Newsletter No. 227

October 2014

The Black Country Geological Society

Copy date for the next Newsletter is Monday 1 December

Contents:

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For enquiries about field and geoconservation meetings please contact the Field Secretary.
To submit items for the Newsletter please contact the Newsletter Editor.
For all other business and enquiries please contact the Honorary Secretary.
For further information see our website: www.bcgs.info

Future Programme

Please note

The lecture meeting on 20 October will be held at Dudley Museum & Art Gallery, St James's Road, Dudley, DY1 1HU. Tel. 01384 815575
Subsequent meetings until further notice will be held in the Abbey Room at the Dudley Archives, Tipton Road, Dudley, DY1 4SQ
7.30 for 8.00 o'clock start unless stated otherwise

Please let Andy Harrison know in advance if you intend to go to any of the field or geo-conservation meetings. If transport is a problem for you or if you intend to drive and are willing to offer lifts, please contact Andy with at least 48 hours notice.

Monday 20 October ***(Indoor Meeting at Dudley Museum & Art Gallery):*** **'Britannia: Discovery, complexity and development (and decline!) of a major UK North Sea gas – condensate field'. Speaker: Les Riley,** Consultant Stratigrapher and BCGS member. (NB: change of speaker and subject.)

Sunday 2 November ***(Geo-conservation Day):*** **Another visit to Saltwells Nature Reserve (SSSI) and Doulton's Clay Pit, led by Alan Preece.** Meet at the Nature Reserve car park (NGR: 393424, 286899) on Saltwells Lane for 10.00. We will be joined by the Saltwells Volunteer Group for scrub clearance within Doulton's Claypit. Wear old work clothes, waterproofs and stout footwear or wellies. Please bring gloves and garden tools; loppers, secateurs, forks and spades if you have them. Either bring packed lunch or hot food can be acquired from the Saltwells Inn adjacent to the car park. Finish at 14.30.

Monday 17 November ***(Indoor Meeting at the Dudley Archives, see above):*** **'Volcanoes of the Azores'. Speaker: Alan Clewlow,** BCGS committee member, and 'Volcanic Experiences Ltd.' tour operator. (NB: change of speaker and subject.)

Saturday 6 December ***(Geo-conservation Day):*** **Barr Beacon and Pinfold Quarry, led by Andy Harrison and Helen Sanger.** Meet at 10:30 at the entrance on B4154 Beacon Road, opposite Bridle Lane (the southern entrance to Barr Beacon) Grid ref: SP 060967. Wear old work clothes, waterproofs and stout footwear. Please bring gloves and garden tools; loppers, secateurs, forks and spades if you have them. Also bring lunch. Finish at 14:30.

Monday 8 December ***(Indoor meeting at the Dudley Archives, 7.00 for 7.30 start):***
BCGS Members' Evening and Christmas Social.

Your contributions are needed for this event!

This is our annual chance for members to share their geological experiences in a sociable atmosphere with a Christmas buffet provided by the Society. We need a few of you to volunteer to do a short presentation (10 - 15 minutes) - on any topic with geological connections; or perhaps bring along ►

some of your specimens and/or photos for admiration, discussion and identification. Please don't be shy about volunteering - this is an informal and relaxed occasion: the more contributions we have, the merrier the evening. **Please contact our Secretary, Linda Tonkin if you would like to make a contribution to this event:** secretary@bcgs.info **or phone: 01902 846074.**

Saturday 31 January 2015 ***(Geo-conservation Day):*** **Another visit to Barr Beacon and Pinfold Quarry, led by Andy Harrison and Helen Sanger.** Details as for 6 December.

Monday 16 March 2015 ***(Indoor meeting, 7.00 for 7.30 start):*** **AGM** followed by '**Minerals and Gems of the Cairngorms'. Speaker: Roy Starkey.**

Procedures for Field Meetings

Insurance
The Society provides public liability insurance for field meetings but personal accident cover is the responsibility of the participant. Details can be obtained from the Secretary. Schools and other bodies should arrange their own insurance as a matter of course.

Health and Safety
If you are unsure about the risks involved or your ability to participate safely, you should contact the Field Secretary. Please take note of any risk assessments or safety briefing, and make sure that you have any safety equipment specified. The Society does not provide hard hats for use of members or visitors. It is your responsibility to provide your own safety equipment (eg. hard hats, hi-viz jackets, safety boots and goggles/glasses) and to use these when you feel it is necessary or when a site owner makes it a condition of entry. Hammering is seldom necessary. It is the responsibility of the hammerer to ensure that other people are at a safe distance before doing so.

Leaders provide their services on a purely voluntary basis and may not be professionally qualified.

Other Societies and Events

BCGS members are normally welcome to attend meetings of other societies, but should always check first with the relevant representative. Summarised information for the **next two months** is given in our Newsletter. Further information can be found on individual Society web sites.

Warwickshire Geological Conservation Group

Wednesday 19 November: 'Chips off the old block: a geological perspective on the Stonehenge bluestones'. Speaker: Dr. Rob Ixer (Institute of Archaeology, University of London).

St Francis Church Hall, Warwick Road, Kenilworth CV8 1HL. Starting at 7.00 pm for coffee before a 7.30pm start. For more details visit: http://www.wgcg.co.uk/ or contact Ian Fenwick swift@ianfenwick.f2s.com or 01926-512531. There is a charge of £2.00 for non-members.

Woolhope Naturalists' Field Club - Geology Section

Friday 17 October: 'The Origin of Life'. Speaker: Dr Geoff Steel.

Friday 21 November: 'Giant meteorite impacts: the evidence from Britain'. Speaker: Dr Mike Simms.

All indoor events are held in the Woolhope Room, Hereford Library starting at 5.30 unless otherwise specified. Guests are welcome, but must take day membership of the Club: £2.00. Further information: Sue Hay on 01432 357138, email svh.gabbros@btinternet.com or visit their web site: www.woolhopeclub.org.uk/Geology_Section/default.htm

Lapworth Lectures

Monday 20 October: 'Dinosaur tracks: from merely scratching the surface, towards a deeper understanding'. Speaker: Dr Peter Falkingham. Royal Veterinary College, London.

Monday 3 November: 'Colour in the fossil record'. Speaker: Dr Jakob Vinther, University of Bristol.

Monday 17 November: 'Are hotspots really hot?'. Speaker: Prof. Godfrey Fitton, University of Edinburgh.

