIndex.

There are three exposed faces in the quarry which we estimate provide a total of around 7m of stratigraphic section. The base of the face at the eastern end of the quarry has evidence of an active badger sett so no work was undertaken within 10 m of this face. Once in the quarry the conservation party split into two groups. One group worked on the so-called breccia beds in the southern part of the quarry whilst the second group focused on the flat bedded upper sandstones at the north-western end of quarry.

The geoconservation party worked hard for around 2 hours. At the end of the conservation activity, the quarry faces were superbly exposed. We then used the WGCG portable jet wash to remove lichen, moss and grime from the faces (Figures 3 and 4). Talus was removed from the base of the faces whilst hand brushing was initially used to remove ivy, moss and loose soil from the exposed faces.

Figure 3. The lower south-eastern quarry face before (left) and after (right) cleaning. Jane Allum later using the WGCG mobile jet wash system to clear lichen and moss from the face.

Figure 4. Clearing the upper north-western quarry flat-bedded face of shrub which made access difficult.

Ian Fenwick, who was involved in the archaeological surveying of the quarry a few years ago, related the anecdotal tale that the quarry was used for 12th and possibly 15th century repairs to the castle. Indeed, Kenilworth Castle has a long history of construction, rebuilding and extension from the 11th Century to the 16th Century with several areas of excavation clearly still visible in LiDAR images of Kenilworth (Figure 5). The quarry is located ~600m south of the castle but only ~200m from the embankments and outer walls of the military enclosure development. The archaeological quantity surveyor calculated that the volume of sandstone removed from the quarry was sufficient to construct most of the outer walls of the castle. Although it is not possible to establish the period when the quarry was worked it seems plausible that it was used for the later rebuilding and outer walls.

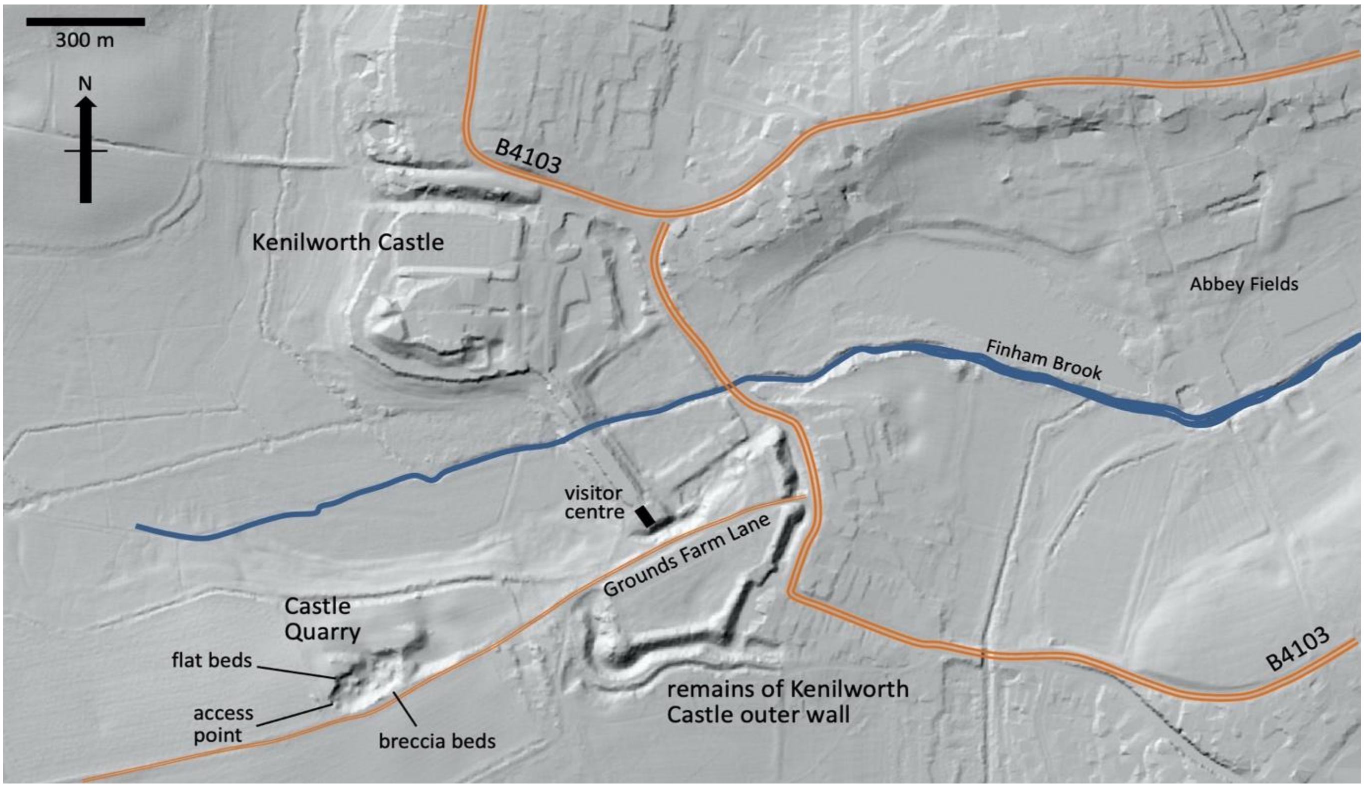


Figure 5. LiDAR image of the area around Kenilworth Castle illustrating the proximity of castle quarry to the remains of the castle.

Figure 6. A reconstruction of Kenilworth Castle as it appeared ~1420AD showing the main castle enclosure, the Pleasance Palace (in the distance) and the military enclosure – the Brays (foreground). Castle quarry is located on the southern side of the lake west of the Brays military enclosure. Image from English Heritage website on Kenilworth Castle.

Although of Medieval origin, the southern side of the quarry has clearly been used for early 20th Century fly tipping with ashy sand lining the side and floor of the quarry containing broken ceramics, an oyster shell (oysters being the food of the poor in the past) and numerous glass bottles. Figure 7 shows and example of a glass bottle in excellent condition which was manufactured by the Leamington Spa Aerated Water Company.

Figure 7. A glass bottle manufactured by the Leamington Spa Aerated Water Company recovered from the quarry floor.

Now that we have cleared the quarry of much vegetation and cleaned exposed faces much work will be undertaken to record the sequence of sandstones in the quarry, collect information on palaeocurrent directions and the pebble content of the so-called breccia beds. The Kenilworth Sandstone Formation is considered to be Permian in age, which spans ~50 million years, from the end of the Carboniferous Period 300 million years ago (Mya), to the beginning of the Triassic Period 252 Mya. Castle Hill Quarry exposes a sequence of cross-bedded and high energy plane-bedded sandstones in addition to the angular pebble conglomerates. At this time there was a mountain band to the south of the Midlands which had formed as Pangea was created. This event called the Variscan Orogeny created the Variscan mountain belt, which includes the mountains of western Spain, southwest Ireland, Cornwall, Devon, Pembrokeshire, the Gower Peninsula and the Vale of Glamorgan. There are several units of pebbly sandstones in the Kenilworth Sandstone sequence which are called 'breccias'. They are actually angular pebble and cobble conglomerates which are water lain deposits, their angular nature suggesting they have not travelled far. The clasts include PreCambrian lavas, Cambrian quartzites and Carboniferous chert which was used by Fred Shotten in 1929 to suggest that they were derived from the west, inferring a highland area as close as the Lickey Hills.

Now that we have very clean quarry faces, the task of better understanding these fascinating sediments is much easier (Figure 8). Field trips to Castle quarry and other related Kenilworth Sandstone outcrops will be organised by the group to explore how they were deposited and unravel their source provenance.

Figure 8. Freshly cleaned quarry faces showing the pebble content.

Thanks to everyone who gave up part of their weekend to participate in the clean-up and worked hard to such great effect. An excellent job very well done!

16th March 2025 MALVERNS Field Trip led by Dr NICK CHIDLAW. Attendance 12

Report by Gareth Jenkins

The Malvern Hills are one of the most distinctive landscapes in the English Midlands. Rising in a narrow north–south ridge about 13 km long, they reach 425m at Worcestershire Beacon. Their name is thought to come from the Welsh '*moel bryn'* meaning "bare hill".

The ridge is both a striking feature and a geological boundary. Hard Precambrian rocks of the Malverns Complex form the high ground, while to the east lie the younger Permian and Triassic rocks of the Worcester to Knowle Basin. The two are divided by the East Malvern Fault, a major structure that has shaped the land.

Dr Nick Chidlaw led the group on the day to explore some of the geological evidence of this fascinating natural history. Assembling in the car park near Tank Quarry (named after the adjacent water tank!) Nick gave the broad geological setting of the area we were to explore.

Nick explains the general geological setting of the Malvern Complex.

The day was cold and threatened rain. Fortunately, the rain did not materialise and the invigorating walks and discussions kept us warm and enthused.

Archie takes a closer look at the boundary between the Precambrian and the Triassic

The group look at the faulted edge of the Malverns

The Malverns contain a remarkable range of rocks that span vast stretches of time.

- At the core are some of the oldest rocks in England, between 680 and 565 million years old. These Precambrian igneous and metamorphic rocks were formed during ancient volcanic and tectonic activity on the Avalonian microcontinent.
- To the west, Cambrian to Silurian strata include sandstones, mudstones and limestones. The Much Wenlock Limestone, with its rich shelly fossils, records life in warm shallow seas. Volcanic ash falls are marked by bentonite layers.
- East of the ridge, Permian and Triassic deposits record deserts, braided rivers and seasonal lakes within the Severn Basin. Some beds contain reptile and plant remains.

Peter and Archie take a closer look at micro-granite intrusion in Tank Quarry

Micro-granite intrusion in Tank Quarry

Landscape and structure

The dramatic shape of the ridge is the result of earth movements. During the Variscan Orogeny in late Carboniferous to Permian times, the East Malvern Fault was reactivated. This uplifted the Precambrian rocks and deformed the older cover to the west. Erosion then removed the softer surrounding rocks, leaving the harder Malverns Complex as the ridge we see today.

Glacial and post-glacial processes of the Quaternary further shaped the area. Softer rocks were worn down while the resistant ridge remained as high ground.

Human and natural heritage

The Malverns are valued for more than their geology. The ridge marks the county boundary between Worcestershire and Herefordshire and the surrounding land supports farming and tourism. Since 1959 the hills have been protected as a designated landscape, now called a National Landscape. Since 2003 they have also formed part of the Abberley and Malvern Hills Geopark.

The hills are also known for their spring water, which flows from fractures in the rocks. These springs have drawn visitors for centuries, from Victorian spa-goers to today's walkers on the Worcestershire Way.

Reflections

The Malvern Hills show in one compact area the sweep of Earth history, from Precambrian magmatism to Silurian seas, Devonian rivers, Triassic deserts and the ice and erosion of the Quaternary. For geologists they are a field laboratory of contrasts, while for all visitors they remain one of the most striking ridges in the Midlands

WGCG Bradgate Park Field Trip Report

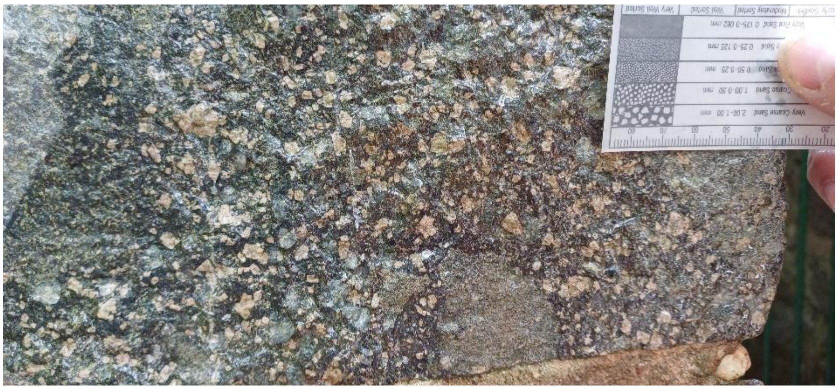
Leader Nick Chidlaw 1/6/25. Report by Ray Pratt Attendance 11

Bradgate Park is located in Charnwood Forest, Leicestershire, an inlier of Pre-Cambrian and early Palaeozoic rocks. The exposures visited on this trip were all Pre-Cambrian, mostly laid down in a deep water setting by turbidity currents. Many of the sediments were originally of volcanic origin that were reworked, often initially disturbed by tectonic earth movement. At that time the area was located in the high southern latitudes. Today Charnwood Forest is a dome structure with the lithologies younging away from the centre.

Participants: Will, Ray, Mel, Di, Peter, Nick, Helen, Alex, Colin & Gareth – Toposcope Old Johns Hill

Most of the area is covered by vegetated Triassic deposits. Crags of the highly folded basement rocks poke through in a NW-SE trend.

Stop 1 was at the public toilets close to the park entrance. These were constructed of Peldar Dacite Breccia, part of the Whitwick Volcanic Complex / Bardon Volcanic Complex thought to have developed sub-sea. They are of felsic composition



Peldar Dacite
Large light-coloured phenocrysts of feldspar in a fine-grained matrix. Large clasts of previous lava flow give a brecciated (agglomerate) appearance

Stop 2, Beacon Hill Formation, Old John Member, was the first outcrop visited. Located just beside Old John Tower, the beds were seen to dip steeply to the south whereas the cleavage, developed through compression, dipped even more steeply to the north. Small scale sedimentary structures were also seen in these outcrops. These thinly fining up beds were deposited by Turbidity currents

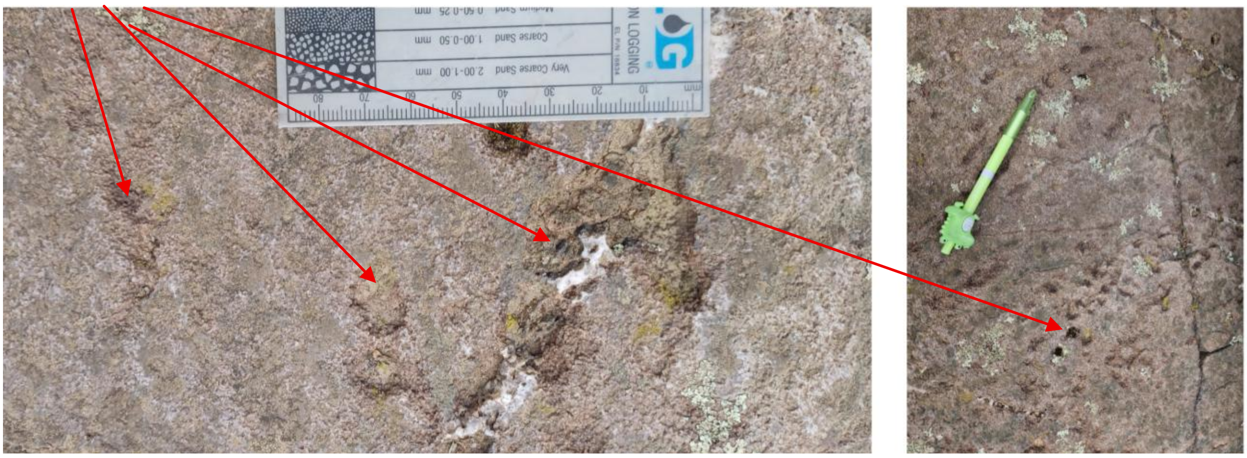
Sediment eroded off volcanic rocks, probably on land, began to be carried down by turbidity currents into the quiet marine environment, forming sand – mudrock fining upwards deposits of both the Old John Member and the Outwoods Breccia Member

A little to the south we crossed onto outcrops of the younger Outwood Breccia Member. Here dramatic slumping and inclusions of blocks were seen as a consequence of mass debris flow, probably initiated by earthquakes

Stop 3. Beacon Hill Fm, Outwood Breccia Member
Slumping & Mass debris flow

Following lunch on the lawn of the Visitor Centre, we headed to the next exposure located close to Bradgate House, home of the deposed Tudor Queen of England, Lady Jane Grey.

