Manchester Geological Association

President: Dr Margaret Hartley

March 2023

www.mangeolassoc.org.uk

Founded 1925

Changes to the subscription rate for Members who receive a paper newsletter

At the recent AGM, an increase in subscription rates for those members wishing to receive communications by post rather than email, the amount to be decided by Council, was proposed by Peter del Strother, seconded by Margaret Hartley and carried unanimously. An increase of £8 per year was previously suggested in the AGM paperwork, but on further reflection, Council has decided that subscriptions should rise by £10 per year, as from January 2024, for these members.

The new subscription rates as from January 2024 are as follows (2023 rates in brackets):

Full member, correspondence by email ……	£16 (£16)
Full member, correspondence by post …….. .	£28 (£18)
Full member and an associate member, correspondence by email	£18 (£18)
Full member and an associate member, correspondence by post	£30 (£20)

Quick Diary

Outdoor Meetings

Wednesday 12th April. Crummack Dale
Saturday 22nd April, prior to MGA afternoon lectures 13.30. Manchester Building Stones 10.30
Sunday 23rd April. Fred Broadhurst Memorial Field Trip, Lyme Park
Sunday 25th June. Waterfalls Walk, Ingleton
Sunday 16th July. Force Crag Mine, underground visit
Saturday 2nd September (or Sunday 3rd if weather is 'unreasonable') to explore the volcanic rocks above Bonsall Village
Sunday 30th September. Alderley Edge Copper Mines, underground (Engine Vein) and surface

Indoor Meetings

Saturday 14 October. Broadhurst Memorial - Volcanology
Wednesday 8 November. Zoom meeting
Saturday 9 December. Structural Geology

Who's Who in the MGA

Officers

President: Dr Margaret Hartley

Vice-President: Dr Rufus Brunt

General Secretary: Sue Plumb BSc

Membership Secretary: Steve Daniels

Treasurer: Peter del Strother

Indoor Meetings Secretary: Ken Jacobs

Field Excursions Secretary: Peter del Strother

Newsletter Editor: Lyn Relph BSc

Webmaster: Peter Giles Msc

MGA Archivist:

Other elected members of Council
Prof. Ray Burgess
Nicola Fowler BSc (Hons)
Dr Steve Donovan
Sally Dulieu

The Immediate Past President, Manchester Geological Association: Niall Clarke

RIGS Representative: Dr Chris Arkwright

MGA email addresses

To contact our President: president@mangeolassoc.org.uk

To contact our Vice-President: vicepresident@mangeolassoc.org.uk

To contact our General Secretary: secretary@mangeolassoc.org.uk

For membership enquiries: membership@mangeolassoc.org.uk

For field visit enquiries: outdoors@mangeolassoc.org.uk

For indoor meeting enquiries: lectures@mangeolassoc.org.uk

For newsletter correspondence: newsletter@mangeolassoc.org.uk

For other enquiries: info@mangeolassoc.org.uk

Castleton Field Trip

By Michael Regan

A large and enthusiastic group of members of the Open University Geological Society and Manchester Geological Association participated in a fascinating excursion around the Castleton area in the Peak District. They were led by Professor Cathy Hollis of Manchester University, who has worked in this area for many years and shared her expertise generously. As well as looking at key outcrops and aspects of the geology of the area the trip had a particular objective to use the outcrops in the Castleton area to view a working petroleum system and mineral deposit.

Mam Tor

Fig. 1. Mam Tor and the landslips.

We started at Mam Tor, a spectacular cliff face about 200 feet high, Fig. 1 it was created by successive landslips over time, which continue to this day. The effects of which are plainly visible in the old A625 road, at the foot of the cliff, which has been closed since the 1979. The roadway is buckled and broken into several pieces. Although it is man-made, it shows interesting parallels with 'natural' geological features, such as listric faults.

