British Cave Research Association (UK registered charity 267828).

Registered Office: Old Methodist Chapel, Great Hucklow, BUXTON, SK17 8RG

BCRA Cave Science Symposium 2023
hosted jointly with the Leeds Geological Association

Symposium - Saturday 21st October, 2023
Field-trip - Sunday 22nd October, 2023
School of Earth and Environment, University of Leeds

FINAL CIRCULAR
With joining details and abstracts

The British Cave Research Association and Leeds Geological Association are pleased to announce details of the 34th Annual Cave Science Symposium and associated field-trip. The Symposium will be hosted by Prof. Simon Bottrell and Dr. Phil Murphy at the School of Earth and Environment, University of Leeds, on **Saturday 21st October, 2023**. The programme of oral and poster presentations will be of interest to anyone wishing to learn more about cave and karst research and the underground environment. All are welcome and we particularly invite Undergraduate, Masters and PhD students to participate. This will be a live event, but will also be streamed on Zoom.

Please arrive from 9am for a 9.45pm start. Sessions will finish at 5pm. BCRA's AGM will take place during the Symposium from 12:00 to 12:50. The programme appears below.

Following the symposium, an informal evening meal will be arranged for those who are interested. Please sign up for all events using the google form below.

A fieldtrip to Gillfield Level and Nidderdale will take place on **Sunday 22nd October.**

Finding the venue

The venue for the Symposium is the School of Earth and Environment, University of Leeds. On the day access will only be available via the main entrance to the building. Please see directions and map below. The event will be held in the foyer and Seminar Rooms that are immediately inside this entrance.

Driving:

The simplest parking is at the multi-storey on campus (but you will have to pay). This can be accessed via the University Main Entrance on the A660 (Woodhouse Lane) or via the Willow Terrace Road entrance (off Calverley Street). In either case the main driving route leads to the multi-storey (see map). Leave the multi-storey by the pedestrian entrance (one floor up and on the opposite side to the drive-in entrance) and turn left to follow the side of the building opposite. You will cross one road and then have to turn right up one flight of steps. At the top of these turn left and follow the side of the building again (do not carry on up the much larger flights of steps!). At the end of the building go up the steps then walk round the building on your right to the Earth and Environment main entrance (see map – green arrows).

Alternatively free parking may be available on Mount Preston Street or adjacent streets (NB: some of this parking has a 2-hour limit during the day). From Mount Preston Street there is a pedestrian access to Chancellors Courtyard. From here follow the building on your left to the corner of the Courtyard, turn left up the steps then walk round the building on your right to the Earth and Environment main entrance (see map – orange arrows).

Walking:

Starting from Leeds Rail Station the shortest route on foot is via the Willow Terrace Road entrance (off Calverley Street). When you enter the campus keep left (with "The Edge" Gym on your left) until the road narrows and goes downhill and slightly left – at this point take the footpath that forks right. This takes you to the "Roger Stevens Pond"; keep right, past the pond and then turn left up the large ramp into Chancellors Courtyard. Keep walking into the Courtyard and take the right fork to the steps in the far right corner; go up the steps then walk round the building on your right to the Earth and Environment main entrance (see map – red arrows).

Joining Online:

The Symposium can also be joined online on Zoom. The link is:

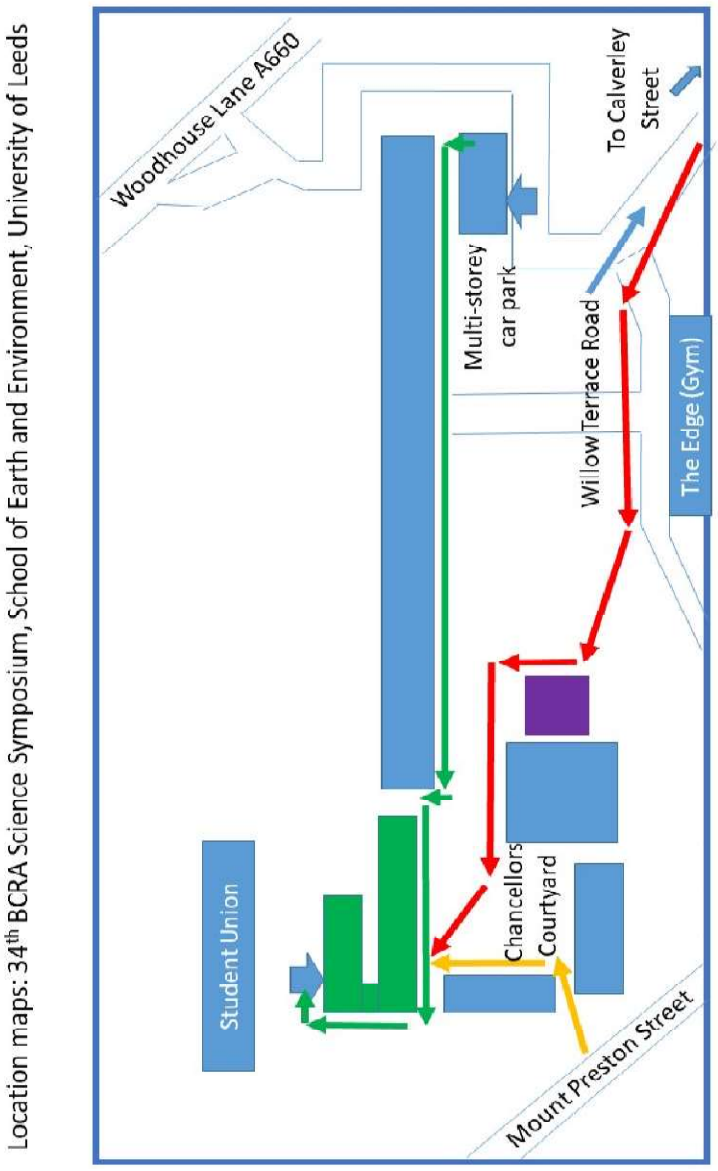
https://ukri.zoom.us/j/98362067751

If joining online please stay on mute with camera off during the presentations.

AGM:

The BCRA AGM will be held during the meeting from 12.00 to 12.50. Those wishing to join the AGM online should use the separate Zoom link:

https://ukri.zoom.us/j/96933998460



Registration

Entry is free of charge but donations towards the cost of the event would be appreciated. (Donations can be made online at https://bcra.org.uk/bookshop/donate.html)

To register your attendance at the symposium (in person or online), meal or field meeting please fill in the google form:
https://forms.gle/ftL7DSufoekMbqw38

Refreshments

Tea, coffee and biscuits will be served during the morning and afternoon coffee breaks. For hot drinks at other times, and for lunch, the Student Union Building is a very short walk from the venue, with coffee bars, Refectory and “The Old Bar”. Other options are available close to campus.

Symposium Organisers

Please contact Prof. Simon Bottrell (s.bottrell@leeds.ac.uk) for details of the venue and local facilities in Leeds as well as details of the programme and for enquiries concerning oral or poster presentations. For details regarding the field trip, please contact Phil Murphy at: P.J.Murphy@leeds.ac.uk

PROGRAMME FOR SATURDAY 21ST OCTOBER

9.00 – 9.45 **Arrival and Registration**

9.50 **Welcome and housekeeping** John Gunn and Simon Bottrell

10-00 **A speleothem-based reconstruction of glacial extent across the British-Irish Isles over the past 300,000 years.** Sina Panitz, Michael Rogerson, Sebastian F.M. Breitenbach, Vasile Ersek

10-25 **Living under a rock.** Jo White.

10-50 **Heaning Wood Bone Cave, Great Urswick, Cumbria: chronology and context of the prehistoric human remains.** Keziah Warburton and Rick Peterson

11-15 **BREAK**

11-30 **Getting that sinking feeling in Ripon: is gypsum dissolution a modern or an ancient process?** Simon Bottrell, Phil Murphy.

12.00 – 12.50 BCRA Annual General Meeting

12-50 – 13-30 LUNCH

13-30 **An Inception Framework Hypothesis for karst development in the Burren, Ireland.** Robert A. Watson, Colin Bunce, David Drew, Simone Fiaschi, Caoimhe Hickey, Eoghan Holohan, John Walsh

13-55 **Nidderdale Caves Linking Limestone Inliers Offering Clues to Early Stages of Cave Inception** Chris Fox

14-20 **BREAK**

14-40 **Natural and artificial drainage of the Foolow-Eyam-Stoney Middleton karst, Derbyshire** John Gunn

15-05 **How comparable are data from bacteriophage and solute (dye) tracer tests in karstic Chalk?** Dan Matthews, Lou Maurice, Jared West, Simon Bottrell, Danny Coffey

15-30 **BREAK**

15-50 **Hypogenic void systems characterisation in Mississippian carbonates in the Derbyshire Platform (Northern England, UK).** Mangione A., Hollis C., Abesser C., Banks V., Farrant A., Gonzalez-Quiros A., Gunn J., Shaw R., Wei W., and Whitaker F.