Stop 4, just to the south of Bradgate House, was a large quartzite exposure cut by a less resistant intermediate igneous dyke. Two lateral faults were identified running approximately east-west, parallel to the dyke suggesting a relationship between the structures and the igneous intrusion. The quartzite displayed ripple marks on its bedding planes and occasional cross bedding in section. On the top bedding plane, we found trace fossils of Arenicolites.



Stop4 Arenicolites burrows

Just to the west of Bradgate House the South Charnwood Diorites are exposed. Prior to the end of the Precambrian, crustal tension stretched the Charnwood area NE-SW, allowing magmas of both intermediate and felsic composition to rise into created spaces running NW SE in the Charnian Supergroup. These form a number of igneous intrusions of widely ranging size and extent, including the south and north Charnwood Diorites.

Stop 5*. South Charnwood Diorites (Markfeldite). Sill like intrusion, massive, coarse grained, deep seated*

The South Charnwood Diorite is c. 200m in total thickness. It is massive, mottled pink and green granophyric groundmass of quartz and alkali feldspar, with phenocrysts of red stained plagioclase feldspar and green chlorite (derived mostly from hornblende). It shows an intrusive relationship with the host rocks in the form of a Sill (or dyke like) body. It is estimated to be a minimum of 10 km long.

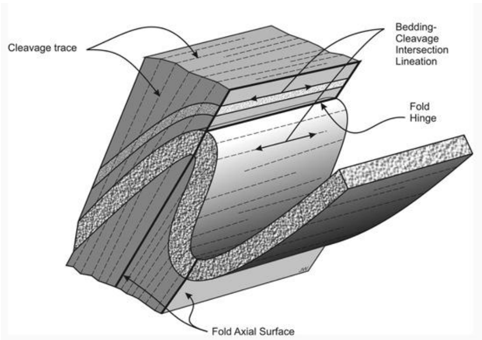
At this point Colin Baker of LLPS talked us through the draining pattern of the Bradgate area. Colin has kindly drafted a summary of this which features in this Newsletter.

Stop 6, Bradgatia Crag, exposes the uppermost division of the Maplewell Group, the Bradgate Fm. This is represented by the Hallgate Member. It is another thick deposit, over 600m, dominantly of fine to coarse grained tuffs which were laid down, then re-worked by marine currents and deposited again by turbidity currents. This environment was colonised by the enigmatic (?) sea pen *Charnia Masonii.* The rocks are blue-grey, fine to coarse grained tuffs. Flat laminated to thinly-bedded with fining upwards textures. Uppermost beds contain Charnia masonii. At this location Bradgatia linfordensis has been recognised.

The actual exposure containing the fossil has been cordoned off to prevent damage. In this picture some group members were examining nearby accessible bedding planes away from the cordoned off exposure in an attempt to find evidence of other surfaces that may contain fossils, in particular Bradgatia linfordensis.

Photo by: G Jenkins

At the final exposure of the day, stop 7, we examined the stratigraphic contact between Outwoods Breccia Member and the Bradgate Formation

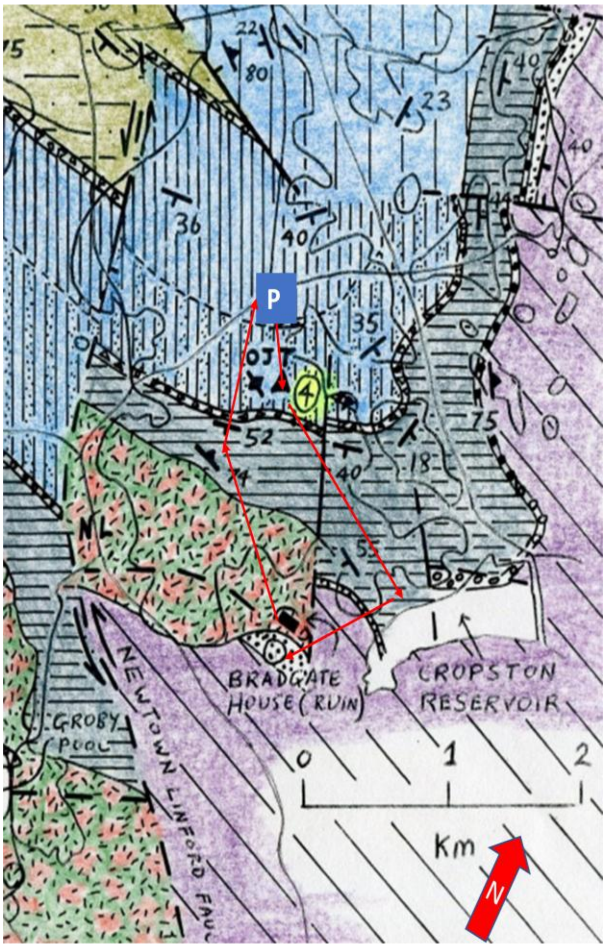


https://courses.eas.ualberta.ca/eas421/lecturepages/metam.html

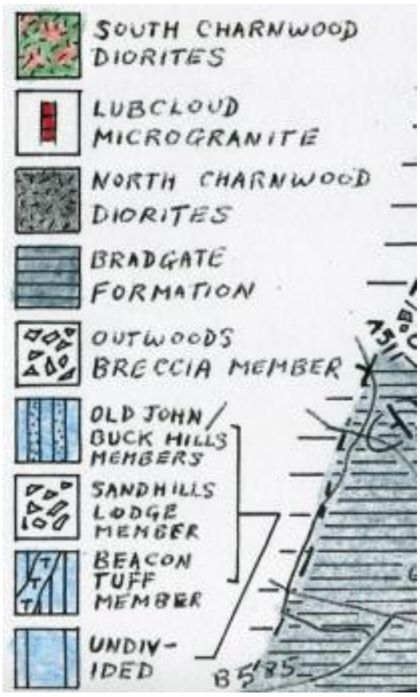
The interbedded nature of the argillaceous and sandy sediments of the Bradgate Formation has resulted in cleavage refraction through the more competent sandy beds. In an argillaceous unit the cleavage will develop at 90 degrees to the maximum stress. In the more competent interbedded strata the cleavage shows an oblique refraction from this stress direction, (see schematic opposite).

Stop 7
Beacon Hill Fm

Bradgate Fm: This is composed of reworked tuffs. The lighter coarser blocky sandy units fine upwards into the darker silty to argillaceous thinly bedded intervals in a cyclical pattern typical of turbidite deposits. Note the wavy bedding indicative of strong currents



The 6km circular route overlain on Nicks Geological Map of the area gives an idea of the variety of the geology seen during this field excursion

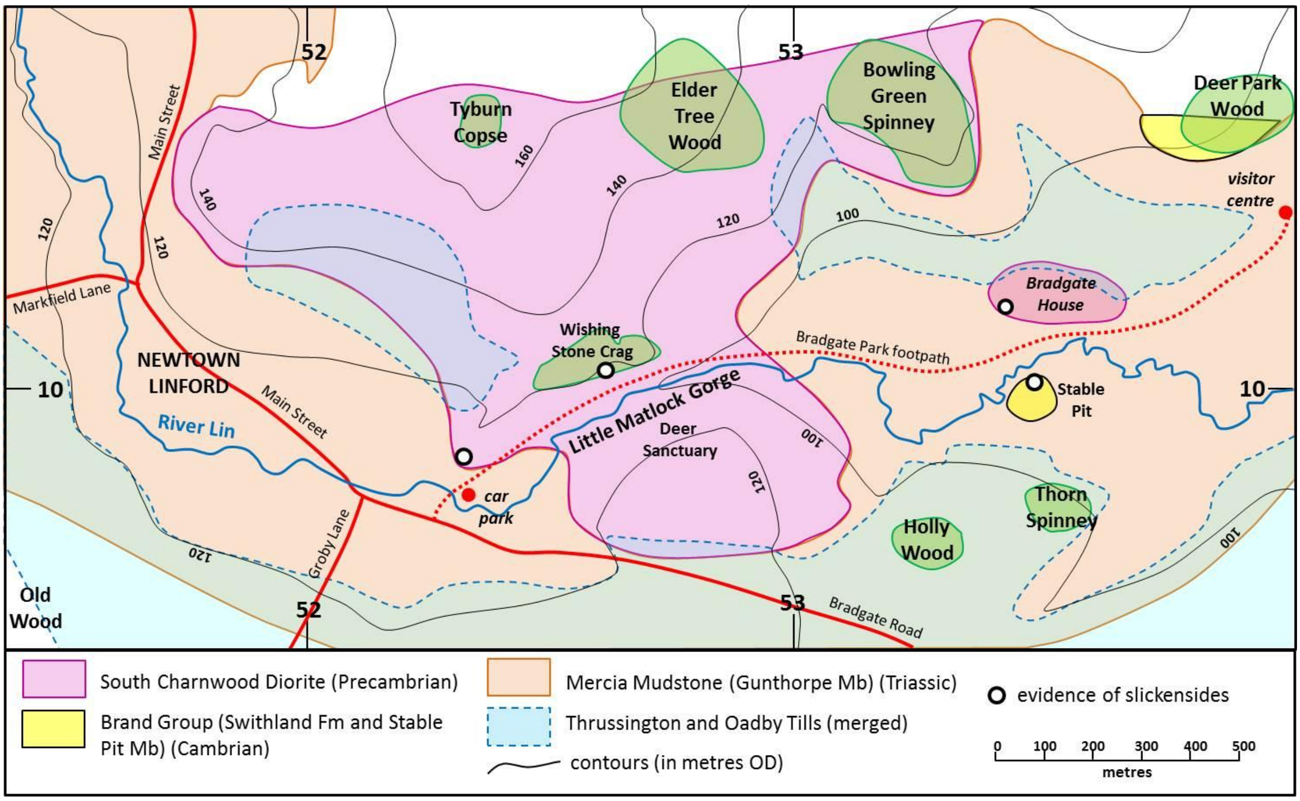


Map by : Nick Chidlaw

Little Matlock Gorge, Bradgate Park

By Colin Baker cabaker135@aol.com

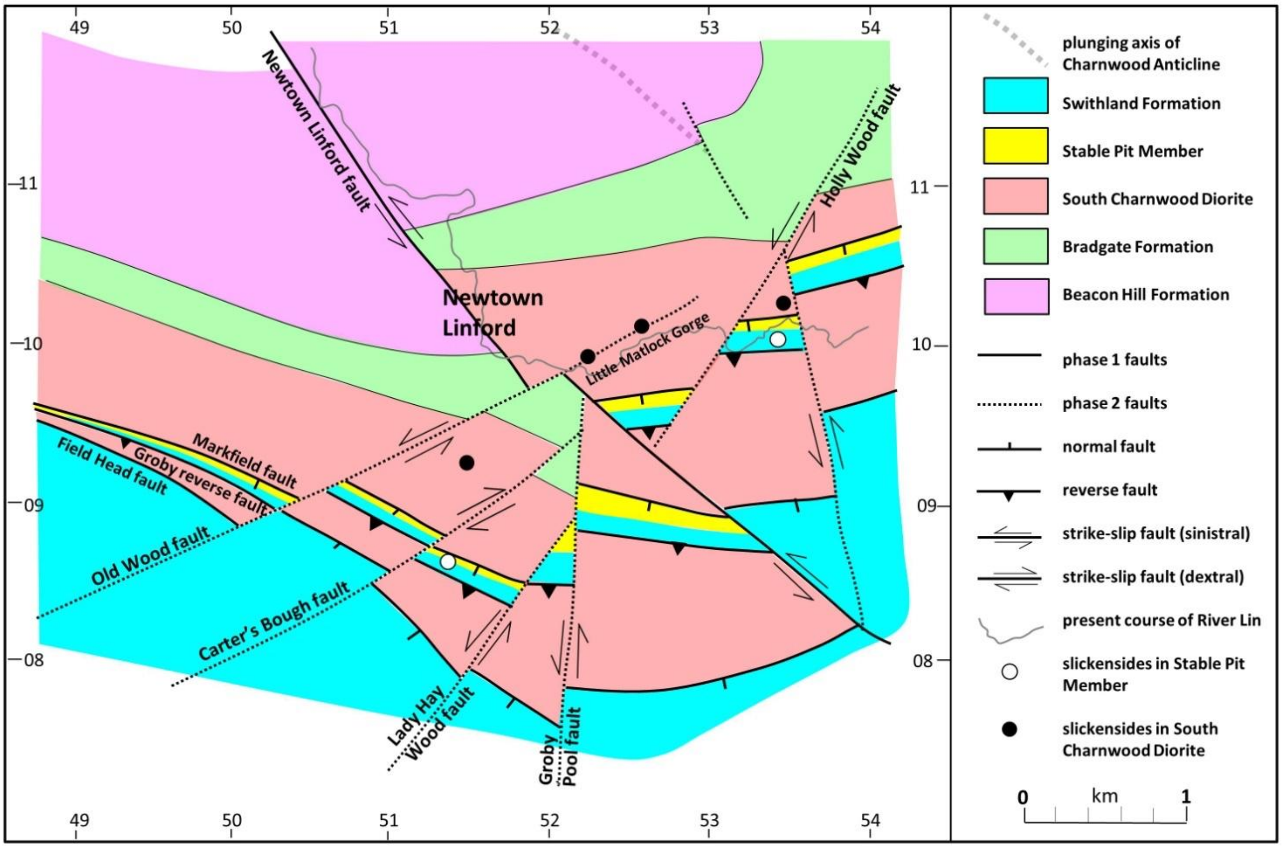
The landscape of Charnwood Forest consists of distinctive rolling hills, craggy summits and Triassic-based valleys (1). Bradgate Park, part of the Forest area and noted for its Precambrian stratigraphy, is home to an unusual feature, the so-called "Little Matlock Gorge" (SK 527100) (Fig 1). Part of the charm of this gorge (attracting park visitors since Victorian times) are the wooded rocky crags overlooking the landscaped pools and weirs of the River Lin. It is cut directly into Precambrian South Charnwood Diorite (2) visible on its north side, around Wishing Stone Crag, and in the bedrock channel of the river. The course of the river is clearly discordant to the Precambrian/ Cambrian basement, one of a number of streams radiating off the Charnwood high ground (3). The discordant nature of these streams has been known for well over a century (4, 5, 6), and is the subject of a recent review (7). Note from Fig 1 that outcrops of mudstone and till stop short of the limits of the gorge; almost certainly these passed through the gap at one stage, but were later eroded out, probably by glacial meltwater. The River Lin is thought to be in the process of exhuming a pre-Triassic palaeovalley, a classic example of "fossil" topography (8).