At the base of the Mam Tor cliff face is an almost black mudstone – the Edale Shale Fig. 2. These are organic rich and often highly fissile shale, of early Serpukhovian (in old money, Lower Namurian) age. They are the first unit above the Lower Carboniferous limestone, and represent the earliest deposition into the sedimentary basin. The shale has a high Total Organic Carbon, up to 10% in places. We were surprised by the number of fossils that we found in them, which included brachiopods, bivalves and a goniatite (Figs. 3, 4). These provided evidence of marine conditions, which it transpired came through a link from open sea to the south. We also found some land-derived fossils, in the form of plant material (Fig. 5).

Fig. 2. Edale Shale at the base of Mam Tor

Fig. 3 Goniatite from the Edale Shale

The Edale shale are analogous to the source beds for the East Midlands oil fields in Nottinghamshire and Lincolnshire, and are broadly equivalent to the Bowland Shale, the potential shale gas reservoir in the North West. So the Edale Shale is also a potential source rock. Unsurprisingly this prompted several discussions about fracking, although equally unsurprisingly not reaching a resolution to this controversial subject.

Fig. 4 Brachiopods from the Edale Shale

The presence of the Edale shale at the foot of Mam Tor is the reason that the cliff is there. The shale has been a failure point and this allowed the overlying rocks to slip and thus the cliff face to be formed. The high carbon content of the shale has added to their effectiveness in this process. The name “Mam Tor” means (according to Wikipedia) "mother hill" – a reference to the number of small hillocks beneath it that have resulted from the frequent landslips. The landslips have also led to Mam Tor being known as “the Shivering Mountain”.

Fig. 5 Plant fossils are common in the Mam Tor beds but rare in the Shale.

Above the shale, the Mam Tor beds are an impressive sequence of micaceous siltstones and fine sandstones interlayered with dark shale. They were formed as a stack of turbidites that were deposited on the floor of the basin as a submarine fan. After the very fine particles had formed the Edale Shale below, the clasts became coarser, brought in by the sediment flows. The interbedded shale resulted from quieter deposition of very fine sediments that continued in between the flow events. We saw a variety of features related to the flow of the turbidity currents, including sole marks, flutes and rip-up clasts. We also saw some small areas where the sandstone and shale material had intermingled. These are dewatering structures that formed shortly after the sediments had been deposited. They resulted when pore fluids from the soft, wet shale intruded into the sand layers above before the sediments were consolidated (Fig. 6). Again, although the rocks were laid down in a submarine environment, we found a number of plant fossils that had originated on land and had been deposited by the turbidites.

Fig. 6 Dewatering structure.

The underlying limestone had formed in a tropical warm-water environment, but the Edale Shale and then the Mam Tor beds represent a significant change to a cooler climate and clastic sedimentation. The source of the sediments is thought to be land to the north, in the vicinity of today’s Southern Uplands, created as a result of tectonic uplift just prior to the Namurian. In this area there was a change in the regional tectonics, from stretching and subsidence in the Lower Carboniferous to compression from the Variscan orogeny.

Windy Knoll

From Mam Tor we walked a few hundred yards to Windy Knoll, which lived up to its name but did offer excellent views across Hope Valley. The geology there is principally seen in a former quarry, where faulting has raised the Visean Limestone to a similar altitude to the lower sequences of Mam Tor. We saw some fossils of the kinds that would be expected in the limestone, including corals and brachiopods, although several members of the party who had visited some years ago were disappointed in how few are now clearly visible.

However, the main point of our geological interest here was at the top of the exposure, where we saw a palaeokarst surface. It is a limestone breccia, and within the fissures we saw black material with a rubbery texture, which turned out to be bitumen (Fig. 7). It is evidence of an ancient petroleum system. The organic material that formed the hydrocarbons probably originated from marine plankton in the Edale Shale. It had been subjected to raised temperatures when it was buried to depths of up to 3km in the late Carboniferous. The hydrocarbons had matured during this period, and some had collected in the limestone outcrop where we now saw them. These rocks have not been deeply buried since – indeed not much more has happened to them over a very long time! This is consistent with what is seen elsewhere across the area. There is fragmentary evidence of Triassic rocks elsewhere in the Peak District, but Jurassic and Cretaceous are absent – in fact, the next youngest deposits that we see in the area today are Miocene.