16-15 **Hypogenic caves in the UK – an update.** Andy Farrant

16-40 **General discussion and close**

POSTERS:

Unlocking the secrets of Vietnam's past climate: a multi-proxy approach using cave stalagmites. Chloe Snowling

ISOPERM: Understanding environmental controls on permafrost using speleothems

Stuart Umbo, Jade Robinson, Sevi Modestou, Ola Kwiecien, Thomas Opel, Sina Longman, Julia Homann and Sebastian Breitenbach

FIELD TRIP ON SUNDAY 22ND OCTOBER

Please meet at 9.30 in the Toft Gate/ Coldstone Cut carpark on the B6265 1.5 km east of Greenhow Hill village. NGR SE12906440 what3words ///strictly.rocker.showrooms

In the morning we will visit Gillfield Level where you will be walking in water up to 40 cm deep and there is plenty of mud. Equipment required will be helmet, lamp, oversuit and wellies. It is mainly walking but there are opportunities for anyone seeking a bit of crawling. The trip gives a fascinating insight into the geology, mining history and karst development in the area and we will be underground for approximately one and a half hours. Please note there is a voluntary monetary contribution towards the costs of maintaining access to this site (a minimum of £5 is suggested).

After lunch (please bring your own) we move to Nidderdale where Chris Fox of the Black Sheep Diggers will host a trip around the caves and karst. This is a beautiful and little studied caving area where new discoveries are shedding light on the development of the intriguing Goyden Pot cave system. You will again need helmet, lamp, oversuit and wellies suitable for brief walk (plus scramble over one boulder) into a cave.

The visit will finish around 16:30.

WELCOME FROM THE BCRA CHAIRMAN

On behalf of the Council and Trustees of the British Cave Research Association (BCRA) I am pleased to welcome members, and those who have not yet joined BCRA but hopefully will do so in the future, together with members of the Leeds Geological Association to the 34th BCRA Cave Science Symposium which is being held in our golden anniversary year. A great deal of work is involved in organising conferences and symposia so we extend our thanks to Professor Simon Bottrell and Dr Phil Murphy at the School of Earth and Environment, University of Leeds for putting together the academic programme and arranging the field trip.

The first BCRA Cave Science Symposium was held at the University of Sheffield in 1984 and it was followed by annual meetings until 1987 when it became biannual (1987 and 1991). There was then a four year hiatus before the meetings resumed in 1996 since when they have been held annually. A physical meeting was not possible in 2020 due to the global pandemic and instead a virtual meeting making use of the Zoom platform was hosted by Northumbria University and the British Geological Survey. Unseasonably inclement weather resulted in the abandonment of the planned 2021 meeting at the Hulland Ward and District Millennium Village Hall and instead we again made use of the Zoom platform for a virtual meeting in early 2022, the academic programme being organised by the University of Huddersfield. In October 2022 the 33rd Symposium was held as a hybrid event, in-person at the University of Manchester but also on Zoom for those unable to attend. This pattern continues at the 34th Symposium and which the University of Leeds becomes the institution that has hosted the most symposia (6), having previously been joint first with the University of Bristol.

The objective of the BCRA is "*to promote the study of caves and associated phenomena wherever they may be situated, for the benefit of the public*" and the Annual Symposium is one of the ways that this objective is fulfilled. The *associated phenomena* include karst landforms on the surface, and this aspect is reflected in the title of the Association's scientific journal, *Cave and Karst Science*. The BCRA

Cave Science policy focuses on four major themes: speleogenesis, archaeology/palaeontology, biology and technology. Speleogenesis is interpreted broadly, including those aspects of geomorphology, geology and hydrogeology that impinge on the development of conduits and ultimately caves. Studies of present cave climates and reconstruction of paleoclimates and paleoenvironments using cave sediments (speleothems and clastic deposits) are also considered under the speleogenesis heading. At the present meeting the speleogenesis theme dominates with just one paper in biology and one in archaeology. There is certainly no dearth of studies, at least in the latter area so we hope for more papers in 2024.

The BCRA AGM is held during the Symposium. Administrative matters are kept to a minimum, the primary objectives being to provide BCRA members with a succinct summary of Association activity during 2023 and to seek views on what should be done in 2024 and beyond. Interested non-members are welcome to attend the AGM (in person or online) and to contribute to the discussion but not to vote.