Monday 1 December: 'Why the Oman Ophiolite cannot have formed at a mid-ocean ridge'. Speaker: Prof. Hugh Rollinson. University of Derby.

Lectures at 5.00 in the Dome Lecture Theatre, Aston Webb Block A - Building R4, University of Birmingham. All are welcome to attend and there is no admission charge. For further information phone: 0121 414 7294 or visit: http://www.lapworth.bham.ac.uk/events/lectures.shtml

Mid Wales Geology Club

Wednesday 15 October: 'A new look at metal extraction in the Bronze Age and the Iron Age'. Speaker: Tony Thorp.

Further information: Tony Thorp (Ed. newsletter & Hon. Sec): Tel. 01686 624820 and 622517 jathorp@uku.co.uk Web site: http://midwalesgeology.org.uk Unless otherwise stated, meetings start at 7:15 (tea/coffee & biscuits) with talks at 7:30 at Plas Dolerw, Milford Road, Newtown.

Teme Valley Geological Society

Monday 27 October: 'The Earth After Us'. Speaker: Dr J Zalasiewicz.

Monday 17 November at 6.00pm: TVGS AGM and lecture **'Chinese Cambrian Lagerstatte'.** Speaker: Prof. David Siveter. (Contact: John Nicklin, 01886 888318)

Monday 8 December: Talk by Dr Paul Olver.

7.30 at the Martley Memorial Hall B4197 by Sports Ground. £3 non-members. For more details visit: http://www.geo-village.eu/ or contact Janet Maxwell-Stewart, 01886 821061

East Midlands Geological Society

Saturday 15 November at 6.00: 'Geotourism in the UK: celebrating our natural landscapes'. Speaker: Dr Kristin Lemon.

Non Members are welcome. Meetings will take place in lecture theatre B3 of the Biology building at the University of Nottingham. Further info at: www.emgs.org.uk or email: secretary@emgs.org.uk

North Staffordshire Group of the Geologists' Association

Thursday 13 November: 'Earth After Us'. Speaker: Dr Jan Zalasiewicz (Leicester).

Lecture meetings are held at 7.30 in the William Smith Building at Keele University. Further information at: www.esci.keele.ac.uk/nsgga/

Shropshire Geological Society

Wednesday 12 November: 'Wine, whisky and beer'. Guest speaker: Prof Maltman, Aberystwyth University.

Generally held at Shire Hall, Shrewsbury, commencing at 7.15pm for 7.30pm. Note that the venue might have to be changed, depending on the possible sale of Shire Hall. A nominal charge is levied for attendance by non-members. Further info at: www.shropshiregeology.org.uk/

Manchester Geological Association

Saturday 15 November at 13.30: 'Eden Valley Deposits'. Speaker: Dr Noel Worley, Yorkshire Geological Society.

Saturday 6 December (start time to be confirmed):
'Ophiolites and Accretion Models for the Oceanic Crust'. Speaker: Dr Johan Lissenberg, University of Cardiff.
'Memories of Ocean Basin Opening and Closing preserved in Ophiolite Peridotites'. Speaker: Dr Brian O'Driscoll, University of Keele.
'Why the Oman Ophiolite did not form at a Mid-Ocean Ridge'. Speaker: Professor Hugh Rollinson, University of Derby.

Most MGA Meetings are held in the Williamson Building, Oxford Road, opposite The Manchester Museum. For further information about meetings go to: http://www.mangeolassoc.org.uk/ or email lectures@mangeolassoc.org.uk Visitors are always welcome.

Geological Society, West Midlands Regional Group

Tuesday 11 November: Advanced Technologies for Contaminated Site Remediation. Speaker: Dr Jeremy Birnstingl, Managing Director, Regensis. Venue: Lapworth Museum of Geology, University of Birmingham.

Tuesday 9 December: A Life in Oil - Prospecting, Recovery and Future. Speaker Martin Carruthers. Venue: Lapworth Museum of Geology, University of Birmingham.

For further details and enquiries, please contact the Group Secretary, Daniel Welch at: geolsoc_wmrg@live.co.uk

Geologists' Association Festival of Geology

Saturday 1 November 10.30 – 4.30: University College London, Gower Street, London, WC1E 6BT. **Entrance Free!** Further information at: www.geologistsassociation.org.uk/festival.html

Exhibitors from the world of geology
Discovery room
Geological talks by Laurance Donnelly, Richard Edmonds, Iain Stewart, Peter Styles
Walks & Field Trips
Amateur Photographic Competition

Sunday 2 November: Field trips (£5.00 charge). See web site for details.

Lickey Hills Geo-Champions

Saturday 18 October 10.30 - 3.30: Lickey Rocks! A day of free activities at the Lickey Hills Visitor Centre, B45 8ER celebrating Earth Science Week. For full details see: http://ehtchampions.org.uk/ch/?page_id=449

Editorial

Because of changed circumstances at the Dudley Museum and Art Gallery, this will no longer be our regular venue for meetings in the future. We hope you all received notification of the changed venue for our last meeting, which took place in the Abbey Room at the Dudley Archives, Tipton Road, Dudley, DY1 4SQ. There was general agreement that the Abbey Room provided very satisfactory alternative facilities, and this will be our regular venue for the next few months, at least up to and including April. (Note however that the meeting on 20 October will be in the Museum and Art Gallery.)

We apologise for the changes to our indoor programme. Our scheduled speaker for 20 October, Dr Brian O'Driscoll, is unfortuntely now unable to attend on that date. We therefore extend our thanks to Les Riley for agreeing to speak in October rather than November, and to Alan Clewlow for stepping into the breach to talk about the Azores at our November meeting.

Visitors to the 'Fossil Fun Day' at Dudley Museum and Art Gallery on 30 August were spoilt for choice with the wide range of activities and exhibits on offer. One of these was the BCGS stand tucked in beside Fluffy, Dudley's very own woolly mammoth. Between magic shows, fossil casting, and perusing the stalls full of breath-taking arrays of fossils, minerals and jewellery, visitors young and old took time to talk to us and look at our exhibits and leaflets. Special thanks are due to Linda Tonkin and Graham Worton for providing material and setting it all up, and to Kayleigh Mills for bringing her own fossil models and engaging so enthusiastically - especially with the younger visitors. ■

Julie Schroder

The Black Country on 'Countryfile'

In early August, Graham Worton and I were contacted by Charlotte Loving, a researcher from the BBC's 'Countryfile' programme. She was interested in doing a feature on the Stourbridge glass industry and the geology of the area. Speaking to Graham for over two hours and individually to me, Charlotte discovered that there was more to the Black Country and its geology than just Stourbridge and its glass industry.