Fig. 7 Black bitumen can be seen filling the spaces, in stark contrast to the white limestone

Very close by we were able to view the entrance to a cave in the limestone. It was excavated in the 19th century and about 5000 skeletons, mainly of bison and reindeer, were found. It is thought that in the early post-glacial period it was a swallow-hole on the migration route between Edale and the Cheshire Plain, which is why the bones accumulated there in such large quantities.

Winnats Pass

The road we took down through Winnats Pass, a limestone gorge, is thought to follow an original feature of the reef. It was a channel that cut through the fore-reef slope, which has more recently been further eroded by meltwaters at the end of the Ice Age.

Fig. 8 View from the top of Winnats Pass.

It provided a fascinating opportunity to walk down the edge of the Carboniferous reef and its slope. At the start of the Pass, we were going past horizontal strata, but ahead of us, farther down the Pass, we could see that the bedding was different (Fig. 8). The horizontal beds at the top of the Pass are interpreted as

Fig. 9 Dipping beds at front of the reef as it builds out into the basin. (People indicate the vertical angle).

having been deposited in shallow water at the back of the reef. Looking ahead, down the Pass, we could see mound-shaped structures high up the walls of the Pass, which are small reefs that built up at the edge of the platform. As we continued down the Pass, the general aspect of the beds progressively changed from horizontal to downward sloping, so that by the time we reached the bottom of the Pass the dip angles were approaching 45 degrees (Fig 9). The dips are original depositional features, not the result of folding. We were in fact following the slope of the original reef platform as it built up and out into the Edale Basin, and the steepening dips indicated the transition from the back-reef platform to the fore-reef slope.

We saw abundant crinoids, brachiopods and some corals in the limestone. It is highly fossiliferous - algae and occasional goniatites, trilobites and bryozoa can also be found. We also saw some evidence of mineralisation. In particular, there were a few traces of the purple calcium fluorite known as Blue John, which is unique to the Castleton area – and we would be seeing much more of it shortly!

We also saw some cavities in the limestone that were filled with calcite. This was layers of cream and white calcite, the white having been deposited from meteoric and ground water, the cream was deposited from sea water.

Treak Cliff Cavern

Our final location was Treak Cliff Cavern, through which we were guided by a member of the Cavern team who explained its history and particularly the mining. It is well-known as one of only two places where the Blue John Stone is still mined (the other being the nearby Blue John Cavern). However, as Cathy explained, the cavern offered us more geology than just the Blue John itself.

Fig. 10 Spaces between the limestone blocks filled with crinoid debris.

The first part of the passage through the cave took us through limestone with a blocky, almost rubbly, texture. This formed when the reef became over steepened and unstable causing rock falls down the reef front. It is within one of these rock falls that the caverns formed. It included discrete masses of black shale, and smaller areas which were almost entirely composed of crinoid pieces (Fig. 10) that washed off the reef top followed by the fine muds before the Blue John crystals formed. Veins periodically opened and closed allowing fluids of different composition to flow through the veins to form the blue and yellow colouration of the Blue John.

From there we moved on into the section of the cavern where the Blue John is to be found. We saw that there are two styles – veins which are a few inches thick but up to a metre long (Fig.11), and roundish nodular forms inside cavities in the limestone (Fig.12). Some crinoid fossils were visible in the nodules (Fig. 13).

Fig. 11 Blue John filling a round cavity.

Fig. 12 A vein of Blue John ; some of which can be a metre or more long.

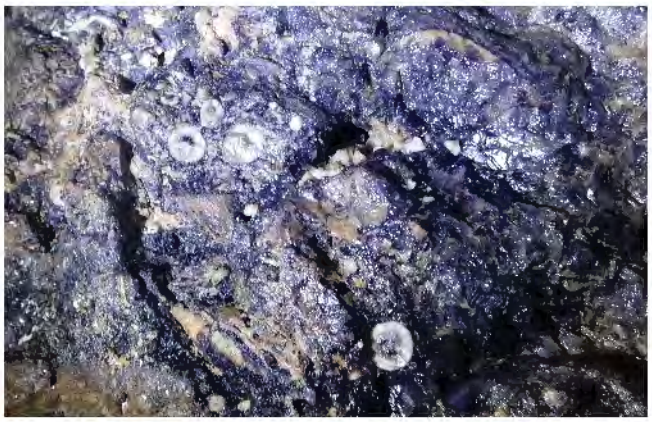

Fig. 13 Crinoid pieces surrounded by Blue John.