Finally, and as we commonly have many non-BCRA members attending as Guests, it is important to note that BCRA is a Charity that is run by volunteers and relies on income from membership fees and donations. If you enjoy this meeting and would like to join BCRA we would be pleased to welcome you (go to http://bcra.org.uk/detail/fees.html) and if you are willing to provide a donation to assist us then please do so via http://bcra.org.uk/donate.

Professor John Gunn, BCRA Chairman

SYMPOSIUM ABSTRACTS
ORAL PRESENTATIONS

A speleothem-based reconstruction of glacial extent across the British-Irish Isles over the past 300,000 years.

Sina Panitz, Michael Rogerson, Sebastian F.M. Breitenbach, Vasile Ersek

Department of Earth and Environmental Sciences, Faculty of Engineering and Environment, Northumbria University, Newcastle upon Tyne NE1 8ST, UK

The reconstruction of glaciations in the British-Irish Isles relies on surface deposits. Despite recent paradigm-setting progress for the last glacial period, glaciations remain poorly constrained worldwide before c. 30 ka. Here, we test whether speleothem growth phases are coherent with reconstructions from surface deposits for the timing and extent of late Pleistocene glaciations in the British Isles as a means to validate this approach for the reconstruction of older periods. Speleothem deposition requires aggressive drip-water, generally indicating absence of ice coverage and continuous permafrost. Their amenability to radiometric dating makes cave carbonates ideal archives of past glaciation and permafrost dynamics. Extensive work on reconstructing glacial-interglacial cycles based on speleothem growth phases was carried out in the 1970s and 1980s using alpha spectrometry uranium series dating. Since this pioneering work, advances in dating techniques using mass spectrometry have improved precision by an order of magnitude. We use 397 modern speleothem U-Th dates from the existing literature covering the last 300 to 5 ka to present an updated reconstruction of speleothem growth phases. We find enhanced speleothem growth during the last interglacial and several interstadials at higher resolution. A pronounced decline in speleothem growth occurred during the last glacial maximum, but by the Early Holocene, speleothem growth is recorded again across the

British-Irish Isles. The reconstructed speleothem growth pattern agrees well with empirical data of the extent of the last British-Irish Ice Sheet. This opens the exciting possibility of using speleothem growth phases to constrain the spatio-temporal dynamics of the last British-Irish Ice sheet and growth / retreat patterns of glaciations at least as far back as 500 ka. Our work provides increased knowledge of how glaciers melt during climatic warming, and a means to validate models of glacial growth and retreat from pre-instrumental observations.

Living under a rock: a study of biofilms and snottites collected from six cave and mine sites in England.

White J.[1] [joanne.white@hud.ac.uk] Rout S.[1], Fox B.[1], Humphreys P.[1] and Gunn, J.[2]

[1]Department of Biological and Geographical Sciences, University of Huddersfield, Queensgate, Huddersfield, HD1 3DH, United Kingdom

[2]School of Geography, Earth & Environmental Sciences, University of Birmingham, Birmingham B15 2TT, United Kingdom

Bacteria living in the oligotrophic settings of caves and mines have learnt to exist in micro-environments within these extreme environments where enough nutrients can be found to sustain them. These bacteria are aphotic and heterotrophic, keeping themselves alive using minerals from the surrounding rock and nutrients being brought in with the water. Some of these bacteria may choose to live in a biofilm – a mucoidal secretion made by one or more of the bacteria present. This offers a way to conserve water and nutrients, helping to prevent the perils of starvation and desiccation present in such an environment. Bacteria living in this way may utilise the products of other bacteria resulting in a syntrophic relationship. In mines these consortiums of bacteria sometimes live in a biofilm structure which hangs off the wall. These are known as snottites and have previously been examined mainly in very low pH environments (pH 0-1). In this study we have examined the microbial communities of snottites found in neutral and slightly acid mine environments (pH 4-7). During this study we have used a range of techniques to assess the geological setting of the underground environments and the water chemistry of autogenic and allogenic waters coming into the caves and mines. We have collected samples of biofilms and snottites across six cave and mine sites in England. Eight of these have been metagenomically sequenced to provide information about their metabolic pathways and their community profiles. Samples have also been cultivated, isolated and identified using 16s rRNA sequencing.