(Figure 1). Topographic and geological context. Contours based on OS Maps API (via National Library of Scotland). Geological boundaries taken from BGS 1:50 000 Series Sheet 155. Reproduced with permission of the British Geological Survey © UKRI [2025]. All Rights Reserved. River terrace deposits, alluvium and head omitted.

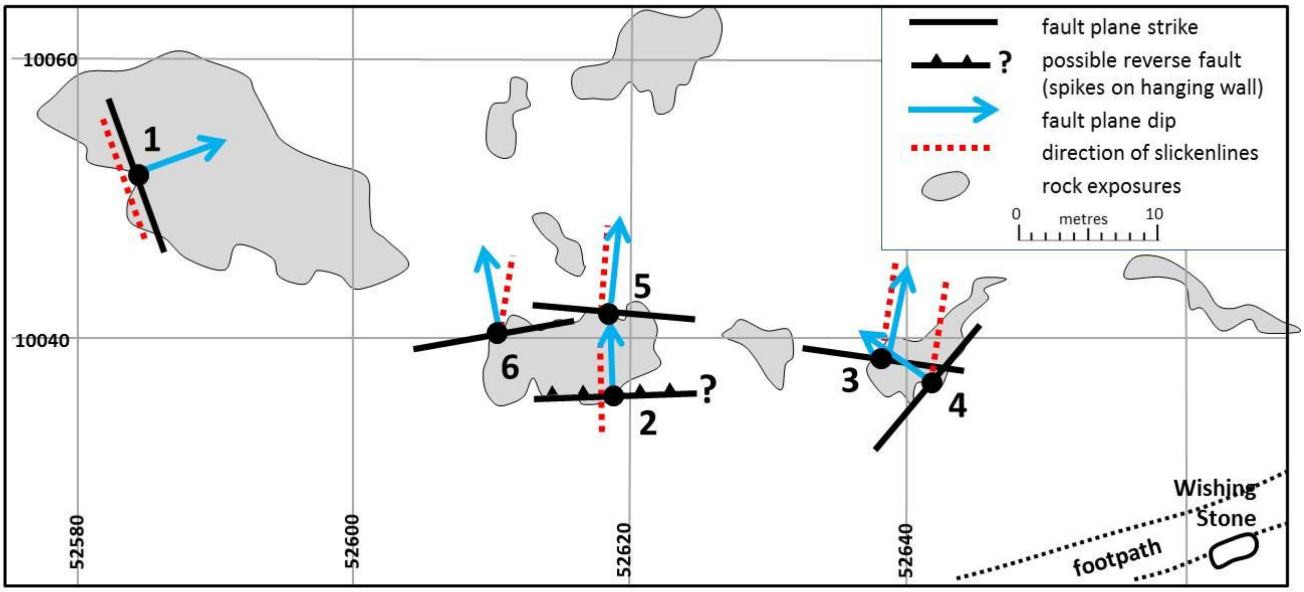
The river's course (Fig 1) is unusual in that the N-S aligned upper section (upstream of Newtown Linford) is clearly fault-guided (2, 9), broadly following the Newtown Linford Fault as well as the strike of Triassic mudstone, while the middle section, after a sharp bend, pursues its anomalous SW-NE course through the gorge. A line of least resistance should have followed a Triassic palaeo valley south-eastwards towards Anstey, but this route is blocked by thick glacial deposits (10). Subsequently, the postglacial course took the more difficult route north-eastwards through the diorite. Various explanations for discordance have been proposed (10): (a) superimposition, (b) exhumation, (c) glacial diversion, and (d) fault guidance. Unfortunately there is no residual mudstone; also no till, erratics or striations survive that might confirm direct glacial agency. Revised BGS mapping (2, 11, 12), completed in 1975-6, found only minor evidence of faulting (10, 11). Discussion of origins has remained "speculative" (10).

The Precambrian/Cambrian basement is multi-faulted (2, 12), but largely concealed beneath thick deposits of mudstone (Sidmouth Mudstone Formation, Gunthorpe Member) and glacial till (Thrussington Till, Oadby Till, and variants) (Fig 2). Fault lines have had to be indirectly inferred e.g. the Newtown Linford Fault is a strike-slip (wrench) fault that displaces the Benscliffe Breccia and Sliding Stones Slump Breccia by between 800-1200 m (9, 13). Principal NW-SE faulting is considered to be Caledonian in age (2, 13), but "Brabantian" would perhaps be a better designation (14) (Nick Chidlaw, *pers. comm*.). Comprehensive analysis of the faulted basement was undertaken in 2012 in the Groby area (13). This established a 2-phased pattern of faulting, with Phase 1 aligned NW-SE (typically Brabantian), and Phase 2 consisting of secondary faults running SW-NE. Phase 2 faults are cross-cutting offsets which progressively wrap Cambrian strata around the nose of the Charnwood Anticline (13). Though Caledonian/Brabantian in age, these faults may have been reactivated later, perhaps during the Acadian and Variscan orogenies (9). Note that the Old Wood Fault displaces the Newtown Linford Fault. by about 100-300 m, and appears to run north-eastwards into the line of Little Matlock Gorge (Fig 2).



(Figure 2). Faulted Precambrian/Cambrian basement based on Scotney et al (2012), with positions of mapped slickensides. Some fault lines have been assigned local names to aid description.

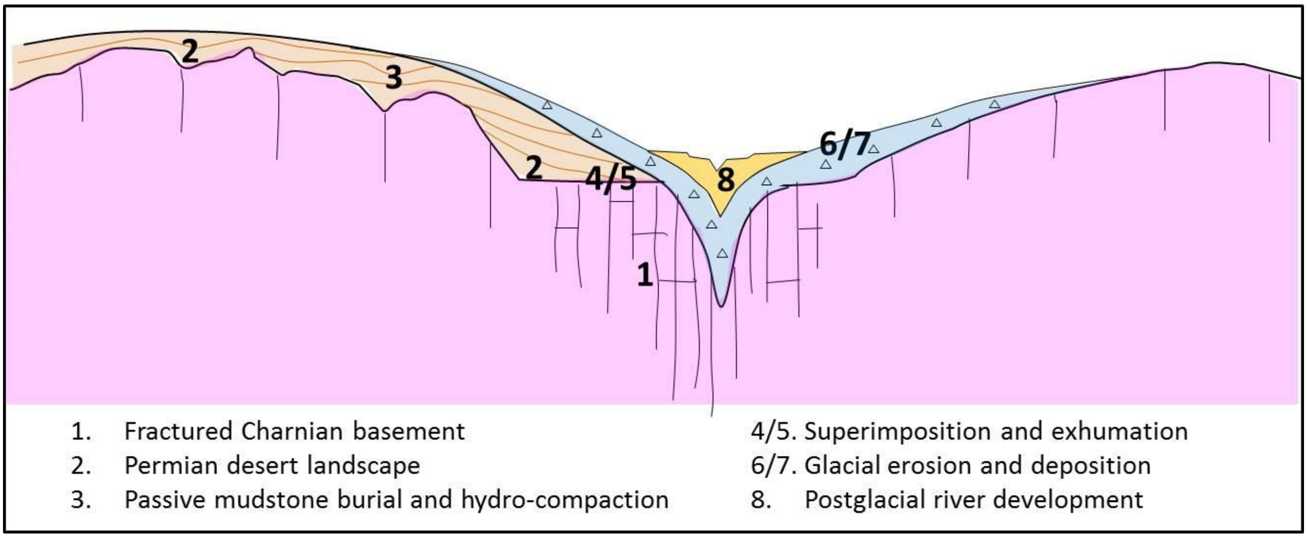
The evidence for faulting within the gorge is found in slickensides, i.e. polished, striated and fibrous surfaces aligned with the motion of faulted blocks. Slickensides within South Charnwood Diorite and Stable Pit sandstone have been reported locally (2, 10, 11, 13, 15). Wishing Stone Crag, located midway along the gorge, and easily accessible from the park footpath, is a case in point. About half a dozen rock surfaces here display slickensides in varying directions (Fig 3). It is recognised that the history of faulting can be a long and complicated one, and that slickensides may only register the latest in a series of complex movements (Roy Clements, *pers. comm*.). Site 1 shows sub-horizontal strike-slip motion along a NNW-SSE alignment. The fault plane dips very steeply at 81° to ENE; slickenlines run parallel to strike, plunging gently (5°) to NNW. Site 2, has a prominent W-E orientated strike with down-dip slickenlines dipping 54° to N. Superficially, its protruding hanging wall conveys the impression of a reverse fault, but it could, alternatively, be the exposed underside of a normal fault; "roughness" (i.e. slickenfibres are usually smoother in the direction of movement) is inconclusive. An added complication is that later reactivation of faulted structures has occasionally reversed the direction of throw (9). Sites 3 and 5 reveal dip-slip motion on low angle faults, probably cutting the Site 2 fault; slickenlines run perpendicular (NNE) to fault plane strike (WNW-ESE). Sites 4 and 6 show similar orientation, but with possible rotation. Final movement in most cases appears to have been S-N.



(Figure 3). Detail of fault slickensides in South Charnwood Diorite at Wishing Stone Crag.

Grid references in SK 5210, centred on 52°41'08"N, 1°13'23"W.

It appears then that faulting was indeed complex, having involved strike-slip, normal, oblique and possibly reverse motion. It is conjectured that this denotes a weakened fracture zone, probably tens of metres wide, running broadly parallel with the present valley line. It represents a continuation of the Old Wood Fault (Fig 2) and therefore points to fault-guidance as the most likely reason for the initiation of the gorge. This would have been well established during or after the Brabantian Event (late Silurian).



(Figure 4). A proposed model for Charnwood drainage evolution (a nested valley-in-valley approach)

The alignment was probably reinforced later by a Triassic palaeovalley and Quaternary subglacial incision. The concept of valley-in-valley morphology or nested valleys refers to a situation in which smaller valleys are embedded in and aligned with larger ones, such as a postglacial river incised into a larger glacial trough. Nested forms result (to borrow a Russian dolls analogy) in multiple valleys repeatedly contained within larger precursors. Charnwood Forest provides a number of examples of this where wadi-like palaeovalleys of Permian age, were cut into the faulted basement. Later passive infilling of Triassic mudstones led to "catenary bedding" or differential hydro-compaction (18) guiding supra-Triassic drainage that mimicked the configuration of the buried topography. Superimposition and exhumation followed on, which in turn influenced the direction of later glacial or subglacial processes. Finally postglacial streams re-occupied the valley, perpetuating the drainage line.

A good example of such nested and discordant valley formation can be found at Croft Bridge (SP 510959) (16). Another is Buddon Wood, Mountsorrel Quarry (SK 567145), showing a fault-guided palaeovalley with till cut into mudstone (17); the route however was never reoccupied postglacially and thus discordance does not apply. Black Brook (SK 465170) and Lingdale Brook (SK 537132) however clearly are discordant. Like Little Matlock, they are considered to be former pre-Triassic palaeovalleys (5, 6) but former mudstone infills have been lost to erosion. A multi-phased model for this nested valley-in-valley scheme is proposed (Fig 4). The model implies two significant hiatuses, at 1/2 and 5/6, being cycles of sedimentation, uplift and erosion in the Devonian-Carboniferous and Jurassic-Cretaceous periods respectively (1). Either of these could have been responsible for the radial drainage network eventually superimposed over the Charnwood area (John Carney, *pers. comm*.).

This review has highlighted the importance of fault-guidance in basement rocks in influencing the drainage pattern of the radial Charnwood streams; at least some elements therefore must date as far back as late Silurian. Little Matlock Gorge appears to have exploited a fractured fault zone following the line of the Old Wood Fault, and evidence of slickensides at Wishing Stone Crag seems to confirm this. A hypothetical model of nested valley incisions illustrates how, once established, the line of a river's course can be perpetuated by repeated cutting and re-occupation, especially during the Permian wadi phase and in the Quaternary glacial period. Streams do not necessarily exhibit all stages of the model, but classic discordant gaps, like that of Little Matlock, probably did evolve this way, even though infill evidence may now be lost to erosion.

<u>Acknowledgments</u>

Thanks to my colleagues at Ice Age Insights (Sue Cotton, Daryl Garton, Ian Ross), John Carney, Roy Clements, Nick Chidlaw, and Bradgate Park Trust.

<u>References</u>

(1) Carney 2007, Merc Geol 16, 231 (2) Worssam and Old 1988, BGS Geol Mem Coalville sheet 155 (3) Rice 1972, in Pye (ed.) Leicester and its Region (4) Watts 1903, Geog Journ 21, 623 (5) Watts 1947, Geology of ancient rocks of Charnwood Forest. Leic Lit Phil Soc (6) Bennett et al 1928, Proc Geol Assoc 39, 241 (7) Baker 2025, Merc Geol 21,2 (in press) (8) Carney 2010, BGS Occ Rpt OR/10/041 (9) Strange et al 2010, BGS Geol Mem Coalville sheet 155 (10) Sutherland et al 1983, Trans Leic Lit Phil Soc 87, 1 (11) Kelk and Old 1982, BGS 1:10 000 sheet SK51SW (12) Moseley and Ford 1985, Merc Geol 10, 1 (13) Scotney et al 2012, Proc Yorks Geol Soc 59, 37 (14) Herbosch and Verniers 2015, Mem Geol Surv Belgium 62 (15) Carney 2000 Geol Cons Rev 20, 33 (16) Rice 1981, in Douglas et al (eds) QRA, Field Guide E. Midlands (17) Carney et al 2009 BGS Geol Mem Leicester sheet 156 (18) Baker 2024, Charnia, winter 2024

WGCG Field Trip to Shropshire: 13-15th June 2025

by Mike Allen Participants 11

Dr. Martin Whiteley was our leader and guide for this weekend visit to the south-eastern part of Shropshire. Eleven participants assembled in Much Wenlock on the Friday afternoon for a short introduction by way of inspecting the varied building stones of this attractive little town at the northern end of Wenlock Edge, a geological feature with the rare distinction of being captured in music, song and verse.

Instructed to meet at the Jubilee Fountain, the first problem I faced was finding this renowned landmark that two locals I approached for directions had not heard of…. This proved to be not the only such problem of the weekend (read on!) but soon resolved itself when familiar faces appeared in the market square, close to the prominent feature in question. Eventually, all participants duly showed up and Martin invited us to look closely at the materials used in the construction of the fountain, dating from Victorian times, the details of which apparently oblivious to locals. Three contrasting rock types presented themselves. A fossiliferous limestone full of shells and other fossil fragments (brachiopods, crinoids, corals, bryozoa and stromatoporoids being the most obvious – but alas no trilobites) obtained locally, from quarries along the aforementioned Edge, and of mid-Silurian age. Inscribed panels and other courses were cut from a sandstone from the north of the county at Grinshill, an aeolian deposit of Triassic age. The third rock was used for the fountain basin, and was accordingly made from a much harder wearing material, a pink granite from Scotland, possibly Peterhead (?). An amble around nearby lanes took in more vernacular architecture, principally of other local materials (mainly limestones and sandstones), ending with the Holy Trinity Church which included some more exotic lithologies including sandstones of both Carboniferous and Devonian age. These were of varying quality (and hence preservation), some revealing sedimentary structures of interest. Headstones in the churchyard also included Cornish slate and grey granites, reflecting the greater choice available to monumental masons over time.