Over the following two weeks Graham met with a team of researchers, including Charlotte, and a film crew from the programme. Guided by Graham they visited Wren's Nest, the Singing Cavern, Moorcroft Wood, Saltwell's, Rowley Hill and the Leasowes. They were told about the Black Country's industrial past, which started with agriculture and was later followed by iron manufacture, mining and glass making. They also discovered how geology was strongly linked to the region's industrial past providing an abundance of accessible raw materials such as clay, coal and iron ore. Graham was impressed at how quickly the research team and film crew took on board what he told them. They also came to realise how much the Black Country had to offer, its significance, and that it would deserve a return visit. At the end of the day they returned home with a mountain of information, photos and unforgettable memories. Prior to the programme going out Graham was concerned about how much and what would be included in the final edit.

The Countryfile episode was aired on Sunday 7 September. Graham was shown being interviewed by Ellie Harrison in the Singing Cavern about the Black Country's industrial heritage and geology. The programme also featured the Leasowes and the Stour Valley, Hagley Hall and the on-going restoration of its gardens, and Kinver's Holy Austin Rock Houses. Overall it was an interesting and informative episode that nicely publicised some of the hidden gems that the Black Country and surrounding area have to offer. Hopefully in the future we may see the return of 'Countryfile' to the Black Country. ■

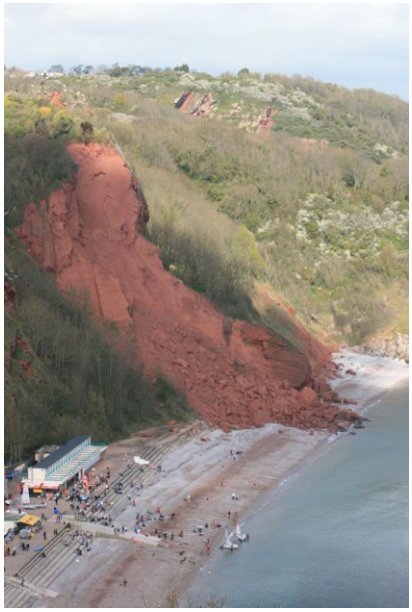
Andy Harrison

Photographic Contest 2014 - the Winners

This year's photographic competition was rather more ambitious in its scope than last year's, and was run and sponsored jointly by the West Midlands and South Wales groups of the Geological Society, and the BCGS. The subject: 'What Lies Beneath our Feet' was interpreted in numerous different ways by the entrants, numbering nearly a hundred in total.

A4 prints of each photo were assembled for the judges, Jon Clatworthy (from the Lapworth Museum), Adrian Durkin (from Dudley Museum & Art Gallery), and Bill Gaskarth (from the Geological Society of London), who met at the Lapworth Museum, Birmingham University early in September to select the winners.

Hafrahvammar Canyon, Iceland



Dramatic Cliff Failure of Permian Red Beds at Babbacombe near Torquay

The first prize (£200) was awarded to Malcolm Nugent (South Wales group of the GS) for his photo: 'Etna Beneath Our Feet' *(see front cover).*

The second prize (£150) was awarded to John Schroder (BCGS) for his photo: 'Hafrahvammar Canyon, Iceland'.

The third prize (£100) was awarded to Scott O'Neil Gwilliams (West Midlands group of the GS) for his photo: 'Dramatic Cliff Failure of Permian Red Beds at Babbacombe near Torquay'.

Fiona Townley and Tim Wright received 'Highly Commended' awards for their photos (respectively), 'Strokkur Geysir, South Iceland', and 'Whaleback Fold, Bude, Cornwall'.

BCGS members were able to view the top 10 entries projected at the start of our meeting on Monday 22 September, and the award ceremony took place at the West Midland GS meeting the following evening, after a talk 'Engineering Geology, Past, Present and Future' given by Jim Griffiths from Plymouth University. During the evening and after the award ceremony we had the chance to view all the printed entries, revealing amazing geology from all over the world. ■

Julie Schroder

Critical water

Hydrothermal mineral deposits often occur as veins, or relatively narrow intrusions in various types of rock. Very often the veins contain large crystals, such as quartz, calcite or barytes. In some cases veins contain workable ore deposits for metals, such as lead, tin or zinc. Many such veins occur in regions of previous tectonic activity where high temperatures prevailed due to the presence of intrusive igneous rocks. The heat in such areas drives convective flows of water, which may be derived from various sources such as magma, sea water or even rainwater that has percolated through porous rocks. The hot water flows from deep within the earth's crust dissolving minerals and other materials, and transporting them through fissures and into surrounding rocks before depositing, or precipitating, its dissolved material to form veins. Precipitation occurs through loss of water (boiling off), cooling, or reaction with local rocks. ►

However, pure water is a very poor solvent (a *solvent* is a liquid that dissolves a solid (*a solute*) to form a *solution*) for most of the minerals or substances that occur in veins. So that begs the question as to how these veins were formed. Water has a critical temperature of 374°C, which means that above this temperature water cannot exist as a liquid no matter what the prevailing conditions (steam is not a 'solvent' for most minerals). In the overall scheme of things this is not that far above the usual boiling point of water of 100°C at atmospheric pressure. Water that forms hydrothermal veins is not pure but is referred to as *brine* because it contains dissolved salts (mostly chlorides, of sodium, calcium and magnesium amongst other elements), as in the case of sea water. Such 'brackish' water appears to be a much better solvent than water for many minerals. The presence of such dissolved substances raises the boiling point of water, but not excessively so: sea water has a moderately higher boiling point than that of pure water.

Where is this leading us? The process of dissolution has several energy implications. Chemical bonds need to be broken in the solid (*solute*) in order that dissolution may occur. Other factors are also involved but we will not consider those here. The energy required to break the bonds in the solute acts as a barrier in the dissolving process: the higher the barrier the less likely is the dissolution process and the lower is the solubility in water. In general, the solubility and rate of dissolution both increase with temperature as the amount of energy in the system rises (there exceptions due to 'other factors').