Heaning Wood Bone Cave, Great Urswick, Cumbria: chronology and context of the prehistoric human remains. Keziah Warburton and Rick Peterson

Keziah Warburton and Rick Peterson [rpeterson@uclan.ac.uk]

Centre for Field Archaeology and Forensic Taphonomy, University of Central Lancashire, Preston PR1 2HE

Excavations by cavers and archaeologists at Heaning Wood Bone Cave (NGR SD 2671 7483) have taken place on three occasions: in 1958 (Holland 1960); by the then landowner Peter Redshaw after April 1974; and then most recently by Martin Stables between 2016 and 2019. All these excavations produced both human and faunal remains, along with a small assemblage of prehistoric material culture. The material from the 1958 and 1974 excavations are currently held at the Dock Museum, Barrow-in-Furness. Material from subsequent excavations is held at the University of Central Lancashire. Once research is complete, all remains will be held at the Dock Museum.

Previous radiocarbon dating on the Dock Museum collection (Smith 2012, 6) had established an Early Neolithic date for cut-marked animal bone and an Early Bronze Age date for one of the burials from the cave. The current research has established that there was an MNI of eight individuals for the human remains and new radiocarbon dating has shown that these relate to three separate phases of activity: in the Early Mesolithic; in the Early Neolithic and in the Early Bronze Age. This paper will discuss the human remains and artefacts from Heaning Wood and contextualise them. Taphonomic evidence from all three periods suggests that the cave was used for deliberate burial in each case. We will consider cave use in these periods in south-west Cumbria and in the wider north-west of England. We will also discuss the importance of Heaning Wood alongside other regional evidence for a very early Holocene presence in this region.

Getting that sinking feeling in Ripon: is gypsum dissolution a modern or an ancient process?

Simon Bottrell, Phil Murphy.

School of Earth and Environment, University of Leeds, LEEDS LS2 9JT, UK.

The city of Ripon (North Yorkshire, UK) has long suffered subsidence problems due to the presence of underlying karstified gypsum. A pilot study showed that sulfate concentrations in the River Ure increased between upstream tributaries and downstream of Ripon, indicating that gypsum dissolution and hydrological export could be an ongoing process. However a more detailed study allowed sulfate and dual sulfate isotope ($\delta^{34}S$ and $\delta^{18}O$) budgets for the R. Ure catchment around Ripon to be constructed. These show that, whilst significant sulfate is added to the R. Ure in the Ripon area this is more consistent with urban sources (the import of tap water with a higher sulfate concentration than the river and with relatively high sulfate-$\delta^{18}O$; addition of sulfate from domestic detergents and cleaning materials) along with a possible component from agrichemicals. Furthermore, Ca and Sr concentrations in the river waters do not conform to a mixing relation between the upstream tributaries and gypsum-influenced groundwater. It is thus concluded that present day hydrological export of dissolved gypsum from the Ripon catchment is unlikely to be a significant process. Subsidence problems are thus more likely to relate to larger-scale gypsum removal under earlier hydrological conditions, e.g. during deglaciation of the late-Devensian ice sheet.

An Inception Framework Hypothesis for karst development in the Burren, Ireland.

Robert A. Watson[1] (robert.watson1@ucdconnect.ie), Colin Bunce[2], David Drew[3], Simone Fiaschi[1], Caoimhe Hickey[4], Eoghan Holohan[1], John Walsh[1]

1. School of Earth Sciences, University College Dublin, Ireland
2. Palaeoenvironmental Research Unit, University of Galway, Ireland
3. Department of Geography, Trinity College Dublin, Ireland (retired)
4. Geological Survey of Ireland (GSI), Dublin, Ireland

The Inception Horizon Hypothesis (IHH) postulates that certain stratigraphic horizons in a limestone sequence, combined with structural surfaces such as joints, provide a framework for cave development. Although subsurface and surface karst landforms are fundamentally linked, the IHH has not yet been extended to surface karstification. Due to its stratigraphic and structural simplicity, we decided to test this extension of the IHH in the Burren karst. We used very high-resolution remote sensing datasets and detailed fieldwork to develop an updated map of the Burren's surface karst features, combined with a 3D geological model containing over 60 km of mapped cave passages.

Our analysis shows that vertically-persistent calcite and silica-rich veins, arising from Variscan orogenic compression, are of primary importance in providing karstic connectivity between the surface and

subsurface. The flow pathways provided by these veins then intersect the following inception horizons: (i) boundaries between distinct lithological units in the limestone sequence; (ii) crinoidal cycle tops within the Slievenaglasha Formation; (iii) thin horizons of non-carbonates ('clay wayboards') within the Aillwee member; (iv) chert lenses within the Slievenaglasha Formation. At the surface, the same horizons have been preferentially exploited by glacial processes, creating surfaces from which meteoric waters now recharge the subsurface.