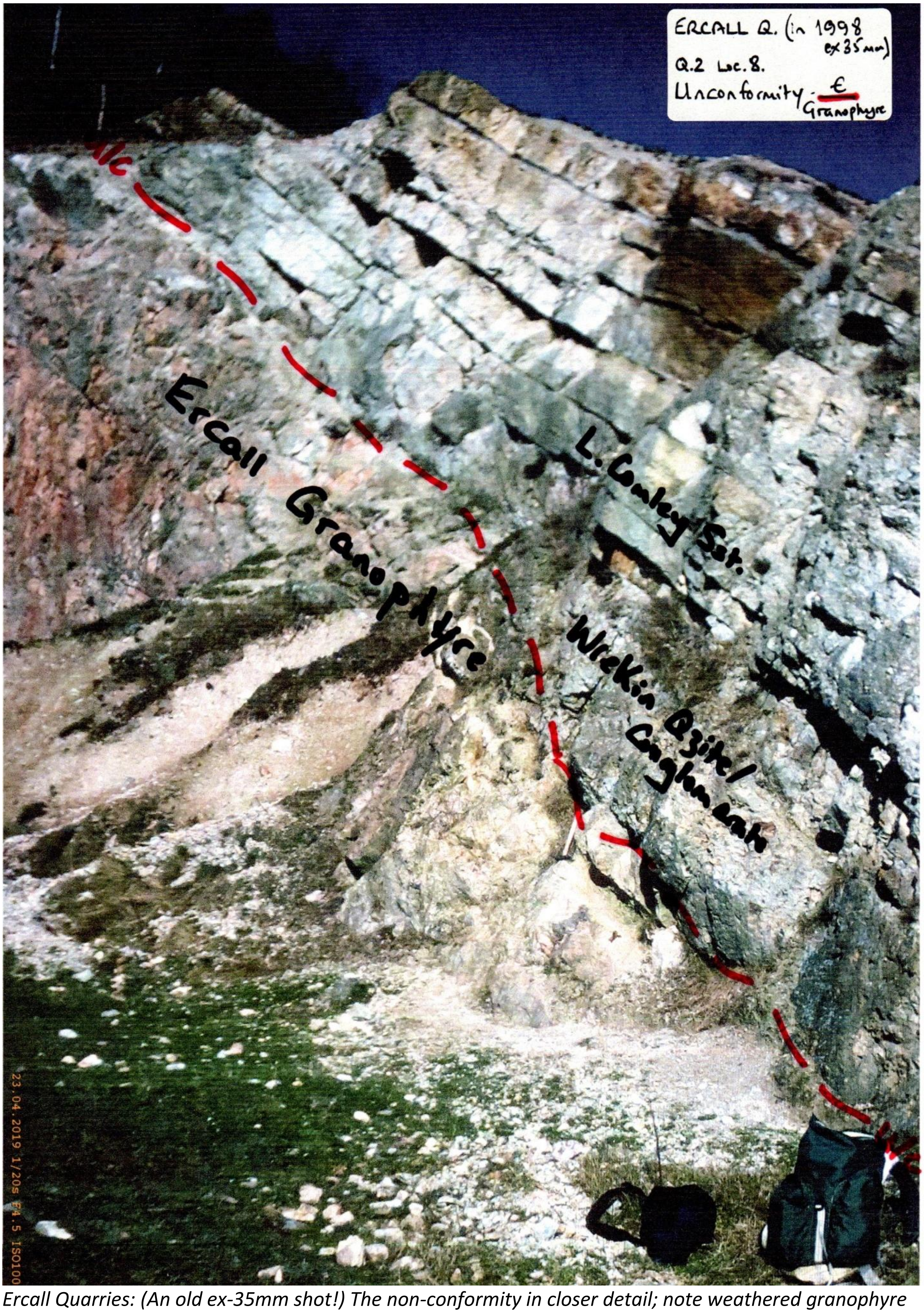
We then all retired to the Talbot Inn where a group dinner had been arranged, but before taking our places at the dining table we gathered outside for drinks and a comprehensive presentation of Shropshire geology, noting that this county enjoys perhaps the most complete geological record of any in Britain: everything from late Pre-Cambrian through to the lower Jurassic, as well as a record of the more recent ‘Ice Ages’. This weekend would take in much of the earlier geological periods (through to the latest Silurian), with promise of a ‘follow-on’ field trip dedicated to the later periods (Devonian to Triassic) next year.

Saturday began with us (all but one at first!) assembling in a parking area on the east side of Lyth Hill, a fine belvedere a mile south of the Shrewsbury by-pass. Unfortunately there was a rival parking area at the west end of the hill which ‘captured’ one member of the party (this proved to be an easy mistake to make as we found out only too well when returning to cars left behind - we needed to reduce vehicles to a minimum for the days manoeuvring along narrow, winding lanes) but mobile phone technology saved the day, and soon we were all together in the same place. This location, a ridge of resistant Pre-Cambrian sedimentary rock, offered a panoramic view from east to west, taking in The Wrekin, Wenlock Edge, the Church Stretton Hills and Valley (an important fault zone) the high Longmynd plateau and Pontesford Hill. The undulating skyline provided a fine canvas on which Martin was able to paint a picture of the main elements of Shropshire’s evolution described the previous evening.

Our next location involved a drive westwards, meeting up as close to the entrance of the Ercall Quarry as we could organise ourselves (the nearby Forest Glen car park, and road parking along a one way system, is a hot spot for people ascending the nearby Wrekin Hill (a Pre-Cambrian fault-controlled inlier of mainly volcanic rock, non-conformable on older basement schists). ‘The Ercall’, a collection five old quarries, is an excellent location to demonstrate several geological principles in a fairly contained space, notwithstanding that it is slowly returning to nature with uncontrolled regeneration of trees etc. Only three of the quarries now offer reasonable exposure, the first of which was of late Pre-Cambrian rhyolite lavas and tuffs assigned to the Uriconian (named after the Latin name for The Wrekin). These subduction-related volcanics were deposited in an island-arc environment on the margin of an ancient southern ‘supercontinent’ (Pannotia), and in part reveal a spherulitic ‘flow’ texture. They have been dated at 566 +/- 2 million years old (Ma), amongst the oldest exposed rocks known in England. A little younger at 560 +/- 1 Ma, is the Ercall granophyre (a form of granite) seen in the next quarry. This was intruded into the Uriconian as a subducting plate began to melt at depth producing a modest volume of acidic ‘partial-melt’ material (more recently utilised for construction of the M54 motorway!). Unfortunately the contact is not exposed, but to compensate for this the boundary between the second and third quarry preserves the excellent ‘non-conformity’ between the granophyre and overlying sediments of early Cambrian age. At this surface one sees that the granophyre had been ‘un-roofed’ and partially weathered, producing kaolinitic clays which form a matrix to a basal conglomerate marking an onset of renewed clastic sedimentation when sea-levels rose, submerging the margins of the land.

Ercall Quarries: Information Board on site


Ercall Quarries: The non-conformity between the Ercall Granophyre (left) and bedded Cambrian beds (right)



Ercall Quarries: (An old ex-35mm shot!) The non-conformity in closer detail; note weathered granophyre below the contact

Ercall Quarries: 3rd Quarry - rippled surface in the Lower Comley Sandstone (Lower Cambrian)

Further sedimentation built up a sequence of quartzite, sandstone, limestone and more sandstone, reflecting changes in the depositional environment (essentially the water depth) during the Cambrian period. Two areas in the upper parts of the second and third quarries preserve an excellent ripple-marked bedding surface (a 'fossil beach') which has since become separated by faulting.

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Closer view of the rippled surface: low amplitude, symmetrical ripples (wavelength approx. 20cm) indicative of wave action

Evidence for lateral slip movements along a fault were seen in the lower part of the second quarry in the form of horizontal 'slickensides' (grooves along the fault surface caused by movement of one rock surface against another). This faulting, along with tilting of the sedimentary beds which today dip around 40^{o} to the south-east, are thought to date to the end of the Silurian period near the end of the Caledonian Orogeny

This gave non-drivers much to ponder on the way to our final destination of the day, a circular walk from Willstone Farm (several miles of narrow lane later), a couple of miles to the ENE of Church Stretton. The geology of the area embracing Caer Caradoc, the Wilderness and Willstone Hill is complicated by faulting associated with the Church Stretton Fault Zone, producing a patchwork of Pre-Cambrian volcanic rocks, Cambrian and Ordovician sedimentary rocks and various minor igneous intrusions. The walk began west-wards along the 'Cwms Track' crossing several Ordovician formations: Cheney Longville Flags, Alternata Limestone (not seen here), Chatwall Sandstone, Chatwall Flags, Harnage Shales (also not exposed here) and finally the Hoar Edge Grit. These were closely inspected in turn, noting the rock types, structural attitude (dip and strike) and fossil content (if any) and in particular the relationship between geology and landform. Martin elaborated, in turn, on the depositional environment associated with each of these varied formations. Basically the more resistant rocks formed distinct linear ridges while weaker and / or faulted rocks formed intervening vales. This pattern became more confused after crossing a fault marking the eastern margin of the Church Stretton Fault Zone (CSFZ), within which the outcrop pattern, and landform, was more irregular. Part of the walk followed in the hallowed footsteps of a certain Mr. Murchison, who first attempted to describe this geology in detail from a celebrated viewpoint on the eastern flank of Caer Caradoc, which ironically first appeared in print in 1839 as part of his monumental work establishing the 'Silurian System'. Silurian beds *are* preserved, but only on the western, downthrown side of, not within, the CSFZ.

The Cwms Track: fossiliferous Chatwall Flags (Caradocian, late Ordovician); one of the harder lithologies forming the low ridge in the track (and The Wilderness ridge northwards…..to the left….out of view)

***"Murchison's View"** on the Eastern flank of Caer Caradoc: The two outer, bounding faults (F1 and F3) of the Church Stretton Fault Zone run either side of The Lawley (prominent hill on left). The wooded ridge of Hoar Edge (eponymous resistant Hoar Edge Grit) snakes along to the right of The Lawley. The ridge on the right, partly wooded, is The Wilderness and Yell Bank beyond (Chatwall Flags). The Wrekin (near the Ercall Quarries) looms on the hazy horizon (centre).*

Our route then crossed south of the 'Cwms Track' and descended towards low ground in Cwms Plantation where we were able to see one of the weaker lithologies (the Harnage Shale) preserved in a stream bed. Rising again we reached a point at which the so-called 'Sharpstones Thrust' (a fault of contrasting style and orientation, forming a slight shelf in the hillside at the base of Willstone Hill), before descending again to circle round to a small quarry just above the lowest ground in Cwms Plantation. A sympathetic landowner obligingly makes this excavation available for visitors to inspect the splendid shell beds of the Alternata Limestone. These are interpreted as storm bank 'coquinas' with the main fossil being *Heterorthis alternata,* the brachiopod after which this bed is named. From this quarry a farm track provided easier going back to Willstone Farm.

The Quarry in the Alternata Limestone

Heterothis alternata brachiopods revealed in a freshly opened bedding surface

On Sunday morning we assembled in a car park in Much Wenlock before driving a short distance to Wenlock Edge car park. A footpath north-westwards, crossing Blakeway Hollow, and past Stokes Barn, brought us to the edge of thick woodland which characterises the Edge for nearly all of its 30 kilometre length from Much Wenlock to Craven Arms. With the help of a fixed rope we were all able to safely descend a steep slope into the long disused Edgefield Quarry. Despite some regeneration this quarry admirably preserves a face which reveals the essence of the Much Wenlock Limestone, the same stratum we had seen in the Jubilee Fountain previously. This limestone is in part evenly and well bedded, but in other parts is conspicuously lacking in any clearly bedded structure. This contrast arises from the presence of patch-reef developments, particularly in the uppermost beds. These are unbedded, but often full of 'framework' fossils that bound the sediment together; a clear contrast to the well bedded inter-reef limestones, which contain different fossils representing the more mobile denizens of the shallow shelf seas of the time. Martin led a long discussion on what these contrasts meant in terms of the depositional environment, especially the very specific conditions that allowed reef development, but also the semi-tropical marine conditions that attracted a rich and varied fauna.

Rope-assisted descent into Edgefield Quarry

Edgefield Quarry: Much Wenlock Limestone formation displaying small, lens-like, patch reefs (unbedded lower section) passing into well bedded inter-reef limestones (above and laterally)

We continued south along the Edge to the Stretton Westwood Nature Reserve where another abandoned quarry preserves a longer face in the limestone. This quarry is situated somewhat back from the top of the escarpment (unlike the previous stop where the rope-descent was effectively over the escarpment edge), and prompted Martin to illustrate the 'scarp and vale' scenery across this part of Shropshire. This quarry cuts down through overlying shales of the Elton Beds to reach the Much Wenlock Limestone, which again revealed the contrast between patch-reef (here rather larger, with steeper margins) and off reef beds. Some splendidly preserved corals and stromatoporoids were uncovered amongst loose blocks of limestone littering the quarry floor.

Stretton Westwood Nature Reserve: Much Wenlock Limestone formation; participants admiring the large patch-reef (centre) with bedded inter-reef deposits on the left and, apparently partly collapsed (due to quarrying?) on the right

Stromatoporoid (large and small): one of the main framework reef-builders (collected in Lea Quarry further along Wenlock Edge]

Colonial Coral mass (? Cyathophyllum sp.) Much Wenlock Limestone formation (collected in Lea Quarry further along Wenlock Edge)

A short stop still further along the Edge, at a convenient lay-by near Hilltop, provided a rare opportunity to get more expansive views NE and SW, although even here tree-growth is beginning to interrupt the views. Standing atop yet another reef-mound, the view north-westwards was across older rocks in Ape Dale, to Willstone Hill and Caer Caradoc on the horizon. In the opposite direction we could look down the dip slope towards the scarp formed by the upper Silurian, Aymestrey Limestone, with still younger Devonian rocks forming the broad expanse of Brown Clee (with its cap of late Carboniferous rocks) on the horizon.

Hilltop, Wenlock Edge: View 'down' the Much Wenlock Limestone dip-slope, south-west, towards Brown Clee Hill

We then travelled down the dip slope to Brockton, to follow the road along the vale between escarpments to the pretty little village of Diddlebury, where we gathered in St Peter's Church car park, outside the village schoolhouse. Here we had a late lunch and re-organised into a minimum of cars for a short diversion *up* a narrow dip-slope lane to briefly inspect the contrasting nature of the Aymestrey Limestone in Fernhall Quarry, situated on the crest of its own scarp feature. Reef developments were absent, with well bedded, nodular limestones the name of the game, though variation was provided for by conspicuous thick and thin bedded horizons, the former marking out especially rich concentrations of shelly fossils (brachiopods, bivalves and gastropods). This limestone is noted for concentrated shell-banks of a particularly robust brachiopod (*Kirkidium knightii)* - the Silurian equivalent of oyster-banks perhaps? - as recorded in celebrated quarries on View Edge near Craven Arms.