No substance is completely insoluble in water, as everything to a certain extent dissolves in water. However, a substance which has an exceedingly low solubility, e.g. silica, calcite or barytes, is often referred to as being 'insoluble' although we sometimes use the more accurate term 'sparingly soluble'. We can appreciate the insolubility of silica by the fact that the beach does not dissolve when the tide comes in! One of the factors that can lead to insolubility is the existence of strong chemical bonding between atoms in a solid. Substances such as silica (quartz) structurally comprise silicon and oxygen atoms bound together by very strong chemical bonds and to break such bonds requires lots of energy. Thermal energy (high water/brine temperatures), would assist in bond rupture, but there is a limit on the amount of this energy as dictated by water's critical temperature. It is unlikely that even at the critical temperature there would be sufficient thermal energy available to increase significantly the solubility of silica. So, in view of the low solubility in water and certainly brine, it is perhaps rather surprising that relatively large crystals of quartz occur widely in deposits of hydrothermal origin. Possibly what happens is that minute amounts of solid slowly dissolve in the almost constant flow of hot brine, which over extensive geological time periods, are transported and accumulate as large crystal deposits in veins. Large crystals result from slow formation or deposition from the hot brine. In the case of magma, it is slow cooling that results in large crystals. Perhaps another factor to consider is that concerning decomposition with increasing temperature of some substances. For example, calcite decomposes into calcium oxide and carbon dioxide at temperatures much in excess of about 700°C. This is another complicating factor in the scheme of things. ■

Pete Stamper

Field Meeting Reports

Sunday 13 July: Stiperstones and Snailbeach. Led by Andrew Jenkinson of (Shropshire Geological Society)

The morning of the trip dawned wet and with a stiff breeze that did not bode well for a good day in the field, but as we approached the Shropshire hills the rain stopped and the skies brightened. A few stalwart members of the BCGS met up with the Woolhope Club's Geology Section for the joint visit.

We met at the Bog Field Centre (SO396578) where Andrew distributed literature pertinent to the visit and pointed out the geomorphological features and placed us within the overall geological setting. The local rocks are Ordovician and the Shelve Formation is of Arenig and Llanvirn Series in age (see Fig. 1). The Bog sits upon The Mytton Flags within the Shelve Inlier with the sedimentary sequences younging to the west and the older Stiperstones Quartzite to the east and south. The prominent hill to the west is Corndon Hill, a dolerite intrusion in the form of a phacolith. ►

Caradoc	Whittery Shale Formation	> 700m
	Whittery Volcanic Formation	0–150m
	Hagley Shale Formation	*c.* 350m
	Hagley Volcanic Formation	20–200m
	Aldress Shale Formation	300–550m
	Spy Wood Sandstone Formation	40–120 m
	Rorrington Shale Formation	200–500m
Llanvirn	Meadowtown Formation	80–500m
	Betton Shale Formation	120–200m
	Weston Flags Formation	100–600m
	Hope Shale Formation: Stapeley Volcanic Member	50–1000m
	Hope Shale Formation: Hyssington Volcanic Member	70–500m
Arenig	Mytton Flags Formation	500–900m
	Stiperstones Quartzite Formation	150–280m
Tremadoc	Shineton Shale Formation and Habberley Formation	Seen *c.* 1000m

Fig.1 Ordovician rocks of the Shelve area. (Reproduced from Toghill, P. 2006).

Stiperstones

We proceeded by car to the Stiperstones car park (SO369977) where we ascended the flank of the hill to the wind-swept Cranberry Rocks (SO365981). These offer a good viewpoint of the surrounding countryside. The area is covered in upland bracken moorland vegetation due to the acidic nature of the underlying rocks. The name Cranberry Rock is a misnomer as the flora here includes not the cranberry but the bilberry or whortleberry (*Vaccinium myrtillus*) and the cowberry (*Vaccinium vitis-idaea)*, the latter of which is at the western edge of its range. This area is one of only a few in the UK where these two species hybridise.

Andrew pointed out the lie of the land with good views of the Berwyn Mountains to the north-west, where the sediments pass upwards into the Ordovician mudstones and shales of the deeper waters of the Welsh Basin. To the north lie the Cheshire plains and the Carboniferous rocks of the Clwydian Range, whist to the east the upland areas are all Precambrian Longmyndian rocks folded and faulted up to the surface, in-between the Pontesford-Linley and the Church Stretton fault complexes.

The Stiperstones ridge at about 10km in length comprises a series of faulted blocks that step towards the east as you look northwards to the Devil's Chair. The bedding in the quartzite is steep and dips west, and was measured as 358/65W. Cranberry Rock sits on a ridge-line composed of the Stiperstones Quartzite. This is not a true quartzite as it is not a true metamorphic rock but is best described as a Quartz Arenite (quartz grains cemented in a high silica content cement matrix). This type of sediment usually indicates a mature, well-worked deposit that is laid down in shallow water in a near shore, usually beach type environment. There was evidence of cross bedding as well as grits and conglomerates inter-bedded with the quartz arenite.

Andrew said that there is a suggestion, however, from a member of the Shropshire Geological Society that the unusually low abundance of fossils in this formation may indicate that this is in fact an older (perhaps even Cambrian) deposit that has slumped down the submarine shelf and been reworked in deeper water off shore. ►

Some trace fossils were found that appeared to be worm burrows, including the vertical burrows of *Skolithos*, once thought to be a near shore intertidal early coloniser and therefore a shallow depth indicator. *Skolithos* is now considered also to be an indicator of shifting sand environments such as storm sand sheets and the tops of turbidity flows. Their occurrence is related to sediment type and deposition rate, not just depth. Another trace fossil found appeared more similar to *Thalassinoides,* a Domichnia trace fossil associated with the *Cruziana* ichnofacies (Benton, M and Harper, D.), which is attributed to the shelf facies of variable water depths. (This can be above or below normal wave base.) The debate therefore remains open: was it near shore or a reworked slump deposit?