Nidderdale Caves: Linking Limestone Inliers Offering Clues to Early Stages of Cave Inception

Chris Fox

The erosion of the Upper Nidderdale valley partially removing the gritstone cover has revealed the Yordale limestones in three inliers some 50m thick at most. The three inliers from north to south are the Limley inlier, Thrope inlier being the smallest and Lofthouse inlier being the largest. The limestones exposed are the Three Yard Limestone & Five Yard Limestone and the Middle Limestone. The Nidderdale caves are chiefly formed in the Middle Limestone. The river Nidd in normal conditions sinks in the Limley inlier and resurges in the Lofthouse inlier. When flood water overflows the Scar House reservoir the caves are overwhelmed and residual water flows down the valley in the normally dry river bed.

The Nidderdale caves, specifically the Goyden system links the three limestone inliers. The most northern Limley Inlier is where the river Nidd sinks into Manchester Hole. The Manchester stream crosses an anticline within the cave breaching the base of the limestone to expose the sandstone top of the Simonstone cyclothem. The underground river from Manchester Hole flows into Goyden Pot with over 7km of passages. The oldest passages in general being on the eastern side and younger passages towards west. The river from Goyden pot flows under the gritstone cover from the Limley inlier to the Thrope inlier. Some minor streams have found their way through the thin gritstone cover to join the trunk route beneath. Examples being Guscott pot and Frog pot both formed in the Five Yard limestone. The Thrope Inlier has significant faulting with associated dramatic changes in direction of the underground river. The river leaves the New Goyden cave and Thrope inlier turning away from flowing under the valley floor south-east under the hill to resurge 2km away just south of Lofthouse village.

The inliers represent the smallest of limestone outcrops in a Yorkshire Dale and the cave system is chiefly formed under a valley floor of Grassington Grit. The Scar limestone associated with large caves in the next valley Wharfedale with its easterly dip takes it deep under the Nidderdale valley. It is the Yoredale limestones that are exposed instead with its thinly bedded limestones. Yet inside the cave is one of the largest stream passages in any Dales cave. This impressive trunk cave between limestone inliers formed before erosion has completely removed the gritstone cover could hold valuable clues to early stage cave development across the Dales.

Natural and artificial drainage of the Foolow-Eyam-Stoney Middleton karst, Derbyshire

John Gunn [j.gunn.1@bham.ac.uk]

School of Geography, Earth and Environmental Sciences, University of Birmingham, Birmingham,B15 2TT UK

The Foolow-Eyam–Stoney Middleton karst lies on the northeastern flank of the Peak District Carboniferous limestone outcrop. To the northeast the limestones dip beneath mudstones and sandstones of the Millstone Grit Group that form a prominent escarpment. A major near-vertical mineral vein is hosted by faulted limestone beneath the escarpment and runs broadly west – east. In

common with other areas of the White Peak, the limestone receives is both allogenic recharge from streams that have their headwaters on the mudstones and sandstones and autogenic recharge, predominantly dispersed percolation of water that has infiltrated through the soils and superficial deposits that overlie the limestone with some concentrated autogenic recharge from dolines. Natural drainage was through conduits and over 11km of cave passage have been explored. Early lead miners began to modify the underground drainage by diverting water entering their workings into underground swallows and later deep drainage adits (soughs) were driven into the mining areas from rivers outside the karst to facilitate the extraction of lead at increased depth. These have changed the drainage pattern to the point where the majority of groundwater is now discharged from three soughs, Moorwood (the largest flow), Watergrove and Stoke (the smallest which also has a thermal component). By the end of the 19th century lead mining had largely ceased but during the 20th century some old mines were reworked for fluorspar, most notably via the Ladywash Mine north of Eyam and the linked Glebe Mine which extends beneath Eyam. Miners commonly encountered natural passages most of which were of limited extent but in the 1980s the Wet West Caverns comprising c. 900m of natural cave passage were intersected during the driving of a new level in Glebe Mine. The final stage of mining began in the 1980s when Milldam Mine was developed at Great Hucklow by driving a decline and working eastwards to eventually intersect the Ladywash workings. This mine closed in July 2023.