The Blue John mineral is a colour-banded form of fluorspar (fluorite), characteristically blue and yellow. The origin of the name is not certain, but one theory is that it originated from exports of the stone to France – deriving from “bleu-jaune” (French “blue-yellow”). It has been mined for over 250 years, and was very popular for its ornamental value during the late 18th and 19th centuries. More recently, in the early 20th century and especially during the first world war, fluorspar was in great demand as a flux in blast furnaces, so the Blue John mining was diverted to that purpose. The formation of the Blue John seems to involve a fairly specific combination of circumstances – limestone containing saline fluid and some hydrocarbons, availability of fluorine ions and a rock layer to act as a cap. The reason for the unique colouration has been debated over the years, and even now there is not a definitive answer, although it seems likely that the radioactive element radon plays a part.

We moved further through the cavern into the main part of the limestone reef and to our final location for the day – the “New Series” of caves, which includes some evocatively-named sections (“Aladdin’s Cave”, “Fairyland”, “Dream Cave”, etc). These displayed some impressive structures created by the deposition of calcite by percolating water, aka speleothems - we saw stalagmites, stalactites and flowstone in the form of calcite curtains (Fig. 14). Cathy then directed our attention upwards, towards dome-like cavities, several metres across, in the roof of the cavern. They resembled large scour-marks, such as might be caused by water swirling around and eroding out a round hole in a river-bed (Fig. 15). Of course, we thought, they couldn’t be formed in this way, they were the wrong way up - but no! Cathy explained recent thinking, that these caves were actually formed by hot water upwelling. She reminded us that today, not far away from Castleton, hot springs rise to the surface at Buxton – the famous spa waters. it is thought that the same sort of thing happened at Treak Cliff. The water acquired its heat at depth and rose. It flowed upwards through fractures in the limestone, enlarging them into cavities and eventually the caverns, and as it swirled around it scoured out the dome-like solution voids that we saw in the roof.

Fig. 14 Flowstone and stalactites.

Fig.15 Solution hole in the roof of the cave.

As we emerged from Treak Cliff Cavern, we noted how close it is to Speedwell Cavern, another show cave in the limestone. Although Speedwell is only about a quarter of a mile distant, and has occurrences of fluorite, it does not have the Blue John stone. The reason for this seems to be that in the limestone above the Speedwell Cavern there is a basalt lava flow - this can be seen in outcrop near Castleton village. The lava prevented surface water percolating down to Speedwell Cavern and so seems to have precluded formation of Blue John.

The group would like to record its thanks to Cathy for a really good day, and to Ken Jacobs for organising it. Many of the group had visited the area before but everyone had seen a lot that was new and it was a very rewarding trip.

Picture credits; Figs 1,10, 13 and 15 Lyn Relph, remaining pictures by the author.

OTHER SOCIETY EVENTS

BCGS http://bcgs.info/pub/

1 April – Field Visit: Wroxeter Roman City
17 April – The origins of starfish and their relatives
20 May – Field Visit: Little Doward and Arthur's Cave

Yorkshire Geological Society http://www.yorksgeolsoc.org.uk/

30 March. Who bit my ammonite? the pathology's tale
27 April. British Mesozoic Fossils and the Emergence of Mammal Traits
29 April. Yorkshire Geology Day 2023!
20 May. Jurassic Ironstone Field Trip
24 May. Finding Your Limits, A look at the palaeoenvironments
25 May. Marine Litter: are there solutions to this global environmental challenge