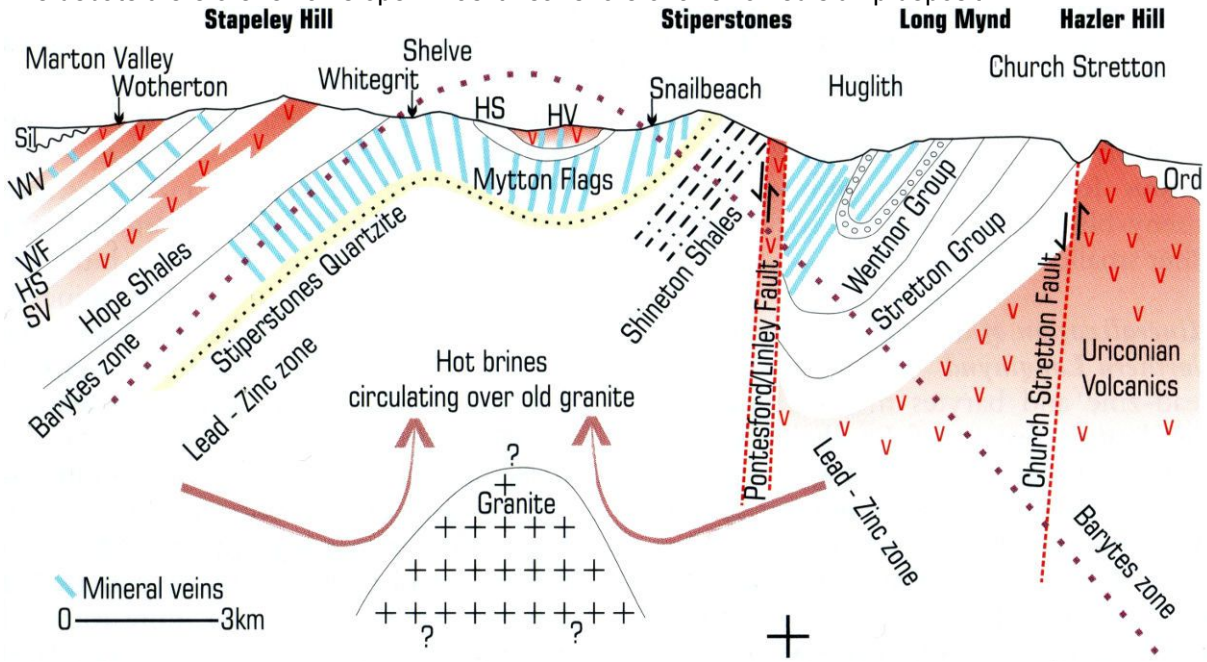


Fig.2. Mineral zones in the Shelve area.(Reproduced from Toghill, P. 2006).

The Bog Visitor Centre

We next returned to the Bog Visitor Centre to look at the relics of the former extensive lead and zinc mining industry of the 18th and 19th centuries, of which little now remains. There is an excellent visitor guide that directs you around the site pointing out all of the localities, and providing brief details of the processes and use of that part of the site. One such locality is the Somme Tunnel, built and named in 1916 as part of a failed attempt to mine barytes. It is now gated off as a bat roost. Further information is available in specialist publications on the Snailbeach mines, available in the Visitor Centre bookshop. (If shopping, be aware that it is cash or cheque only.)

The Bog vein that hosts the mineralisation is completely within the Mytton Flags and represents east-west trending fracture and joint complexes that have been filled with hydrothermal deposits. No intrusive granitic body has yet been located but may lie at depth in the heart of the Ordovician anticline. The Bog, Tankerville, Perkins Beach and Snailbeach mines lie within the lead/zinc and barytes mineral zones (Toghill, 1990) that would surround a granite pluton, but the Mytton Flags do not enter the copper zone at depth; therefore no copper-based minerals are found. This type of mineral zonation is typical of that produced by deep seated granite plutons such as those in Cornwall where early exsolution of the aqueous phase gives rise to hydrothermal veining and a metal zonation that follows the pattern Sn-W to Cu to Pb-Zn (Robb, 2005).

The primary minerals in the Snailbeach area are the sulphides galena and sphalerite in calcite and quartz gangue, and barytes, a barium sulphate. The mineral veins have been radiometrically dated at 355Ma which is early Carboniferous. It is now thought more likely that the mineral deposits in the Shelve area are not the same as those of south-west England (Toghill, 2006), but represent hydrothermal solutions formed from connate waters**.** Saline water from shallow Carboniferous seas in the nearby Llanymynech area percolated down into the rock and dissolved minerals as they went to depths of perhaps 5km. Heat from a buried, perhaps Caledonian, granite at depth heated the waters and re-circulated these brines, zoning the minerals in the veins as they were deposited under decreasing temperature and pressure gradients (see Fig. 2). ►

All of the mines in the near vicinity are in east-west trending veins between the Snailbeach mine in the north and the Bog to the south, with Tankerville, Pennerley and Perkins Beach mines in between, but mineral veins never occur in any formation other than the Mytton Flags. Further west there is mineralisation in the overlying younger Stapeley Volcanic Formation.

Shelve

After lunch (very nice teas and cakes available at the Field Centre) we proceeded to the village of Shelve where we examined an outcrop of the Hope Shales (SO335990). These are olive-green to grey finely laminated and heavily jointed shales that are extremely fissile and represent deeper water sediment. Shelve Church was the location of a famous graptolite locality used by Charles Lapworth and his researchers when using these fossils to correlate the stratigraphy that culminated in the erection of the Ordovician System, but it is no longer exposed. Examination of the building stones of the church turned up an eclectic mix of Hope Shales, Mytton Flags, sandstones, Stiperstones Quartzite and Grinshill Sandstone, which is a Permian rock characterised by quartz and barytes veining in the body of the rock.

Roman Gravels

Next stop on the tour was a brief look at Roman Gravels, another abandoned mining area that still had a lot of white coloured calcite and barytes spoil tips in place. Those at Snailbeach have been mostly removed or buried in pursuit of health and safety concerns and to make the area 'prettier'. The name derives from a lead pig of Roman origin found somewhere in the area but there is no proof that the Romans ever mined lead here. The most interesting feature is the existence of lime loving flora that exist only on the calcine tip areas. Otherwise the surrounding soils are very acidic. Specimens of an unidentified purple orchid and birdsfoot-trefoil (*Lotus corniculatus*) were growing on the very thin and poor soil above the dumps.

Hope

Our penultimate locality stop for the day was at the village of Hope (SO341015) where an outcrop of heavily folded Hope Shales was examined at the 'Bus Stop' outcrop. The outcrop comprised shale, sandstone and volcanic ash bands: the 'Chinastone Ash' that was erupted from a volcano out to the west some 450Ma. The subsequent folding came at the end of the Ordovician (Ashgill age) and was part of the Taconian Orogeny that affected southern Britain, but as this term best reflects folding in North America a new name for the widespread folding in Shropshire was coined, the 'Shelveian Orogeny' (Toghill, 1990). The tectonic collision of Avalonia (a micro-continent comprising of east Newfoundland and southern Britain) and Baltica, and the final closing of Tornquist's Sea caused this orogeny.

Fig 3. Folding in Hope Shales at the Bus Stop outcrop. Photo: R Bucki.

