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Abstracts
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Presented in alphabetical order of the speaker's surname (underlined)

Sea caves with sequences relating to Oxygen Isotope Stage 5 on the Cyrenaican coast, NE Libya

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The Mediterranean basin provides a unique region in which the effect of climatic variability, tectonics and human activity has a long history. A long, complex archive of sea-level changes and terrestrial and coastal sedimentation has been identified in recent fieldwork at the coastal area in front of the Haua Fteah cave in Cyrenaica NE Libya. New mapping located a complex of small former sea caves and analysis of the stratigraphy, sedimentology, geochronology, palynology and archaeology showed sequences relating to Oxygen Isotope Stage 5. These caves developed on a pre-existing shore platform and contain a series of marine sediment layers consisting of sands and limestones, interbedded with flowstones and small stalagmites and diamicts. The caves were under water at times and emergent for other periods with subaerial flowing water and mud flows. The caves show strong evidence for multiple high sea stands and a complex climatic history, with the littoral providing important raw materials for early humans. Detailed sedimentary evidence can be compared with that emerging from Haua Fteah cave, 1.5 km away. This paper presents a comprehensive climatic investigation and analysis of the sea caves and provides an assessment of the landscape and environmental context in which early modern humans operated.

Modelling the growth rate and oxygen isotope composition of stalagmite calcite.

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Two numerical forward models, designed to investigate the growth rate and oxygen isotope ($\delta^{18}O$) composition of stalagmites, were used to quantify stalagmite growth rates and concomitant calcite oxygen isotope ratios resulting from high-frequency fluctuations in cave atmosphere pCO_2 and temperature. Stalagmite growth rates were modelled based on previously published high-resolution cave monitoring data from Scoska Cave, UK, (5th July to 10th August, 2008) (Whitaker *et al.*, 2009) and New St Michael's Cave, Gibraltar, (28th April 2004 to 24th February 2008) (Mattey *et al.*, 2010), and stalagmite $\delta^{18}O$ was modelled by stepwise isotopic fractionation through Earth's hydrological cycle, beginning with initial oceanic source conditions, for a stalagmite ('Gib04a') from New St Michael's Cave (Mattey *et al.*, 2008).

Modelled stalagmite growth rates respond to high-frequency fluctuations in cave atmosphere pCO_2 and, to a lesser extent, temperature, implying that cave air dynamics are an important control on stalagmite growth rates. Modelled growth rates for the 'Gib04a' stalagmite exhibit strong seasonality, resulting from seasonality present in parent dripwater [Ca^{2+}] and cave air pCO_2 (Mattey *et al.*, 2008); higher-frequency fluctuations in both dripwater [Ca^{2+}] and pCO_2 apparent in the monitoring data and in modelled growth rates. Assuming the measured drip water [Ca^{2+}] pattern is representative of the entire growth period of 'Gib04a' (53 years), modelled total growth (~3 mm) considerably underestimates actual growth (~45 mm). However, the required growth is achievable using measured drip rate and cave air pCO_2 if drip water [Ca^{2+}] is raised uniformly by 75 ppm. The modelling suggests that temporary cessations of growth are likely to be a common feature of stalagmites, even if dripwater is supplied continuously to the stalagmite.

A second numerical forward model, developed based on step-wise isotopic fractionation associated with seawater evaporation, moisture migration and rainout, was used to generate meteoric precipitation and stalagmite $\delta^{18}O$ data. Oceanic source regions for Gibraltar precipitation were inferred from ensemble back trajectory analyses; for each region, seawater $\delta^{18}O$, sea surface temperature and relative humidity data were incorporated into the model. Modelled meteoric precipitation $\delta^{18}O$ time series data correlate with estimated hydrologically-effective precipitation at Gibraltar ($r^2 = 0.66$); this correlation is comparable to that determined from Global Network for Isotopes in Precipitation (GNIP) data ($r^2 = 0.63$) and modelled precipitation $\delta^{18}O$ data replicate the amplitude of GNIP $\delta^{18}O$ variability.

For each oceanic source region, a pseudoproxy stalagmite $\delta^{18}O$ output was generated. Some outputs replicate the variability in actual Gib04a $\delta^{18}O$ moderately well, although others exhibit lower amplitude, suggesting that the regions on which they are based contribute less frequently to precipitation in Gibraltar. An important modelling result is that adjustments of only the fraction of rainout within realistic boundaries produce satisfactory fits between pseudoproxy and actual Gib04a $\delta^{18}O$ data. This research illustrates that modelling can help evaluate the parameters that ultimately affect stalagmite growth and stable isotope records, and which are otherwise difficult to constrain.