Fernhall Quarry near Diddlebury: Aymestrey Limestone (Ludlovian, late Silurian); thicker bedded passing up into more thinly bedded nodular limestones (note prominent shaly partings in places)

Aymestrey Limestone: An old (ex35mm) close up of the Kirkidium knightii concentrated shell banks [View Edge Quarry near Craven Arms]

***Diddlebury Church**: Various building stones…..*
olive / buff Downton Castle Sandstone (Pridolian, latest Silurian) left
red Triassic Sandstone (? Grinshill) archway stonework
grey / buff Coal Measure sandstone window surrounds
reddish / purplish Old Red Sandstone (Devonian) small-course stonework on right

The excursion ended with a brief look at the varied building stones used in Diddlebury Church, including some Devonian lithologies, offering an appetiser for a future trip across the upper Palaeozoics of southern Shropshire.

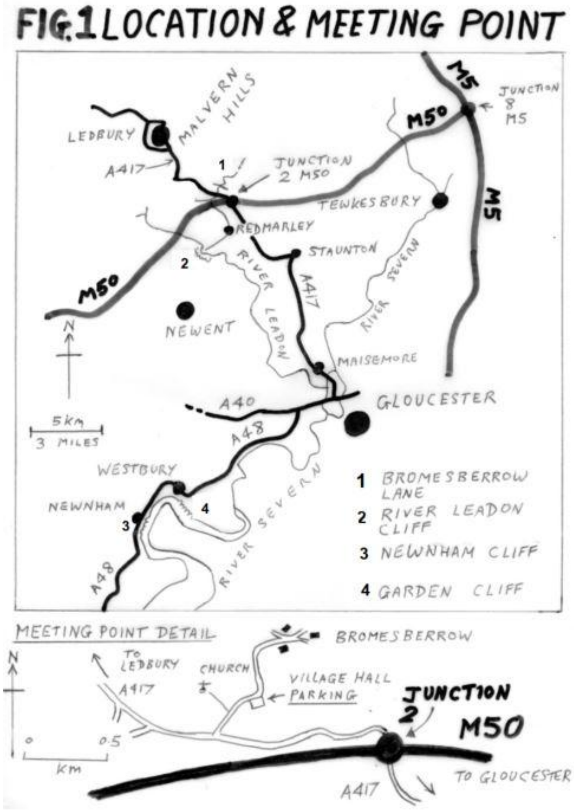
A final word of thanks goes to Martin for constructing such a logical itinerary, and his lucid presentation of the geological journey Shropshire has gone through, from its early existence 60^{o} south of the equator to its present location almost 60^{o} north; and quite a journey it has been!

Field Course Study: the New Red Desert led by Nick Chidlaw

Report by Gareth Jenkins. Attendance 12

The sun was shining on Saturday **June 23rd 2024** and it was the hottest day of the year to that date. This was a perfect accompaniment to the Gloucester based field course 'Study the New Red Desert'; a one-day field course led by Dr Nick Chidlaw. Packed lunches and refreshments were packed alongside sun cream and hats.

The purpose of the field course was to see some New Red Sandstone Supergroup deposits. These deposits are from the Permian and Triassic (~300-200mya) when Britain was north of the equator within the Pangaea supercontinent. As such, conditions were dry and arid and continued to be so until the end of the Triassic.

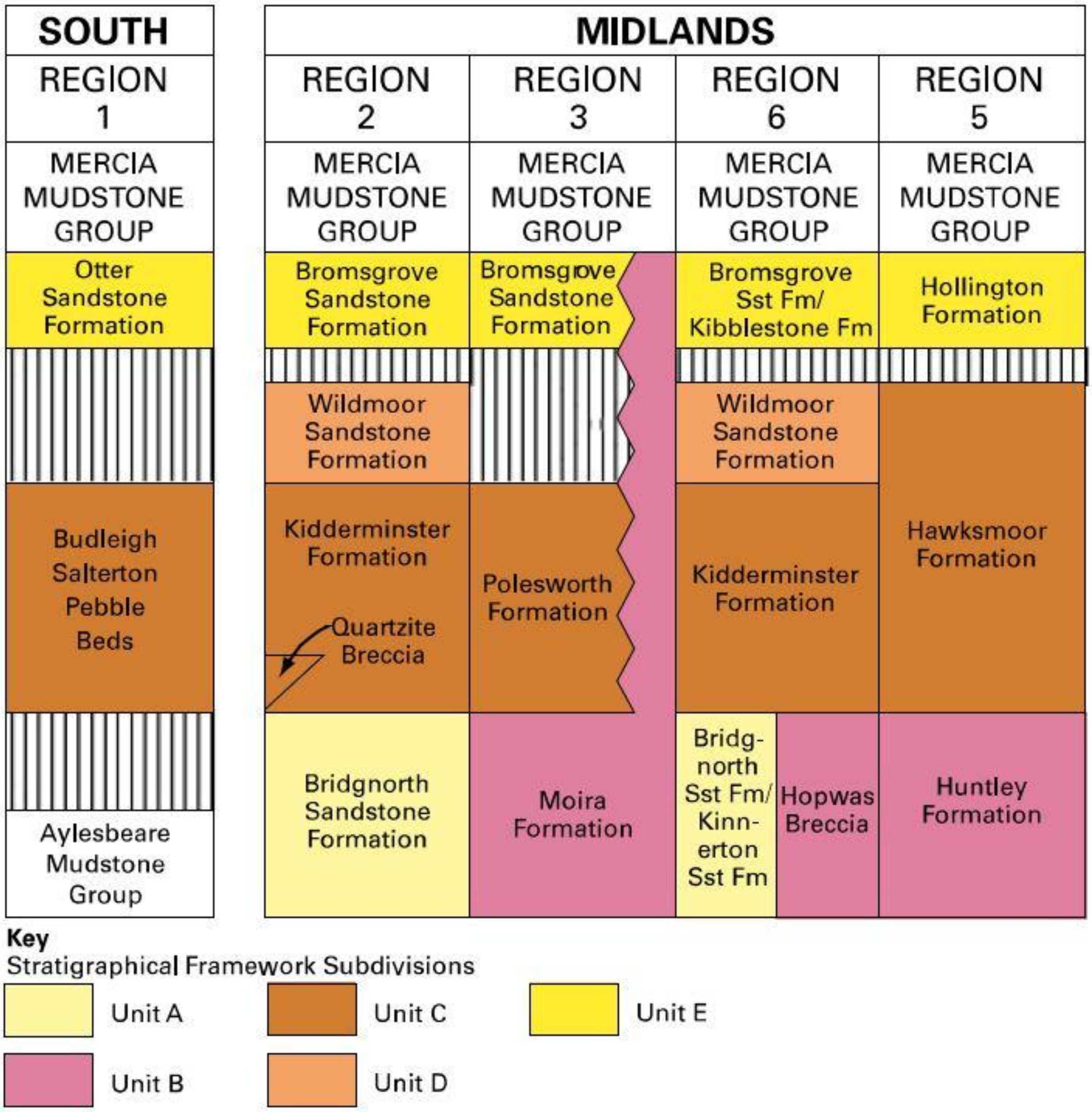


After registration and introductions, the team split into three sperate groups so that we could car share. Stop one was at Bromesberrow Lane in the Gloucester village of Bromesberrow, just south of the Malvern Hills. A short walk up the lane and we were confronted with exposures of the Bridgnorth Sandstone Formation (~280mya), deposited in the Early Permian. It is an extremely weak, red-brown, medium-grained sandstone, it was the impressive cross bedding displayed which caught the eye. Beds could be seen to have eroded into each other and the result was a to create a mix-match of striped patterns.

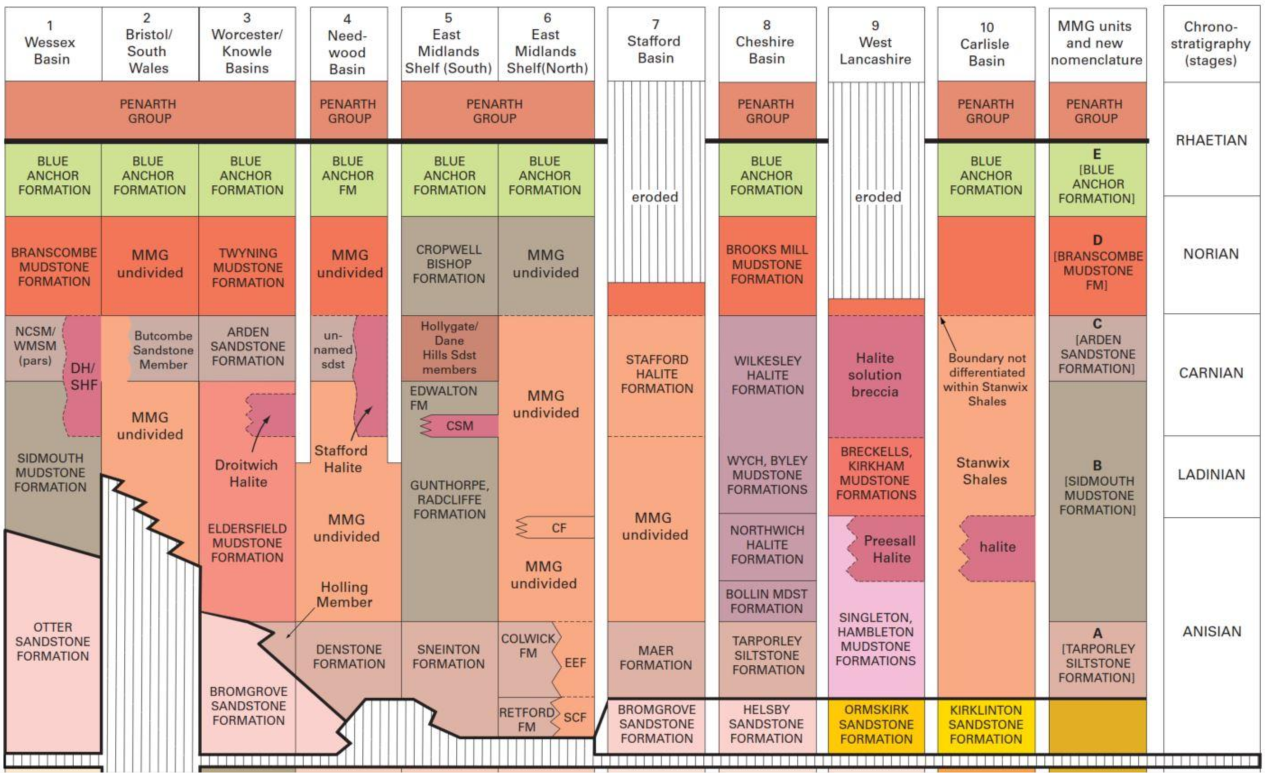
Figure courtesy of Nick Chidlaw.

Cross-bedding in the Bridgnorth Sandstone Formation – Permian sand dunes.
Picture courtesy of Gareth Jenkins.

Between the occasional passing four-wheel drive and horse box, Nick explained that the steepness of the cross bedding indicated that these would not have formed in a fluvial environment. The size, together with the reddish-brown colour (iron oxide), sorting of the sand grain size and pitting on the grains all indicated an aeolian depositional environment. These were sand dunes blown by ancient winds.



Relative lithostratigraphy of the Bridgnorth Sandstone Formation, Sherwood Sandstone Group and Mercia Mudstone Group in the South and West Midlands basin. Together these make the New Red Sandstone Supergroup. Note, the Bromsgrove Sandstone Formation is now known as the Helsby Sandstone Formation From BGS Research Report RR/14/01



Lithostratigraphy of the Mercia Mudstone Group in its various basins. Note, the Bromsgrove Sandstone Formation is now known as the Helsby Sandstone Formation
From BGS Research Report RR/08/04

The team examine the Bridgnorth Sandstone Formation, Bromesberrow Lane
Picture courtesy of Gareth Jenkins

Assured these would be the only aeolian deposits we would see today it was time to head to stop 2, River Leadon Cliff. The team set off and soon found the parking and headed down past an old mill to find the river and the cliff.

Where is it? The team thrash through the undergrowth to find the hidden cliff.
Picture courtesy of Gareth Jenkins

Unfortunately, the cliff was a little harder to find. The undergrowth was thick here and it took 10 minutes of searching before it was spotted and a way to get to it could be thrashed out. Once there, a large exposure of the Helsby Sandstone Formation, Sherwood Sandstone Group (~250mya) was visible. The Helsby in the south-west Midlands was formally known as the Bromsgrove Sandstone Formation. The bedding in this sandstone was much thicker here than at the previous stop. And although there was evidence of cross bedding it was also on a much smaller scale than seen earlier in the morning. Channels could be identified in the exposure and there were also thinner deposits of mudstone which had weathered to a silty clay. Nick explained that this would have formed in a large, braided desert river network and I showed the field test for determining if a material was a clay or silt.

There it is! The team thrash through the undergrowth to find the hidden cliff.
Picture courtesy of Kathrin Schutrumpf

Having finished with our observations, lunch was had at the old mill before setting off to our separate cars for a longer journey south to Newnham on the River Severn. By the time we arrived the sun was very high in the sky and everyone was enjoying one of the first proper summer days of the year and a chance to see some Mercia Mudstone Group deposits.
At Newham cliff a recent landslip had revealed a section of the Arden Sandstone Formation (~237mya). This was the first of three formations of the Mercia Mudstone Group to be viewed in the afternoon. Whereas all the other formations seen today are 100s of metres thick, the Arden Sandstone Formations was ~2m and comprised thin, interbedded red-brown mudstone and green-grey siltstones. About 4m of Sidmouth Mudstone Formation was seen below the Arden Sandstone but was poorly exposed. Nick introduced WGCG regulars Stuart Burleys and Jonathan Radleys paper 'A Hard Rain is Going to Fall' and how interpretation of the formation has evolved from estuarine to desert lake deposits (with occasional marine incursions); 'Lake Arden'. This is associated with a period of heavy rainfall known as the Carnian Pluvial Episode and can be identified in other rocks of a similar age around the world.

Arden Sandstone Formation at Newnham cliff. The underlying Sidmouth Mudstone Formation is largely obscured. Picture courtesy of Kathrin Schutrumpf.

The change of colour from red-brown to green-grey was described as being because of different concentrations of available oxygen in the depositional environment. The Arden Sandstone Formation contains fish fossils, reptile footprints and worm casts, but sadly none were found on the day. However, we did find some good mudcrack casts.

Enjoying the view at Newnham cliff. Picture courtesy of Kathrin Schutrumpf.

The final stop of the day was a short drive to Garden Cliff, Westbury-on-Severn. Here the Branscombe Mudstone Formation (~220mya) and overlying Blue Anchor Sandstone Formation (~205mya) were exposed. These were the most stunning exposures seen during the field course and in the hot sunshine made a fabulous end to the course.