This locality exposes some impressive folding with upright close folds having axial planes plunging at 40°N and displaying well-developed axial planar S_1 divergent cleavage in the more competent ash bands (see Fig. 3). Whilst at this locality, we took the opportunity to walk around a very gothic looking old church to examine the building stones, mainly sandstones from a nearby quarry, before moving on to our last stop of the day.

Snailbeach

The final stop, albeit brief due to shortness of time and an impending World Cup football match, was to the old mine site tip at Snailbeach (SJ 374023). There is little left now of this once extensive 'white tip' of calcite and barytes gangue minerals with up to 5% of heavy metals. The mine was once the richest lead mine in Shropshire and one of the richest in Europe, and between 1845 and 1913 produced ►

139,000 tons of lead ore (Toghill, 2006). The Huglith Mine was still producing 20,000 tons of barytes per year in the 1930's. The white tip was exploited to make 'pebble dash' rendering in the 1970's before most of it was finally removed and grassed over in the early 1990's, as it was considered a health hazard due to airborne dust and heavy metal pollution of ground water sources. What is left of the spoil tip today has been extensively picked over by collectors but a few of our members did find some specimens of galena and sphalerite. The promise by the authorities who removed the tip to turn over what is left on occasions to expose new material for visitors to collect seems to have gone the way of many promises when financial pressures rear their heads.

This was a most informative and enjoyable day, ably led by Andrew Jenkinson, to whom we extend our thanks on behalf of all those members who attended. ■

Bob Bucki

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Saturday 16 August: The Building Stones of Worcester. Led by Andrew Harrison (BCGS Field Secretary)

This was a joint field visit with the Woolhope Club's Geology Section. We met outside the Guildhall on Worcester's bustling High Street where the army were putting on a bit of a show. The weather was kind and remained sunny all day.

The visit generally involved an exploration of Worcester's building stones following two Herefordshire and Worcestershire Earth Heritage Trust (H&WEHT) building stone trail guides. The first trail, 'Worcester City Centre', started at the Guildhall before going to St Helens Church, the Fire Station (including St Andrews School and St Albans Church), the Cathedral exterior, Friar Street paving slabs and the Old City Wall. Towards its end the trail also included several relatively modern buildings including Marks & Spencer's, the Lloyds and NatWest Bank Buildings and Debenhams. The second trail, 'Worcester Cathedral', explored the magnificent Cathedral's interior, which like the City, is a mix of building stones reflecting a varied history.

Geological background

Before starting we looked at where? why? and how? Worcester is located where it is. The City is situated within the Severn Valley, straddling the River Severn. To the west the land is generally flat and elevated between 25m and 40m AOD. The land to the east is more undulating and generally rises from approximately 14m AOD, at the River Severn to approximately 90m AOD on the eastern outskirts of the City. The Worcestershire to Birmingham Canal passes through the eastern parts of the City before intersecting the River Severn to the south. The railway serving Shrub Hill and Foregate Street also runs north to south through the east half of the City.

Underlying the City and surrounding area the solid geology comprises Sidmouth Mudstone Formation, part of the Mercia Mudstone Group, which formed in the arid wadis of the Triassic. A broad ribbon of superficial river terrace and alluvial deposits associated with the River Severn, and confined to the floor of the Severn Valley, overlies the solid geology. The action of glaciers at the end of the last Ice Age, approximately 10,000 years ago, set the present southward course of the River Severn, from Central Wales towards the Bristol Channel. The river has been an important influence upon the City of Worcester since its early beginnings, providing fertile ground, a communication and transport route and an ever lingering threat from flooding.

Historical background

The first inhabitants of the Worcester area were Neolithic farmers, around 3,400 BC, who settled on the high ground where the Cathedral now stands. This location provided good views over the Severn and a ford, or crossing point. Migrating Celts, of the Doubini Tribe, later settled the same area around 400BC and built a defensive rampart. Around the late 40s and 50s AD the invading Romans arrived ►

and quickly established a number of roads and trade routes. The Romans favoured the location for its river ford, which acted as a major military crossing point for the route between Gloucester and Wroxeter. A fort was constructed, surrounded by a ditch with wooden ramparts, which later developed into a centre of trade and manufacture that lasted around 300 years. The Anglo-Saxons settled here after the Romans left in 407AD, bringing Christianity to the area and they developed the site into a 'burg', or fortified settlement. The Cathedral, then constructed of wood, was founded in 680AD. Following their arrival in 1066, the Normans introduced the use of stone for building. In Worcester, newly constructed stone structures included churches, a third phase of City walls and reconstruction of the Cathedral. In 1202 much of the City, which was mostly built of wood and thatch was consumed during a 'Great Fire', which also badly damaged the Cathedral. King John, who had visited the Cathedral before this event, financed some of the restoration works. Today his tomb along with many other important figures can be found within. Throughout the Medieval Period and onwards the City developed into a thriving centre of manufacture with many connections with royalty. It was also subjected to several battles and civil wars, which ended in 1651 with the defeat of Charles II near Powick.

The exterior wall of the Cathedral
photo Andy Harrison

The Industrial Revolution saw Worcester continue to grow and become an important centre for porcelain, gloves, brick and tile manufacture. The Worcester to Birmingham Canal was opened in 1815 and the railway, which now serves Shrub Hill and Foregate Street opened in 1850. The Victorians did much to change the face of Worcester bringing in more exotic building stones from further afield, via the River Severn and the newly opened canal and rail links.

The onset of the Industrial Revolution reduced the importance of stone in favour of cheaper, quick to manufacture brick. Building stone usage was confined to buildings of importance or those buildings constructed by the wealthy, looking for something slightly more exotic. Today the manufacturing may have gone, but Worcester survives as a centre for tourism and retail trade. The use of building stone has also changed from forming the main fabric of buildings to providing an attractive exterior skin.