Leeds Geological Society http://www.leedsga.org.uk/

4 May The real Jurassic world – frog earths in the middle Jurassic

GeoLancashire https://geolancashire.org.uk/lectures-and-excursions/

April meeting. Date TBA. A talk on the Canaries

See website for list of joint meetings with other groups

OUGS North West Branch https://ougs.org/northwest/

25 March Alderley Edge and Wood Mine

Manchester Geological Association

MGA outdoor meetings 2023

Contact: **outdoors@mangeolassoc.org.uk**

Wednesday 12th April. Crummack Dale.
Approximately seven kilometres from Horton in Ribblesdale to Austwick. Meet at Austwick at 10.30am. We will then drive to Horton and park near the station, which will be the meeting point for the start of the excursion. Enough cars will be left in Austwick for later shuffling of drivers back to Horton. This will be a trail in the MGA 100th anniversary book of trails, currently in preparation. The excursion will test this trail. Further details and draft text of trail available via the outdoors@ email. Leader Peter del Strother.

Saturday 22nd April, at **10.30am**. prior to MGA afternoon lectures. Manchester Building Stones, with historical asides. Meet at St Peter's Square, in front of Manchester Central Library, Leader Peter del Strother.
13.30pm. How can the subsurface help us achieve Net Zero: examples from the North Sea and Greater Manchester - Prof Mads Huuse
An overview of HyNet, with a focus on carbon dioxide capture, transport and storage - David Walker
Biosteering the world's oldest and deepest gas reservoirs - Wyn Hughes

Sunday 23rd April. Fred Broadhurst Memorial Field Trip, Lyme Park. Leader Jane Michael.
This trip is now fully booked but Jane would be prepared to start a waiting list. If you would like to attend please contact her at gmicsch@gmail.com

Sunday 25th June. Waterfalls Walk, Ingleton.
Joint with Westmorland Geological Society. Details available via outdoors@ email. This is quite a demanding walk on a well-maintained path with an estimated 1000 steps. There is a charge for parking/entry to the walk. https://www.ingletonwaterfallstrail.co.uk/ Please contact using the outdoors@ email address above. Leader Lesley Collins.

Sunday 16th July. Force Crag Mine, underground visit.
Joint with GeoLancashire. Contact secretary@geolancashire.org.uk for details.

Saturday 2nd September (or Sunday 3rd if weather is 'unreasonable').
North Staffs Group of the Geologists' Association has invited members of the MGA to join this excursion to explore the volcanic rocks above Bonsall Village, one of the four Peak District Carboniferous volcanic centres. Included will be Tearsall Farm, an old fluorspar open cast quarry exposing the Upper Matlock Lava. Leader Dr Mike Allen. Details to follow nearer the time. Please contact the outdoors@ email if interested.

Sunday 30th September. Alderley Edge Copper Mines, underground (Engine Vein) and surface.
Joint with GeoLancashire. Details to follow nearer the time. Limit on numbers, so please contact using the outdoors@ email address.

Manchester Geological Association

Outdoor meetings 2023

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Indoor Meetings 2023/4

Saturday 22nd April, at **10.30am**. prior to MGA afternoon lectures. Manchester Building Stones, with historical asides. Meet at St Peter's Square, in front of Manchester Central Library, Leader Peter del Strother.

13.30pm.

How can the subsurface help us achieve Net Zero: examples from the North Sea and Greater Manchester - Prof Mads Huuse

An overview of HyNet, with a focus on carbon dioxide capture, transport and storage - David Walker

Biosteering the world's oldest and deepest gas reservoirs - Wyn Hughes

Saturday 14 October. Broadhurst Memorial - Volcanology

Dr Craig Magee (Leeds University), TBC
Prof. Hazel Rymer (formerly Open University), TBC
Tivonne Howe (Lancaster University), TBC

Wednesday 8 November. Zoom meeting

Saturday 9 December. Structural Geology

2024

Wednesday 10 January Zoom meeting

Saturday 10 February 2024 **AGM**. Presidential address & member presentations

Wednesday 6 March Zoom meeting

Saturday 13 April. Resources

Bring Your Own Flask

Would Members please bring their own flask as we will not be providing refreshments for these events.