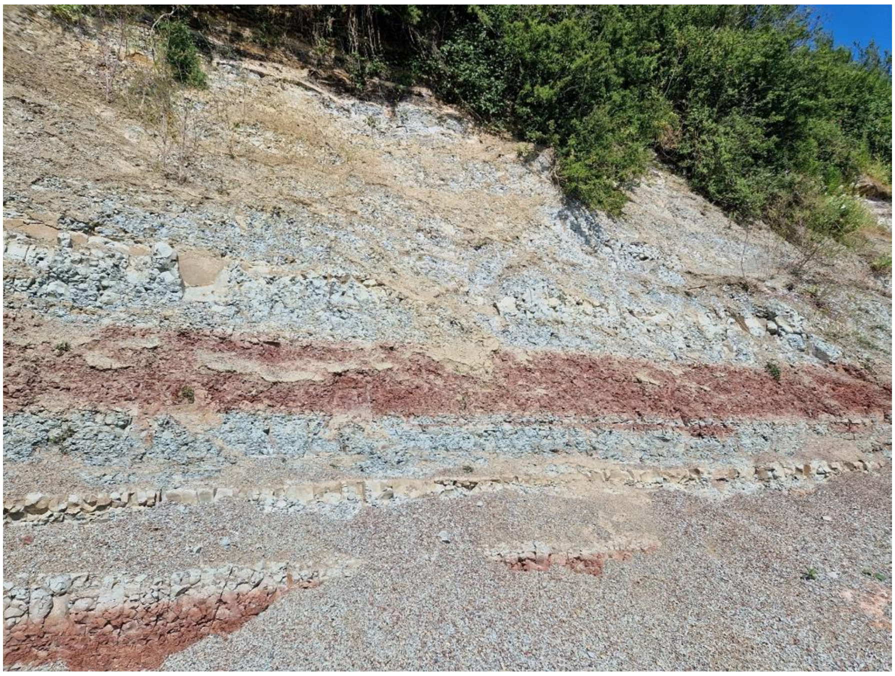
The Branscombe Mudstone Formation was striped with green-grey siltstones known as 'skerries'. These indicated periods when the desert floor would have been inundated with water before a return to normal deserts conditions. Large vertical discontinuities (joints) could be seen to persist from the beach to the top of the cliff. Some of these contained very thin (c. 1 mm) sheets of satin spar gypsum. There was evidence of some collapse of the materials. Everyone was given a hard hat for this part of the excursion, and no one complained about putting them on.

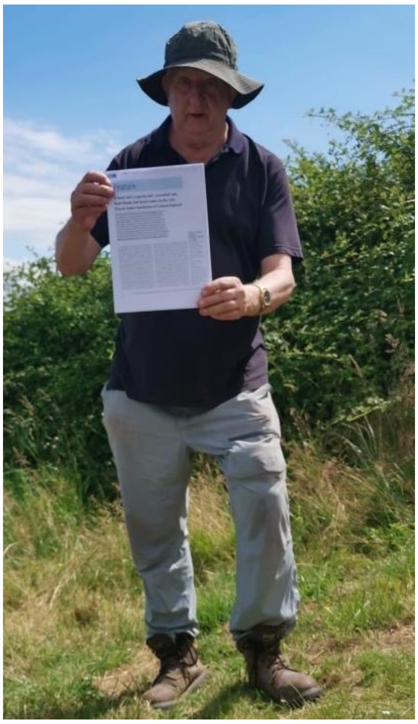
The Branscombe Mudstone Formation at Garden Cliff, Westbury-on-Severn
Picture courtesy of Gareth Jenkins

Further along the beach the Branscombe Mudstone Formation could be seen to be overlain by the Blue Anchor Formation. This is the final gasp of the Mercia Mudstone Group and represents part of the very late Triassic. The Blue Anchor is a desert lacustrine deposit occasionally covered by the sea: a 'sabkha', and marks the end of the desert conditions which dominated what is now Britain. At this time the sea began to inundate the land and the next stratigraphic unit above the Blue Anchor is the Westbury Mudstone Formation, Penarth Group (~201mya), a dark, pyritic shale and indicative of marine conditions.

Named after Westbury-on-Severn, the Westbury Mudstone Formation exposure is now considered too degraded at this location to be of much value. The type sections are now in and around Penarth in south Wales and the Westbury Mudstone Formation is the oldest of the Penarth Group.

Making observations at Garden Cliff, Westbury-on-Severn Picture courtesy of Kathrin Schutrumpf.



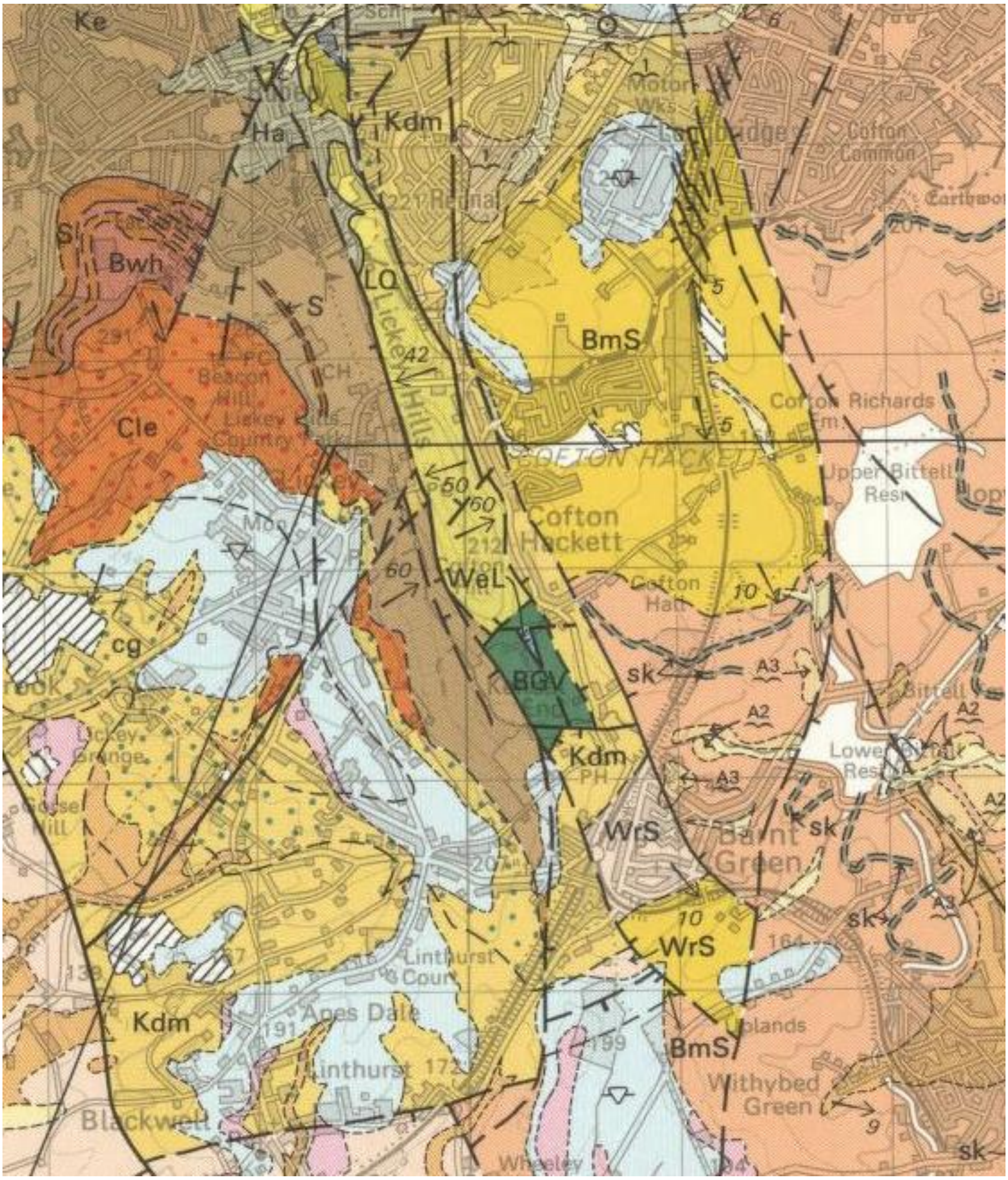


The Blue Anchor Formation overlies the Branscombe Mudstone Formation at Garden Cliff, Westbury-on-Severn
Picture courtesy of Gareth Jenkins

And then it was back to the car to drive back to Warwickshire with the air-con on!
Thank you to Nick Chidlaw and all that came and supported this excellent field course.

WGCG Geology of the Lickey Hills, Field Trip Report - Led by Ray Pratt

by Ray Pratt 20-7-2025. Attendance: 13



Lickey Hills – BGS Geological Map Redditch Sheet 183

Introduction

The Lickey Hills are the secret geological gem of South Birmingham, resting on the border with Worcestershire, less than 10 miles from the city centre. This has been a popular place for the Birmingham residents to visit since 1888. For nearly 200 years, geologists have been studying these rocks and coming up with many different ideas. Even today there are a number of features which are still debated as the participants of the WGCG event would find out.

Bilberry Hill

Following registration at the visitor Centre, the delegates wandered up onto Bilberry Hill and took in the vista to the east. Here they learned that the Lickey Ridge upon which they were standing was composed of Ordovician quartzites and down below were Carboniferous and Triassic rocks. We then walked a short distance northward along the ridge to another viewing point where the ridge began its decline to Rednal Gorge. Here we had a clear view to the north with the Golf course and underlying Carboniferous in the lowland to the northwest of the ridge.   To the left we could saw Beacon Hill location of the Permian Clent Breccia - our final destination of the trip.

Taking in the vista and information panel on Bilberry Hill – Photo by Gareth Jenkins

Backtracking a few metres brought us to the first exposure of the day. Sitting on the crest of the hill were a number of boulders composed of quartzite breccia. Two of which included the actual contact between the Breccia and underlying Lickey Quartzite, from which it had been made. Geo-conservation work undertaken by the Lickey Hills Geo-Champions over the past few years had unearthed a number of these boulders which are believed to have formed in Triassic times, a period when the area was located on the eastern side of Pangea c. 20 degrees north of the equator where dry desert like conditions probably prevailed. The breccia is thought to be bound together, along with the upper part of the quartzite, by a silcrete.

The Triassic Breccia atop of Bilberry Hill – Photo by Gareth Jenkins

Warren Lane Quarry

From here we back tracked to Warren Lane Quarry, just opposite the Visitor Centre. The outer limb of the western side of the Lickey Ridge anticline is seen to be dipping c. 50' west.

Warren Lane Quarry – Photo by Gareth Jenkins

Despite only a narrow range of beds in this quarry there is a lot to see. A sandstone bed was identified at the southern end of the quarry interbedded with the quartzite. Close by a trilobite feeding trace confirmed marine deposition of these deposits. Ripple marks with varying wavelengths indicated shallow and deeper marine shelf depositional environments. Occasional pebbles and pit marks suggested intertidal settings, or even periods above the tidal stretch. One very thin clay rich bed believed to be of volcanic origin was also noted. A couple of small faults with fault breccias were seen cutting across the beds.

At the northern end above the concrete bays are two contentious deposits were examined. These were deemed to be either a syndepositional storm channel deposit. The base of this oldest bed has a number of pebbles lying with their log axis parallel to bedding. There are a number of sandstone and clay clasts and overall show a fining up sequence, or a Triassic open joint infill, depending upon which arguments you believe. A little time was spent for participants to have a closer look for themselves.

Ray summarises the discussions between a syn-sedimentary storm channel or a fissure infill for this feature.

Barnt Green Road Quarry (Cofton Hacket)

From Warren Lane we headed South East to the Barnt Green Road quarry on the opposite side of the ridge. Here the outer beds forming the eastern side of the anticline dip to the north-east
The most striking thing within this quarry is the chevron / overturned folding seen in the western wall and the northward plunging antiform seen in the southern wall. A NW – SE running fault separates the northward dipping interior folding from the external north-east dipping beds. Clearly the disparity between the folding directions indicates that this is not a simple unidirectional one-off compression event. (This was discussed over lunch).

The second most striking thing seen at this quarry was the colour. Every face was reddish brown. The quartzite beds are not thick and are interbedded with clay rich sandy beds. XRD (X-Ray Diffraction analysis) and thin section work of both the clay-rich sediment and the overlying quartzite indicate that much of the material was derived from an acidic volcanic origin. Despite the clays being dominantly illite there is sufficient quantity of mixed clay (smectite & illite) seen to indicate a probable bentonite origin. The red colour was due to haematite coming from the clays.

Discussing the features in Barnt Green Road Quarry. Photos by Gareth Jenkins.

Kendal End Quarry

From Barnt Green Road quarry we headed to Kendal End quarry, the most southerly exposure of the Lickey Hills. The first thing we did was distinguish the bedding planes from the jointing. This done we identified the fault close the external boundary with the western most beds dipping to the west. The internal beds are skewed, dipping to the east. In addition to the easterly dip the structure plunges southwards at 30 degrees

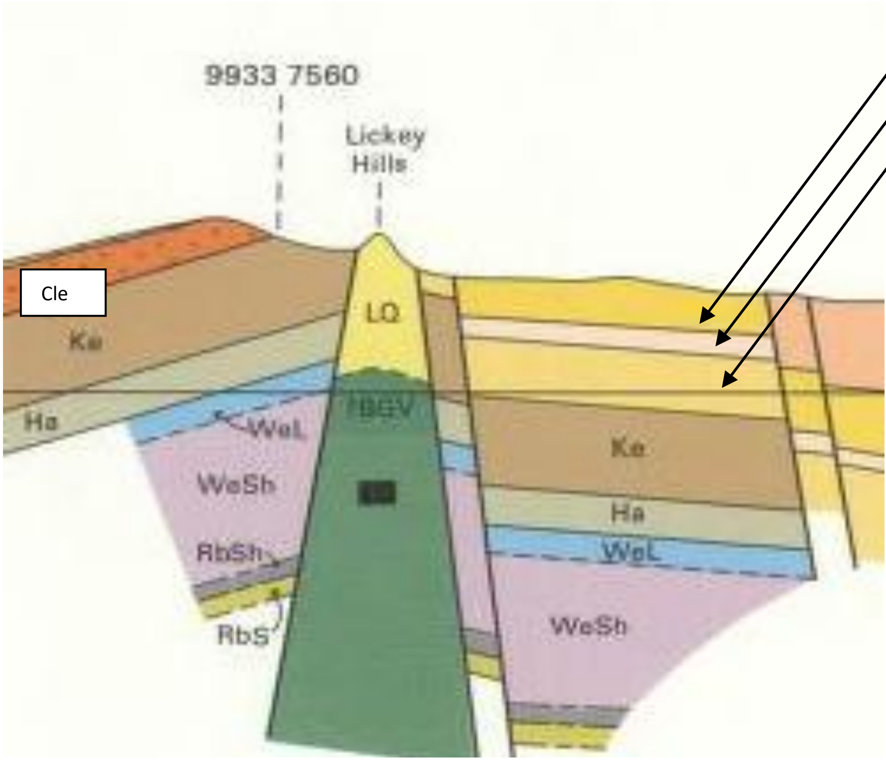
This quarry contains a number of sandy zones either associated with faulting and fault breccias of associated with bedding. A very thin light clay bed with sandstone over the top was seen. The clay is believed to be volcanic. The sandstone had a black manganese outer colour as a consequence of its permeability acting as a water conduit. (There is a similar bed in Warren Lane). Again, participants were shown where these sandstone sections existed and were invited to take a look and come to their own conclusion regarding whether or not they could be considered as fissure fill deposits. They were also advised to keep an eye open for worm burrows and hummocky bedding which has been identified within the quarry indicating that the beds were the right way up.