Most of our exploration of Worcester's building stones concentrated on examples dating between Norman and Victorian times, and included:

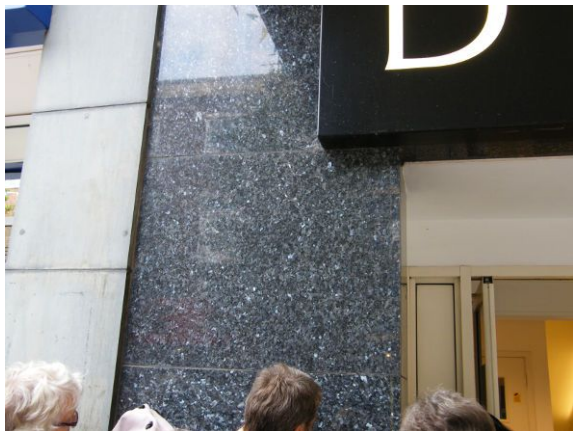
Sandstone: One of the earliest building stones used, which can be seen in the Cathedral and churches such as St Helens and St Albans, and the Old City Wall. The sandstone used included Triassic Bromsgrove Sandstone from Holt near Ombersley, and Coal Measures Sandstone from Highley in Shropshire. Both locations are north of Worcester and easily accessible via the River Severn. Easily weathered and eroded with time it is common to see where blocks of these sandstones have been replaced with hardier varieties, such as Triassic Corsehill Sandstone from Annan in Scotland, Hollington Stone from Staffordshire, and Yorkstone from near Halifax. Today these building stones provide a patchwork of colour and textures to the structures they form. The Victorian NatWest building at the northern end of the High Street, is built of sandstone of unknown origin. However, the blocks show excellent examples of current movement and scouring across a sedimentary bed.

Oolitic Limestone: Another early example of a building stone that was also used during Victorian times. In the Cathedral, churches and the Guildhall (built in 1721) it has been used as corner stone or to edge windows and doors. In the Cathedral it was used to construct Prince Arthur's chantry. Prince Arthur was the eldest son of Henry VII and brother to Henry VIII, who died aged 15 at Ludlow Castle in 1502. Oolitic limestone was also used in the Cathedral to construct the columns holding up the crypt, which dates from Anglo-Saxon times, and in the Victorian Lloyds Bank building, north along the High Street. Identified as Bathstone or Cotswold Stone this building stone could easily have been transported along the River Severn from locations south of Worcester. It may have been used for ballast by traders returning from down river. ►

Other Limestones: Included within the tombs of King John, Prince Arthur and the columns of the Cathedral is fossil-rich Purbeck Marble. This stone, called a marble because it polishes well, formed in fresh water lakes during the early Cretaceous. It is packed full of snail shells (*Viviparus)* and originates from the Isle of Purbeck in Dorset. The floor tiles of the Cathedral comprise black fossiliferous Carboniferous limestone and white Carrara marble from Italy. Jurassic Portland Stone from the Isle of Portland, has been used in the lower half of the fire station, built in 1942.

Paving Slabs: Carboniferous sandstone, or Yorkstone, paving slabs from Highmore in Yorkshire have been used along Friar Street. Similar slabs have been used along the High Street, but the origins of these is not known. Both sets of slabs show examples of concentric brown banding, called Liesegang Rings. The precise mechanism for Liesegang Ring formation is unknown. However, they are believed to be a secondary diagenetic feature resulting from iron nucleation in groundwater that leaves behind zones of iron supersaturation and depletion.

Exotic Cathedral Stones: Various exotic stones were used during the Victorian's restoration of the Cathedral between 1864 and 1875. These include mottled and white alabaster, Cork marble and green serpentinite in the pulpit and the Earl of Dudley's Tomb, white Highley sandstone in the tomb of King John, and fractured polished limestone in the Quire steps.



Larvikite facing stone - photo Andy Harrison

During our exploration we saw many examples of the modern use of stone as a decorative facing for buildings. The trail guide includes a pale cream metamorphic stone showing calcite veining on the Marks and Spencer store, and Larvikite on the frontage of Debenhams, a variety of monzonite, rich in feldspar from Larvik in Norway. The frontage to the Worcester College of Technology, St Andrew's Building, is faced with orange-red ironstone showing brachiopod nests, and belemnites. The source of this stone is not known; however it is very similar to the ironstone of the Burton Dassett Hills in Warwickshire.

The Lloyds and NatWest banks represented the end of the H&WEHT Worcester City Centre trail and the end of our field visit. I would like to thank Sue Hay and the members of the Woolhope Club's Geology Section for attending, and look forward to our next joint venture. ■

Andy Harrison

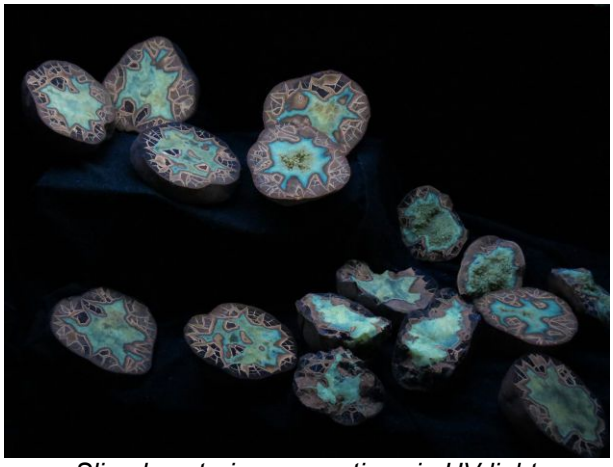
Maison des Minéraux: Crozon Peninsula

Now then, I haven't gone all 'parlez-vous-francais' without good reason. But once again on my travels I have had the good fortune to stumble upon another excellent local showpiece for those interested in the world of geology. And once again you are left wishing that perhaps it was located rather more favourably 'on the beaten track' *(reference to Creetown Museum in my last piece, Issue 226 p.10).*

Maison des Minéraux - photos by Mike Allen

However, I suppose part of the 'raison d'être' for these isolated gems (pun entirely intended) is the fact that they are intended to serve the more adventurous spirits amongst us.

So where am I (or rather 'was' I)? If you have ever wandered around the coastal extremities of Brittany you may well be ahead of me. The Crozon peninsula lies at the heart of the tortuous western Finistère coastline, with its northern shores facing the city of Brest and its southern shores facing 'Cornouaille' across the broad 'Baie de Douarnenez'. On reaching the town of Crozon, turn south along another peninsula off the main peninsula, and head for the village of St.Hernot, just before which you will run ►



Sliced septarian concretions in UV light (it's calcite that glows)

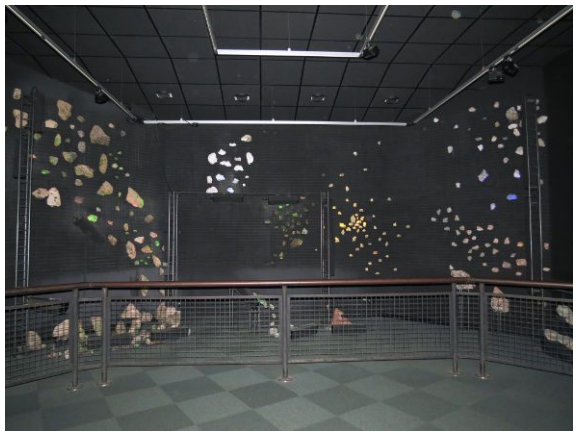
up against this establishment clearly advertised from the road. Not quite as 'pretty' as Creetown, but it is certainly an assertive building, within which one can learn quite a lot about the geology of this area, and a little about what lies beyond.