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Preliminary Carbon and Oxygen Isotope Results from an Indonesian Speleothem

POSTER

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The Australasian region is climatically important because it lies adjacent the Indo-Pacific Warm Pool (IPWP) a warm, tropical, body of water associated with El Nino/Southern Oscillation (ENSO) events; and is affected by the Australasian monsoon, the strength of which is controlled by the intensity and position of the Inter-Tropical Convergence Zone (ITCZ).

Speleothems present an opportunity to obtain detailed continental records of past climate (temperature, precipitation) and vegetation change because the isotopic composition of calcite is affected by changes at the surface. Stalagmites are readily dated using the U/Th method and may be sampled at a fine scale, this can allow them to have a detailed age-model with high resolution.

We present new stable isotope (C and O) and U-Series data collected from a stalagmite (LR07-G4) from the Liang Luar cave, Flores, Indonesia. The stalagmite covers a period from *c.* 24.0-9.0 ky BP, covering the last glacial maximum (LGM) and the transition from the last glacial to the present interglacial period. This period of Flores' history is significant because it witnessed the extinction of a newly discovered species of hominim: *Homo Floreiensis* at *c.* 12 kyr BP.

The stalagmite exhibits variable growth rates, with very rapid growth (>10 mm/kyr) between 24-19.5 kyr BP, followed by much slower growth rates (< 1 mm/kyr) between 19.5-9 kyr BP. Counter-intuitively, the period of rapid growth is co-eval with the LGM and associated sea-level lowstand; a period known to have been drier than present.

Down stalagmite (top to base), calcite $\delta^{18}O$ (vsmow) values range from 26.0 to 27.2‰, and $\delta^{13}C$ (vpdb) values from -10.1 to -3.5‰. Periods of rapid calcite growth exhibit a strong correlation between carbon and oxygen isotope values, and display isotopically light (heavy) $\delta^{18}O$ ($\delta^{13}C$) values. The strong, down stalagmite correlation indicates non-equilibrium calcite precipitation during this period. Conversely, periods of slow growth exhibit poor down stalagmite stable isotope correlation indicating equilibrium calcite crystallisation during this period. Three Hendy tests performed on several growth layers across the stalagmite are inconclusive as to whether there was lateral disequilibrium calcite crystallisation and further test are required.

Both C and O isotope profiles display large changes which start at the end of the LGM (*c*. 19 ky BP) in concert with the observed change in growth rate. The change in growth rate corresponds to a sharp change in the morphology and habit of the calcite crystals: from sugary, milky coloured, porous calcite during the phase of rapid growth; to translucent, non-porous calcite during the phase of less rapid growth.

These preliminary carbon and oxygen isotope and U-Series data indicate that stalagmite LR07-G4 has potentially useable climate data for post-LGM times, when stalagmite growth was slow, and for poor climate data during the LGM when stalagmite growth was rapid and non-equilibrium. However, it is noted that there is good potential for obtaining high resolution organic molecule data (fatty acids) during the period of rapid growth because of the opportunity to obtain large sample sizes across small time periods.

The status of the cave dwelling linyphid spider *Porrhomma rosenhaueri* in Wales.

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The cave dwelling spider *Porrhomma rosenhaueri* (L. Koch) is unique to the British fauna as it is considered to be the only species of paleotroglobiont spider present. The spider has a very limited distribution in the UK and is only known from two cave sites, both of which are in South Wales: Ogof y Ci near Merthyr Tydfil and Lesser Garth Cave near Cardiff. This presentation will look at the overall known world distribution of the spider, the little that is known on its ecology and the status of the spider population within Wales, especially that of the Lesser Garth Cave population. Future areas of research on this and related species of spider will also be considered.

Investigation of Cave Inception Horizons at Creswell Crags, Derbyshire, England.

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Creswell Crags, located on the Derbyshire–Nottinghamshire border, is the site of some of Britain's most important archaeological caves. The Crags are named after the prominent cliff faces along the north and south sides of a shallow gorge downcut by fluvial action through an outcrop of Upper Permian limestones of the Cadeby Formation. Numerous cave and fissure entrances are exposed in the cliffs on either side of the gorge, several of which contain ancient sedimentary and flowstone deposits, stone tools, cave art and faunal remains dating to the Middle and Upper Pleistocene. The oldest speleothem deposits in the Creswell Caves have been dated to about 300kya. Previous studies of the geomorphology of Creswell Crags have suggested that there might be two principal altitudinal levels of cave development within the Creswell gorge. The purpose of this contribution is to report the results of a new survey of the altitudes and locations of cave entrances at Creswell Crags, prompted by the recent discovery of a hidden low-level cave entrance buried under colluvial sediments below the entrance to the archaeological cave of Church Hole.