Kendal End Quarry a small quarry with lots of features. Photo by Gareth Jenkins.

Lunch: Recap and Tectonics discussion

Returning to the Visitor Centre for lunch we discussed the variability of the Lickey Quartzite around the differing quarries and indeed within each quarry. Ray laid out the BGS geological map and cross section and pointed out that what we have is a Horst and Graben system. The normal faults associated with such a system seem to have been active within the late Carboniferous enabling the thick accumulation of Carboniferous beds. These must also have been active during the Triassic period also. This meant that in the Late Carboniferous and Triassic this area was under tension. In all probability it would have been active in the Permian also as Permian rifting forming the Worcester Graben, Stafford and Knowle basins is well documented. Therefore, the dips associated with the Carboniferous Permian and Triassic beds are likely to have occurred in the latter part of the Triassic or more likely the Jurassic when the North Atlantic rifting and the North Sea Graben development was ongoing. It's difficult to envision an end of Carboniferous (Variscan compression event) occurring here when the area was under tension. This argument supports Boultons 1927 observation of a small reverse thrust in Eachway lane, placing the Quartzites over the Carboniferous which in turn overlaid the Bunter Pebble Beds (Triassic).

Boulton argued that the Lickey anticline was in place by the end of the Silurian, with the Devonian a period of denudation. The Late Carboniferous beds were believed to have been laid down over a good portion of the Lickey hills, with blocks of quartzite or Rubery sandstone observed to be in their basal sections. The observations made regarding the fold directions in Barnt Green Road Quarry and Kendal End quarry support Boltons argument for 2 separate compression events.



BmS Bromsgrove Sandstone
WrS Wildmore Sandstone
Kdm Kidderminster Fm

Cle Clent Breccia

Ke Keel Mudstone Fm
Ha Halesowen Fm

Wel Wenlock Limestone
WeSh Wenlock Shale
RbSh Rubery Shale
RbS Rubery Sandstone

LQ Lickey Quartzite
BGV Barnt Green Volcanics Fm

Lickey Hills cross-section – BGS Geological Map Redditch Sheet 183

This suggests that there were three periods of tectonic activity, an initial anticline at the end Silurian, a horst and graben development from Late Carboniferous to Mid Triassic and thrust faulting at the end Triassic or in the Jurassic.

Rubery Road Cutting.

This was the most northerly outcrop to be examined. Here we viewed the unconformity between the Ordovician Lickey Hills Quartzite and the overlying Silurian Rubery Sandstone. The colour contract between the two makes this easy to follow, the Rubery Sandstone being stained red. The irregular uneven top of the Lickey Quartzite is typical of many rocky foreshores we see today. We observed that the basal deposits of the Rubery sandstone often contained clasts and pebbles of the Quartzite indicating that these Ordovician sandstones had already been transformed to quartzite before the Silurian. We observed Rubery sand lining the exposed vertical joint faces of Lickey quartzite. The red fault zone was explained as having been initially thought of as a neptunian dyke until it was jet washed exposing the fault breccia and slickensides.

Examining the Rubery Sandstone – Photo by Ray Pratt.

We walked a little up Leach Green Lane to view the boulder pocket lying on top of the unconformity. There was a comment that this could possibly be a river channel deposit. This was not discussed. We also noted to thin darker beds towards the top of the Lickey Quartzite. Walking a little further up Leach Green Lane we came to the footpath exposure of Lickey quartzite, representing some of the youngest beds of this formation. Here we saw interbeds of quartzite and sandstone, cross bedding and even a bed of apparent foresets indicating a flow northward.

Leach Green Lane – Sandstone Foresets in Lickey Quartzite – photo Ray Pratt.

EachWay Lane – Worm Burrows

As always, the worm burrows proved to be of great interest to field outings participants. These indicate that this bed was probably laid down close to the low water line. Overlying this bed is a very fine black sand thought to be of volcanic origin. This may have killed off the worms enabling their burrows to be preserved. A thin quartzite bed separates this black volcanic sand from a white to light grey smectitic clay also thought to be volcanic in origin.

Section view of the worm burrows - Photo by Ray Pratt

Beacon Hill – Clent Breccia


Collection of cobbles from the Beacon Hill Clent Breccia

Clent breccia, a Permian fanglomerate, (a collection of alluvial fans), has a very argillaceous matrix and consequently becomes overgrown rapidly when not maintained. At Beacon Hill it forms the car park surface and is composed mostly of blocks of volcanic ash.

From the car park are views to the west to the Clent Hills. Looking SW, we had a great view of the Malverns and Worcester, (and the storm clouds gathering). We quickly made our way to the Toposcope and took in the skyline to the north, which includes the city of Birmingham. We also could see Rubery hill which marks the most northerly exposure of Lickey Quartzite. We just made it back to the cars before the heavens opened. Despite the ominous weather warnings, we had a great day in the field without getting wet. How lucky were we!

WGCG – Field trip to the North Malvern Hills, Tuesday 19th August 2025

Lead by Adrian Wyatt Attendance: 7.

Seven members, including two from LLPS, joined the leader on this field trip.
The following is a summary of the sites visited, preceded by the short overview supplied to attendees.

<u>GEOLOGICAL OVERVIEW OF THE AREA COVERED</u>

The Malvern Hills area is one example of an outlier of Precambrian age rocks in southern Britain. Establishing its geological history is considered work in progress since in even recent papers the professional geologists who venture into print will not be drawn on all the details. This is not surprising since there are few exposures suitable for research and although the Malvern Hills occupy only a small area there is a wide range of lithologies to deal with. Hence the descriptive term 'Malverns Complex' that is generically used to refer to the rocks of the Malvern Hills.

The area is described in detail in the BGS Memoir 'Geology of the Country around Worcester', by Barclay *et al*, (1997), National Environment Research Council. The bibliography in this has a comprehensive list of previous papers. We shall be walking on ground above rocks that form part of the Malverns Complex. The word 'complex' is used because there is no simple way of describing the origin, history and relationships of the many different rock and mineral assemblages so-far exposed.

The following text is selected from Barclay *et al*, (1997), to show the variety of rock just in the northern part of the Malverns Complex:
"*The Complex is composed largely of diorite, tonalite and hybridised and sheared derivatives of these protoliths…in most exposures a penetrative foliation is present, locally giving a schistose or superficially 'gneissic' appearance… Mafic and ultramafic rocks are present in minor amounts. Granite occupies the north-western and southern slopes of the Worcestershire Beacon and is also present in smaller intrusive bodies on*

the eastern slopes of the North Hill and Worcestershire Beacon. Thin sheets of microdiorite are also discordant to the ductile foliation of the complex."

In his book review on this publication, ('Down to Earth' Issue No. 19, June 1997), Chris Darmon exclaims: *"As such, it is an area that has for many years provided thorny problems, especially in the Malverns where the juxta position of many different rocks in a small area, coupled with poor exposure at critical points has led to scant knowledge of the structure."*

Note: The terms 'diorite' and 'tonalite' have been interpreted differently over time. The majority of samples likely to be seen are going to be diorite and this is defined as a melanocratic coarse-grained plutonic intermediate igneous rock, consisting of plagioclase (sodic) feldspar (white), one or more ferromagnesian minerals (hornblende/biotite) (dark green/black) and little or no quartz (up to 10%); (50-55% silica). Tonalite has more free quartz – (total silica 60 – 65%) where plagioclase is the main mineral, hornblende and some biotite forming the remainder. Thin sections are required for confirmation.

Although the Malvern Hills are generally considered as a monolithic entity they actually comprise rocks of different ages. This is one of the reasons for the lack of certainty on the geological history. The results from the few rock samples used for dating purposes can only really be taken to apply to the locality where the sample was taken.

The Malvern Hills are seven fault-bounded 'blocks' with an overall length of about 12km. There are variations in geology between blocks and within each block. Dates published relate to final crystallisation and so the original date of emplacement and cooling may be earlier. There is chemical analytical evidence to show that large igneous masses were formed as part of an island arc complex associated with the Avalon terrane when in the southern hemisphere around 677 +/-2 Ma. The initial emplacement is now considered to have been in the form of dyke-like feeders that ballooned out at the point of resting in the crust, accumulating at about 10 – 15km below the then earth surface.

Other samples suggest that due to tectonic activity (may be collision processes) in the course of being forced to the surface the structures were re-heated, deformed, metamorphosed, original minerals were re-crystallised and greenschist or amphibolite facies were overprinted. Dates for rocks that show these events are c650Ma for the metamorphic re-heating and after gradual cooling another re-heating event around 610-600 Ma associated with hydrothermal alteration and intrusion of pegmatites. To add further complication there is a major fault running through the district known as the Malvern Lineament (traceable from Bristol to the Chester area) that runs along the east side of the Malvern Hills. This is known locally as the East Malvern Fault (EMF). In the middle of the Malvern Hills there is a fault bounded block of volcanic rocks with its eastern edge along the EMF. These volcanic rocks are dated at around 566Ma and have not been found anywhere else in the area*.

**There are unproven suggestions that clasts of these rocks may occur in the later Cambrian age marine deposits known as Cambrian conglomerate and Malvern quartzite, currently exposed in the southern Malvern Hills.*

Prelude

The geology of just the local rocks comprising the Malverns Complex as noted above is an enormous problem to solve let alone working out how the structural features fit in to the overall geology of Great Britain. John Dewey in his paper presented for the 35th William Smith Lecture (1982) introduced an interesting analogy that could possibly apply here saying "*It is generally not possible to reconstruct tectonic 'climate' from local geological 'weather' without synthesizing extremely large regions*". The aim of the visit was to provide outcrop evidence of how complex the geology of the Malvern Hills really is.

Start point for registration: Car park near the Wyche Cutting. Risk Assessment and Health and Safety information was shared. The proposed route and plan for the day was then announced.

Location 1
Old Wyche Cutting

Examples of Malvern stone, as typically used for various building structures, were seen and the stone in original and extremely weathered condition was compared. Common rock types were pointed out; examples of granite and diorite being available. Comment was made that although it has (and maybe still is) thought that the Malvern Hills are made of granite, this is not strictly true and in fact only a relatively small part of the exposed Malverns Complex is in fact granite. One of the first challenges of the day was to prove that other rock types can in fact be found. A brief look at the geological map was made for bedrock information and also to the map published by Lambert and Holland (1971) to further clarify what rock types have been reported. The unusual outcrop on the crest of the cutting was examined and with the leader's assistance was shown to be a microdiorite, a rock that has been locally intruded into the surrounding granite forming a dyke. The date of intrusion is uncertain but would have been in late Precambrian time.

Location 2
Gold Mine (site of a single mine shaft, now long filled in)
This site is on the main path up to the Worcestershire Beacon and has had many passers-by. The leader recounted the visit by members of the old Malvern Field Club in July 1939, when the then committee members went for a stroll along with invited guests Professor Alfred Brammall and Professor H. H. Read, distinguished geologists in their day, and each having written papers specifically on topics related to the Malvern Hills. A paper was published giving analytical results for the content of gold and silver in the Malvern Hills (Brammall, A, & Doane, D. L., 1936). The location was an opportunity for a group photo, members standing almost in the same place as those with the Malvern Field Club many moons ago! Alas, the gold mine and mine shaft are nowhere to be seen now but the leader showed the group evidence of its possible position.

Location 3
Tolgate Quarry – sometimes known as Laird's Quarry
This well overgrown disused quarry poses a problem for any passing geologist for there is hardly any rock surface that has not got moss or lichen growing on it. However, looking at the main rock face it can be visualised that the feature displayed is most likely to be an intrusion, another dyke. The strike is north to south and having previously examined a small sample of scree material, the leader confirmed that this is another example of microdiorite. From research, it appears that the aforementioned Professor Brammall had identified at least two phases of microdiorite intrusion, the earliest he concluded were those of the Ivy Scar rock. The Ivy Scar rock is a large prominence on the east side of the North Hill, so named by the Victorians. The second type of microdiorite dyke Professor Brammall called the 'newer' (sic) and were found noticeably to run in a north-south direction. So, here then could be one of those newer (later) dykes. The surrounding host rock is granitic but evidence was also seen for the presence of a small pegmatite vein (with coarse grained pink feldspar and milky white quartz).

Location 4
Upper Tolgate Quarry – centre
The group was shown scree material that was clearly not granite or diorite. It was also not microdiorite or typical pegmatite. The quarrymen had left this part of the quarry untouched due to its poor quality for commercial sale. The rock had been sampled and studied by Professor Brammall and he concluded (after examination using thin sections) that this is or was an example of biotite hornblende pyroxenite that had undergone subsequent enrichment by a potash rich fluid intrusion resulting in a small pod within the surrounding rocks. The white appearance of the weathering face is possibly due to decomposition products being produced and it was suggested that the main one could be the rare mineral known as sepiolite. This mineral was reported as having been found at a locality near here back in the 1960's, Firman, R. J. (1966). Indeed Dr. D. W. Bullard, when invited by Malvern U3a Geology group to visit in 2018, has confirmed that he also considered this to be the case when collecting data on the Malvern Hills for his PhD in the 1975.

Location 5
Upper Tolgate Quarry – South face
The group went over to the south face of the quarry to verify the main rock type that had been quarried and to see if this matched the geological map drawn up by Lambert and Holland. Indeed, the main face is quite distinctly pink coloured granite. However, eagle eyed members quickly found that there is also evidence for two more dyke intrusions. The leader confirmed that these had been found to be microdiorite but that there appeared to be a difference in the hardness between the two. This suggested that there may be differences

in the amount of free quartz and maybe therefore that the intrusions were two different events. The apparent dip of the dykes was noted to be towards the east.

Location 6

Upper Wyche Quarry – North face

Having walked only a short distance further south, the group turned to face the other side of the unquarried mass that separates this quarry from the previous one. Being only a short distance it was expected that the rocks seen at Location 5 would again be seen at this location. However, to everyone's amazement this is not the case! Instead of a granite face with two dykes the whole north face displays a large pink granite mass, to the east, 'resting' at about 45° on an equally large microdiorite intrusion on the west side. No-one was able to explain how this had come about. Further research is required here. All that could be said at the time was that the junction between the two rocks is dipping to the east and that it does not look like a fault (due to the undulations in the contact surfaces and the lack of shearing evidence).

Location 7

Upper Wyche Quarry – South face

After taking a moment to assimilate their thoughts, members walked over to the other side of the quarry to look at the south face. This was expected to appear the same as the last view only as a mirror image, surely? Of course not! This is the Malverns Complex, the group jostled for position but instead of seeing granite on the east side it forms the bulk on the west. And down in the east corner is clearly another large microdiorite dyke; with a distinct shear zone near the centre. And to top it all this dyke is apparently dipping to the west, not to the east.