Be warned, however, that we are in France... so much of the information is, not unreasonably, in French. But even with my inadequate schoolboy grasp of the language, I was able to gather most of what was going on; after all, a 'Neseuretus' trilobite is 'Neseuretus' in any language, although I had to check that 'Stauroides' really did mean staurolite.

Having paid a modest entrance fee (3 euros, I think it was), the guide (and owner?) ushered me through to the first spacious gallery which housed a number of large photographs of scenes from the local geology, all labelled informatively in 6 languages - English, German, Dutch, Italian, French and Breton. A good basic geological map was also part of the display.

Moving on, the next gallery covered the local geology in greater detail, with a few well chosen fossils of a quality one would expect in a museum that charges an entrance fee! However, the next couple of galleries laid much greater emphasis on rocks and minerals. This is quite understandable when one considers that Brittany is in great part igneous and metamorphic country, and there is much emphasis placed upon the scenery and its relationship to the geological bedrock. A gallery largely devoted to more artistic 'panorama' photographs ably illustrated how weathering of different rocks provides the scenery one finds in these parts. Some good models dwelt on the subject of the deep weathering of granites, quite a feature across much of 'Armorica'. If you are in the area, I also recommend the inland town of Huelgoat much further east, and its 'chaos' of granite boulders, as well as the coastal area around Trégastel-Plage in the north.

A display of metamorphic rocks and minerals was much to my liking, as my main reason for visiting this part of France was to inspect the outstanding blueschists of the Ile de Groix: these are indeed world class and it was a useful introduction to what I could expect to find on the ground, to see specimens in the museum beforehand.



The fluorescence gallery in white light

The highlight was, however, still to come in the large final gallery - a display of fluorescent minerals such as I have never seen before. The gallery switches automatically on a 10 minute cycle from white light to UV light, so it is a matter of chance as to how you find the display on entry. I entered on the UV cycle and thought I had stumbled across the Matlock Bath illuminations! Once in white light, I could see that the main display was akin to a climbing wall, with batches of minerals sharing a common fluorescent colouration grouped together. Other display cases featured minerals individually. The whole effect was quite breathtaking once the UV returned! And a suitable climax to a very enjoyable experience all round (even more so when I emerged to find I had missed the only downpour I was to come across in a fortnight of touring). ■

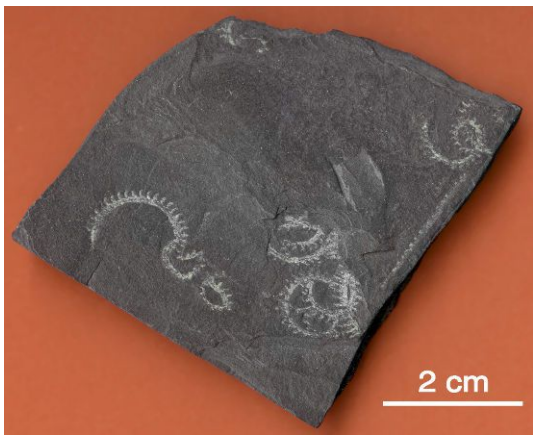
Mike Allen

The fluorescence gallery in UV light

Geobabble

We are fortunate to be located in such a fine area for geology, particularly fossils. The Silurian paleogeography gave rise to the shallow seas, and reefs in a sub-tropical climate that was teeming with life. When we go into Wales, deeper water was encountered and the most distinctive fauna consisted mainly of graptolites; indeed, when learning my geology at school we were taught that the Ordovician was the period of the branched graptolites and the Silurian the time of the Monograptus. That period is divided into over 20 graptolite zones, many of them Monograptus. When leading parties of keen students to the Wren's Nest, I have sometimes been asked if we could find any graptolites and I always answered in the negative, explaining that they were planktonic and if they were caught up in the turbulent water around the reef, they would be smashed and destroyed.

But I can recall at a very young age being on a field trip close to Charnwood Forest and one of the party asked the leader if there were any fossils to be found. The standard answer 60-70 years ago was: 'No, there are no fossils or traces of life in the Precambrian'. As science moves forward and investigation techniques are improved, we now know that the Precambrian seas were full of living organisms. But in geology and other observational sciences we have a tendency to only see what we are looking for and it takes a bit of lateral thought to identify something new. Perhaps we might reassess our thoughts about graptolites and the Wren's Nest; it is true that a complete specimen has not been found there. A common genus at that time was Cyrtograptus; it would not have survived the rough conditions of the shallow water turbulence, but it would presumably be broken into smaller pieces, and perhaps we should be looking for them.



Spirograptus spiralis. Scanned by L. Fernández García, Wikimedia Commons

There is some pioneering research being carried out, based at the Dudley Museum & Art Gallery, in which interesting microfossils have been found in the Wren's Nest bentonites. I just wonder if there are any broken pieces of graptolite that have been ground down to be found? This is highly unlikely I know, but I try not to lose sight of the fact that the Silurian was the age of the Monograptus and we now have the ability to investigate down to a very small scale. In science when we are faced with a negative, we should always search for the positive. ■

Bill Groves

Members' Forum

Watch an Icelandic dyke forming

The Icelandic Met Office has a very interesting website in English (http://en.vedur.is//) that informs about more than just the weather! They have a regular page with details of Icelandic earthquakes for the last 48 hours, but have augmented this with many details of the current eruption in the Holuhraun lava field north of Vatnajökull. One page that I found particularly interesting is the 3D interactive model (http://en.vedur.is/earthquakes-and-volcanism/articles/nr/2971) of earthquakes since the middle of August. Since this activity started there have been thousands of earthquakes and their positions are shown on this model in the order that they occurred. Being a 3D model, you can click and drag to see from different angles and appreciate the depth of the quakes. You can see the development of a dyke from the plane of the quakes and watch it progress north, several miles below the surface. The actual eruption is not so obvious from looking at the model, contrary to my expectation.

Julie and I have been following this with much interest as we were on holiday in Iceland in July and visited places that were quite close to the eruption which are now closed for safety reasons. ■

John Schroder