Since the 1980s a series of water tracing experiments using fluorescent dyes have begun to unpick the complexity of the present day underground hydrology. To the west of Follow there is an area of divergent drainage where some water from sinking streams flows north to springs in the Bradwell area, some flows south to springs at the head of Cressbrook Dale, and the majority flows broadly east to the Watergrove and Moorwood soughs, and possibly to Stoke Sough. During periods of prolonged rainfall the soughs cannot accommodate all of the recharge and water rises into higher elevation passages and is discharged from Carlswark Cavern. During prolonged drought the tail of Watergrove Sough is dry but water continues to flow upstream and is thought to drain into conduits that are tributary to the Streaks – Merlins cave streamway. The recent discovery of the Stoney Middleton Master Cave has facilitated further tracing to elucidate the internal links. A novel aspect of the recent (June 2023)research has been that a CTD (conductance / temperature / depth) logger, installed at Moorwood Sough tail to monitor travel times of salt injected at points in Moorwood Sough also detected pulses of increased conductance and temperature that are interpreted as being caused by the pumping of water from Milldam Mine where an earlier study found elevated conductance and temperature in one of the pump lodges.

How comparable are data from bacteriophage and solute (dye) tracer tests in karstic Chalk?

Dan Matthews, Lou Maurice, Jared West, Simon Bottrell, Danny Coffey

The vulnerability of a karstic chalk aquifer in a peri-urban catchment is very high. There are numerous sources of pollution from agricultural, industrial, and residential sources. Fissure and conduit networks, fed by surface flow into stream sinks, provide rapid, poorly attenuating pathways through the aquifer that are well-connected to critical receptors, such as public water supply springs and abstractions. In this type of environment, groundwater flow and contaminant migration tracing are a vital method of identifying and characterizing source-pathway-receptor linkages. However, the effectiveness of traditional techniques using fluorescent dye tracers are limited due to the combined impact of: i) a low water quality limit (10 ppb) at public water supply sites, set to mitigate against the risk of colouration, and ii) high natural background fluorescence after rainfall events that impacts the limit of detection. Bacteriophage tracers may offer an effective alternative. They are safe, colourless and, as a result, extremely high concentrations can be released into the aquifer. Unlike ‘conservative’

fluorescent dye tracers, bacteriophages are reactive, i.e., their fate and transport are impacted by the physicochemical conditions in the aquifer. Unsurprisingly, this complicates the interpretation of bacteriophage breakthrough curves.

In this talk, the results of a catchment-scale tracer migration experiment comparing MS2 bacteriophage and sodium fluorescein dye will be presented. Key differences and similarities will be explored using normalised tracer breakthrough curves and transport parameter estimates. Processes that may be affecting the fate and transport of MS2 bacteriophage will be discussed. Finally, the benefits and limitations of using bacteriophage tracers in karstic chalk aquifers will be evaluated.

Hypogenic void systems characterisation in Mississippian carbonates in the Derbyshire Platform (Northern England, UK).

Mangione A., Hollis C., Abesser C., Banks V., Farrant A., Gonzalez-Quiros A., Gunn J., Shaw R., Wei W., and Whitaker F.

Hypogenic void systems comprise both non-stratabound and stratabound components that display morphological features characteristic of formation by rising flow. Dissolution is attributable to fluid cooling, fluid mixing, changes in redox and/or pH due to injection of CO_2 or H_2S-rich water and pressure. Despite an increasing number of studies of hypogenic void systems, they are still less well characterised than epigenic systems that are formed by direct surface recharge. In part, this is because, commonly hypogenic void systems have no surface expression and hence their presence in the subsurface is often difficult to detect. Hypogenic void systems have recently been identified in numerous locations on the Derbyshire Platform, northern England, in both limestone and dolomite strata. Distinguishing between hypogenic and epigenic systems can be challenging, in part because in the study area, hypogenic features were overprinted by epigenic processes. Our focus is on relationships between hypogene cavity occurrence, fill, morphology (e.g., identification of morphological features characteristic of upward-flowing fluids), size, location, geology (e.g., association with faults, stratal architecture, and rock type) and hydrogeological context. This enables us to have an overview of the geological context, processes, and genesis of the void systems that, in turn, will help us discriminate between epigenic and hypogenic systems and build conceptual model/s that can be employed in other areas.

Three classes of hypogene void systems have been identified in the study area. 1) Partially to completely mineralised cavities filled with ore deposits (Pb-Zn-F-Ba mineralisation) and coarsely crystalline calcite. Mineralisation is thought to have occurred during the Variscan Orogeny (Carboniferous-Permian), so these void systems are the oldest in the area. 2) Sediment and mineral (including calcite) filled voids; some are entirely filled by well-formed coarsely crystalline calcite commonly >5 cm diameter. These probably represent the last cementation event on the platform. 3) Open, vertical, and sub-vertical cavities. These are very hard to date since there is no fill, suggesting that they are relatively young (Neogene or Quaternary) void systems. To understand fluid source and temperature following formation of the hypogene void systems when they are at least partially filled by coarsely crystalline calcite (i.e., class 1 and 2 above), we analyse the coarsely crystalline calcite to determine if they provide evidence for the genesis of the voids that they fill. Analysis of these largely homogenous, unzoned crystals suggests constant fluid composition and redox conditions during crystal growth, with precipitation at high temperature or from isotopically depleted groundwater and potentially with an input of magmatic CO_2.