Locality 8

Wyche Cutting – main road

Dazed and reaching mental exhaustion members gathered themselves to safely cross the main road and reached the east side of the Wyche Cutting. Here the leader explained that the north side of the cutting comprises pink granite. This could indeed be confirmed by looking at the fallen block in the driveway of the Wyche House. This block has just recently been dislodged by the action of tree roots! The falling rocks hazard warning sign for road users is clearly necessary. The rest of the cutting on that side of the road is granite but due to weathering and other causes the usual dark grubby looking patina now obscures easy identification. Reference to Lambert and Holland's map shows that this cutting follows the path of an east to west fault line across the Malverns Complex. This is one of six cross faults along the hills. Unsurprising now, the rock on the other side of the fault and of the cutting is totally different. Conveniently the only footpath through the cutting is on the south side and follows the south face of the cutting such that a good look can be had of the characteristic features of this unusual rock that has hitherto not been encountered. A dull greyish rock with distinctive linear features, feint indications of flow like structure, maybe even banding. This is a metamorphic rock with schistose or even gneissic texture. Although clearly not a true schist or gneiss as per text book or of type localities in extensive mountain building areas there clearly has been some form of deformation in the past. Locally the term 'Malvern gneiss' has been used for well banded examples. Professor Brammall (yes, again) (1940) spent time studying this outcrop and found that the direction of shearing changes as one walks across the top of the ridge above the cutting. To add further interest (and confusion?) one of the resident presenters on the BBC programmes for the Open University Geology courses run in the 1970-80's, Dr. Richard Thorpe, published a paper on his research study based in this area and he says that he found evidence of partial melting caused by frictional slippage. This lead to the formation of very thin bands of black liquid substance that solidified to a glass-like mineral. This was then later devitrified during later activity, resulting in a mineral he called pseudotachylite, Thorpe, R. S, (1987). However, no obvious sign of this was seen during the walk through of the cutting on this occasion.

Locality 9

Perseverance Hill – view from the summit

The final site of the morning was the climb up on to and view from the summit of Perseverance Hill, just above and to the south of Wyche Cutting. From here the group were informed of the main points of

geological interest. Looking to the east, with a significant and steep slope in front of us there is the line of the East Malvern Fault. The actual contact is unfortunately covered in talus and not accessible. Beyond the slope is the wide valley of the River Severn that is formed by a graben that was initiated in Permo-Triassic times. Deposits of sand and fine dust filled the subsiding structure that has a maximum depth of over 2500m according to bore hole data collected at nearby Kempsey on the other side of the River. The Jurassic outlier of Bredon Hill can be seen in the near distance with the scarp-dip slope of the Cotswolds in the far distance (to the south east), also of Jurassic age. Over to the west, in stark contrast, the noticeably hillier and slightly higher ground with its wooded ridge tops and grassy valleys, represents a totally different lithology formed during a different age. The rocks in the near distance are marine deposits of Silurian age comprising harder limestones and siltstones and softer shales and mudstones. Beyond these are the rolling vales of Devonian sandstones and mudstones.
The group then took a well earned lunch break.

Part 2 – On reassembling the group took to their cars to drive north to North Quarry car park.

Location 10

Scar Quarry

At the north end of North Quarry car park is the remains of a quarry bench and at the north end of this is a strange looking outcrop. It has several almost vertical clefts in its face. On closer examination the group could see evidence of a hard cemented breccia that appeared to be trapped in the clefts. Debate ensued as to the cause, the age of the event and source of the breccia. Work is ongoing but the most likely explanation is that minor sympathetic faulting during extension allowed apertures to open up and loose overburden to fall in. Subsequent subsidence and burial during compression followed by lithification/cementation maybe assisted by ground water. Just as the group was about to leave, departure was delayed to examine another dyke that could only faintly be seen running almost horizontally across the rock face. This looks like a secondary granite intrusion and evidence was seen that it was displaced by one of the vertical shear planes previously described.

Location 11

Tank Quarry – The great quartz vein

A little further north, at the northern end of Tank Quarry there is another unusual feature. Just a few metres wide in a low bank is a brown stained mass of barren quartz. The quartz is milky white, typical of the sort that would usually carry metallic minerals elsewhere in the country. But here there is no trace of any other associated mineral. The brown or dark red colouration is considered to be due to staining from the rocks above, the goethite, hematite and manganese oxide (possibly wad) seeping into the fractured quartz. This is the largest known single mass of quartz exposed on the Hills.

Location 12

Tank Quarry – The great sill (actually a dyke by strict definition)

A little to the west of the quartz vein is the north face of one of the quarry benches. Here a 10 -15 metre long, up to 200mm thick, almost horizontal dyke of pinkish-red granite stands out prominently from a darker coloured diorite host rock. Its orientation has led to it being called a sill but since it separates igneous rock above and below (and not sedimentary bedding planes) it should strictly be described as a dyke. The group having finished gulping at yet another surprise, tried to imagine how it got there and even from which direction the incoming fluid came, since a thin fork could be seen running out to the west below the main dyke. And even to consider whether the fracture in the host rock was actually vertical or at some other angle prior to the intrusive event. Suffice is to say that this dyke like all the others has a hidden history yet to be revealed.

Location 13

Tank Quarry – Plinth mounted display rock samples

Arranged around the car park area are a number of large selected rock samples together with small ones mounted on plinths plus individual laminated display board descriptions. The group proceeded to walk around each exhibit. The leader pointed out that although this part of the Hills, according to Barclay et al, (1997), comprised predominantly granite, diorite and tonalite; examples of only granite and diorite could be seen on display. The lack of any source for tonalite now is another puzzle we are in need of solving.

Location 14
North Quarry – East Malvern Faut exhibit (or not?)

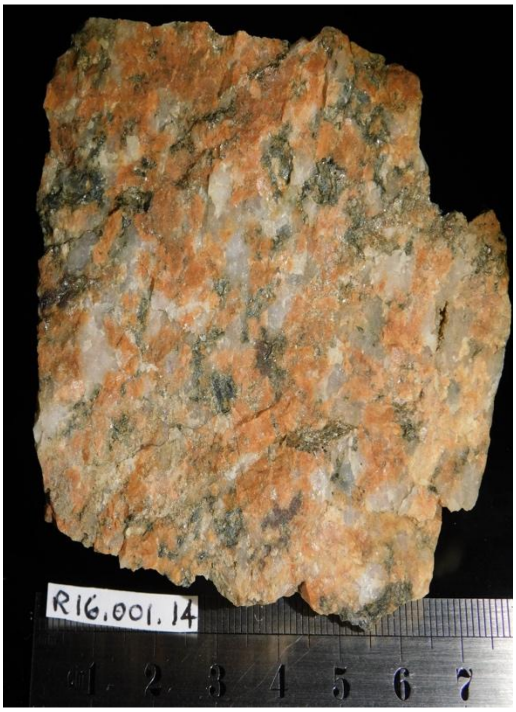
The gallant group now headed back to North Quarry to find a display board hidden amongst a small 'forest' of trees. The notice board stands in front of a long near vertical rock face and is entitled The East Malvern Fault. However, determining the exact position of this feature on the map and comparing it with the mapped line of the East Malvern Fault shows that the feature lies to the west of the main fault. It is assumed that this is actually a spur fault. The footwall of the fault was examined. Structurally, this is the western edge of the half graben where the hanging wall has slipped down or has been removed by quarrying. There appears to be a relatively thick well-cemented breccia adhering to the wall in places. This is 10 - 20 centimetres thick in places with numerous semi rounded clasts (up to 5 – 7cm diameter). Again this is considered by most, including the leader, to date from Triassic times but after recent clearance an alternative theory has been proposed. The possibility of the breccia material being of Silurian age is currently being considered.

Location 15
Recap, discussion and questions

Having seen so many rock outcrops and minerals in the day and having accumulated so many unanswered geological problems the group was led to the peace and quiet of the local church hall to unwind and take stock. Discussion of the day's findings followed. In summary it was concluded that the Malverns Complex deserved its unique name! Everyone departed content with the knowledge gleaned and experience gained.

References:

Barclay et al, 1997, Geology of the country around Worcester, NERC, BGS Worcester sheet memoir.
Brammall, A. & Doane, D.L., 1936, The distribution of gold and silver in the crystalline rocks of the Malvern Hills, Mineralogical Magazine, Vol 24, p260 – 264.
Brammall, A, 1940, p52-62 in report of the Easter field meeting at Hereford, Proc. Of the Geol. Assoc., Vol 51.
Bullard, D. W., 1975, Unpublished PhD thesis
Dewey, J. F., 1982, Plate tectonics and the evolution of the British Isles, 35th William Smith Lecture, J.Geol. Soc, London, Vol 139, pp371 – 412.
Firman, R. J., 1966, Sepiolite from the Malvern Hills, Mercian Geologist, Vol. 1, No 3.
Lambert R. StJ., & Holland, J. G.,1971, The petrography and chemistry of the igneous complex of the Malvern Hills, England., Proceedings of the Geologists' Assoc., Vol 82, 323 – 352.
Thorpe, R. S., 1987, Pseudotachylite from a Precambrian shear zone in the Malvern Hills, Proc. Of the Geol. Assoc., Vol 98, p 205-210.



1. Granite

Several quarries near the Wyche Cutting were quarried for granite. This example clearly shows the mineral grains. Interlocking crystals of pink feldspar (orthoclase) and white quartz can clearly be seen, together with some muscovite mica. Grain size does vary but in all cases can be seen with the naked eye. Other minerals will be present but usually only detected by magnification.

2. Diorite

This sample is from the north Malvern Hills quarries where Malvern stone was blasted out for building facades, walls and gravel paths. The grain size is clearly seen in this example and shows dark green hornblende with cream coloured feldspar crystals. The feldspar here is plagioclase

UPCOMING EVENTS

WGCG Lecture Programme Live at St Francis Kenilworth and on Zoom for 2025-2026

2025

- 18th September — Ross Anderson — Preserving Earth's first complex life (Oxford University Museum of Natural History)
- 16th October — Xiang Yan, PhD student (Imperial) — AGM then a talk on the Warwick Sandstone
- 20th November — Chris Rochelle — Geothermal Energy
- 11th December — Christmas Social

2026

- 15th January — Tim Pharaoh — Midland Microcraton
- 19th February — Peter Gutteridge — Stoer Group (Torridonian)
- 19th March — Adrian Wyatt — Malvern Geology
- 16th April — Colin Prosser — GeoConservation

Workshop

14th February 2026 Annual Workshop Kenilworth Senior Citizens Club 10:00 – 16:00

The workshop is focussed on developing field skills. The morning will work with maps and using geological tools available in free software to accurately record what is seen in the field. The afternoon will be a hands-on session in identifying the lithology and the depositional environment and logging it. We have acquired a 5m section of slabbed core from a North Sea reservoir for this session.

Field Excursions

June 2026

Shropshire: Leader Martin Whiteley

Several day trips evening trips are being prepared.

Public Engagement Events

Earth Science Week, October 12-18, 2025

- Sat 18th October 10:30-13:30 Ask a Geologist. Herbert Art Gallery and Museum, Coventry.
- *Dippy the dinosaur is on display*

Ask A Geologist Warwick Museum

Sat 6th December 10:30 - 13:30

Events by other organisations

Geologists' Association (GA) 18:30 hrs

October 3rd - 5th. Annual Conference, Keele Hall, Keele University WGCG have a stall at this conference.

October 10th - Hybrid Meeting. **October 10th - Hybrid Meeting**
Thames Through Time: Cornish Flavour, Ian Mercer

December 5th - Zoom meeting. **Mull Dyke Swarm.** Prof Joe Cartwright, Oxford

https://geologistsassociation.org.uk/lectures/ https://geologistsassociation.org.uk/ukfield/

East Midlands Geological Society

EMGS Lectures are held in the School of Geography Sir Clive Granger Building on the Nottingham University Park campus http://www.emgs.org.uk/

Black Country Geological Society (BCGS)

New Venue: The Lamp Tavern, 116 High Street, Dudley, West Midlands. DY1 1QT 7.30pm
https://bcgs.info/pub/the-society/programme-of-events/

The Lapworth Museum of Geology

https://www.birmingham.ac.uk/facilities/lapworth-museum/events/

Leicester Literary Philosophical Society

Presentations are held in theatre at the Leicester University campus at 7:30 pm, from whence they will be broadcast **on-line via Zoom.** Zoom links will be emailed to WGCG members a few days before each talk.
https://www.charnia.org.uk/

North Staffordshire Group of the Geologists Association

Lectures generally at Keele University 7:30pm on the second Thursday of each month -

Summer field programme

TBC September 2025: Stanton Moor Mining Field led by T. Wood

https://nsgga.org/

Shropshire Geological Society (SGS)

Talks are held in hybrid form, in person at the Higher Education Centre, Shrewsbury College, London Road, Shrewsbury SY2 6PR, and by Zoom

Teme Valley Geological Society (TVGS)

Talks take place in Martley Memorial Hall (MMH – postcode WR6 6PE) from 7:30pm

TVGS talks are free to members with a small charge at the door for non-members.

https://geo-village.org/

The Woolhope Club

All meetings are held at Hereford Town Hall. Friday evening meetings start at 6 pm, Saturday afternoon meetings at 2 pm. There is a £2 charge for all non-members.
https://www.woolhopeclub.org.uk/geology

The West Midlands Regional Group of the Geological Society (WMRG)

Talks are in hybrid form, in person at Mott MacDonald's Office (10 Livery St, Birmingham B3 2NU) & Zoom
https://www.geolsoc.org.uk/wmrg

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Christine Hodgson

Helen Jones

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Instagram	Kathrin Schütrumpf & Lauren Sewell
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Julie Harrald

Jon Radley

Your Picture could be here

Andrew Sanderson

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WARWICKSHIRE GEOLOGICAL CONSERVATION GROUP

WGCG
Hidden wonders in the landscape of Warwickshire
Warwickshire Geological Conservation Group

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Association of Welsh RIGS Groups Avon RIGS http://avonrigsoutcrop.blogspot.co.uk
Bath Geological Society www.bathgeolsoc.org.uk
Bedfordshire Geology Group www.bedfordshiregeologygroup.org.uk
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Bristol Naturalists' Society www.bristolnats.org.uk/geology
British Micromount Society https://bms.mineralcollective.com
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Cambridgeshire Geological Society www.cambsgeology.org
Carn Brea Mining Society https://www.cbms.org.uk/
Cheltenham Mineral and Geological Society http://cmgs.yolasite.com/society.php
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Devon RIGS Group www.devonrigs.org.uk
Devonshire Association https://devonassoc.org.uk/organisation/ sections/geology-section/
Dinosaur Society www.dinosaursociety.com
Dorset Group (LG) https://dorsetgeologistsassociation.org/
Dorset Natural History & Archaeological Society enquiries@dorsetcountymuseum.org
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Oxfordshire Geology Trust www.oxfordshiregeologytrust.org.uk
Peak Lapidary & Mineral Society http://rockexchange.uk/
Peterborough Geological Palaeontological Group http://peterboroughgeology.org
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