Hypogenic caves in the UK – an update.

Andy Farrant

Over the past few years there has been renewed interest in hypogenic caves, partly as they are analogues for what may be happening in the subsurface at the present day, and thus be of interest from a geothermal energy perspective. A recent reappraisal of some well-known caves across the UK, coupled with some recent discoveries has led to the recognition of many new hypogenic caves, and led to insights into their modes of formation and possible age.

POSTERS

Unlocking the secrets of Vietnam's past climate: a multi-proxy approach using cave stalagmites.

Chloe Snowling

The agricultural practices and water resources of human societies in Vietnam are largely dependent on the seasonal monsoon rainfall. However, this same monsoon rainfall can also give rise to natural disasters such as flooding, landslides, and extreme weather events. As a result, Vietnam has been recognized as a region that is particularly vulnerable to the effects of climate change. Due to the diverse topography and complex climatology, the monsoon season significantly varies across the different sub-regions of Vietnam. The southwest summer monsoon is responsible for most of the rainfall across Vietnam. However, regions such as the North Central Coastline receive the majority of its rainfall from the northeast winter monsoon. Rainfall from the NE winter monsoon is comparatively understudied in contrast to its counterpart, the SW summer monsoon. Published paleoclimate studies have been inconclusive in delineating the relationship between the summer and winter monsoon over longer, pre-anthropogenic timescales.

This study aims to fill the gap in knowledge concerning the spatial-temporal variability of monsoon rainfall in different sub-regions of Vietnam, over the last glacial-interglacial cycle. To achieve this, stalagmite-based climate reconstructions from the Northwest, Mekong Delta and North-Central regions will be utilised to place the NE winter monsoon into a broader climatic context. Using stable isotope and trace element analysis, this project will extend instrumental rainfall records, creating the first north-to-south paleo-monsoon transect for Vietnam. This will contribute to the understanding of wide-scale monsoon circulation patterns and tropical climate dynamics as well as further constrain climate models, aid in policy making concerning agricultural practices and assist in geohazard preparation.

ISOPERM: Understanding environmental controls on permafrost using speleothems

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ISOPERM is a four-year Leverhulme funded project to investigate environmental controls on East Siberian permafrost stability along a north-south transect from the Laptev Sea to Northern Mongolia.

We utilize multiple novel speleothem proxies (clumped isotopes, levoglucosan, lignin biomarkers, speleothem derived fossil pollen) to establish a record of palaeo-permafrost stability and environmental drivers of permafrost thaw. Since speleothem growth depends upon the presence of liquid water (Vaks et al., 2013, 2020), Useries dating of our samples establishes a chronology of palaeo-permafrost thaw above our cave sites. We use clumped isotope thermometry to reconstruct mean surface temperatures at times of permafrost absence, alongside laser-ablation techniques to measure trace element changes at the micron scale – giving insights of seasonal changes in local hydrology and other environmental parameters. We combine speleothem derived fossil pollen (Sniderman et al., 2016), with lignan oxidation product (LOP) biomarkers (Yan & Kaiser, 2018), to identify specific vegetation species and infer broad changes in vegetation cover from woodland to grassland dominated systems. Finally, we reconstruct past wildfire from measurements of speleothem levoglucosan concentration – a biomarker produced solely by the combustion of cellulose and transported to the speleothem in dripwater. (Homann et al., 2022). We present preliminary results from Tortonian (8.7 ± 0.6 Ma) speleothems from Taba-Bastaakh (72°15' N, 126°56' E) in Arctic Siberia. The Tortonian provides an excellent analogue for near future climate — with atmospheric CO2 concentrations similar, or slightly higher than present (Foster et al., 2012; Sosdian et al., 2018), global average temperature ca. 4°C higher (Pound et al., 2011), and a summer ice-free Arctic (Stein et al., 2016). Our findings suggest permafrost absence across most of Siberia during a time interval similar to that expected under near future 'business as usual' climate scenarios. We deduce multi-annual mean Arctic temperatures ca. +20°C higher than today, providing real-world constraints on possible future Arctic amplification dynamics, a strongly seasonal hydrological regime, and evidence of conifer forest in a region that resides far north of the modern-day treeline.

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