The majority of recorded cave passage floors at Creswell Crags cluster at levels of 4 to 8 metres above the level of the present day water course in the base of the gorge. A cluster of higher level caves, with passage floor levels 12 to 14 metres above the water course, is mainly restricted to the western part of the north side of the gorge, while low-level caves, with floors from 1 to 3 metres above the level of the present day water course, are restricted to the south side of the gorge. There is some evidence for a relationship between the altitude of cave inception and hydro-geological, factors including the stratigraphy and tectonic alteration of the limestone bedrock and former positions of the water table, but the data obtained from visible cave entrances may also be constrained by the topography of local limestone exposures.

The Geology of Ogof Ffynnon Ddu.

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Ogof Ffynnon Ddu (The Cave of the Black Spring) is a major cave system in the Upper Tawe valley south and east of The Cribath Disturbance and on the east side of the valley (Railton, 1953; O'Reilly, 1969; Smart and Christopher, 1989). It has over 48km of passage that extend over a vertical range of 330m (1010 ft). It was first entered and explored in 1946 by Harvey and Nixon of South Wales Caving Club and became the subject of major extension in 1966–67. Since then, apart from linking all parts of the cave physically, there have been no major extensions. The sections of the cave are described as OFD I, Cwm Dwr, OFDII and OFDIII to reflect the stages of exploration. There are three entrances: the *Bottom Entrance*, OFDI (just above river level at 202m and the way into the known cave in 1946–66), *Cwm Dwr* at 340m and *Top Entrance*, OFDII, at 430m. There are other relict entrances, e.g. via Downies Cave and Pant Canol, which were former inlets or resurgences, and many blocked entrances and truncated passages reflecting the effect of extensive surface erosion. The water in the Main Stream Passage within the cave comes principally from Pwll Byfre, some 5km to the NE. There are also fourteen minor inlets on the up-dip side of the Main Stream. The cave and the lands above have been designated as a Site of Special Scientific Interest (SSSI) to protect the cave from quarrying.

It was quickly recognised that this is a very old dominantly phreatic cave which has been the subject of major base level lowering by downcutting of the Tawe valley. This resulted in vadose trenching of the down dip elements of the phreatic network. The well developed groups of passages at discrete levels have been correlated with erosion surfaces recognisable at Penwyllt and further afield across much of Southern England (Ball *et al*., 1996). From these they infer an age of early Pleistocene for the chambers close to the Top Entrance. This is an opinion with which I would not disagree.

The cave is developed in a narrow sequence of the Holkerian Stage (S_2) Dowlais Limestone, sandwiched between massive underlying beds of Devonian Old Red Sandstone and overlying Namurian gritstone (Marros Group). The Old Red Sandstone beds are overlain unconformably by the basal beds of the limestone sequence, the Courceyan Stage (K), formerly known locally as the Lower Limestone Shales, and now part of the Avon Group. The Holkerian Stage rocks have an exposed section of 70–80 metres on the surface. The basal beds have been heavily dolomitised diagenetically rather than by co-precipitation. These are exposed in the floor of the Main Stream Passage of OFD II and III, where due to their relative insolubility; they form ledges and small waterfalls.

By contrast, the entrances all lie in the highest beds of the sequence, which are capped unconformably by the Honeycombe Sandstone and by limestone beds of the Asbian Stage, which also contain small caves. There are a number of biostratigraphical markers in the sequence, the most significant of which is a thick bed containing *Composita ficoides,* well exposed in the roof of the Bottom and Top Entrance series passages. Below this is a sequence of arenaceous limestone, followed after 7–15m by a band with *Lithostrotion sp*, which coincides with erratically occurring shale beds, well exposed in the RAWL Series of OFD1. A few metres below this is a thin dolomite bed, closely followed by a bed with *Syringopora* corals, whilst just below the dolomite beds which follow is another thin *Composita ficoides* bed. The bottom of the sequence is marked by a bed containing *Lithostrotion martini*.

The bulk of the cave is developed in the top 29m of high purity intrasparite limestone (average composition: 54.72% CaO and 0.64% MgO, i.e. 97.7% pure calcium carbonate). Whilst there has been no detailed stratigraphical survey of the cave, we know from observation that the higher entrances are close to the top of the limestone sequence and the stream passage exposes the dolomite beds near the bottom. on the basis of our currently imperfect state of knowledge it is not possible to be more precise about stratigraphical influences on cave development.

Structurally the cave is constrained vertically between the underlying Old Red Sandstone and the overlying Namurian grit. This block of limestone had been subjected to compression of Hercynian age. The main feature of the local structure is the Cribarth Disturbance, a powerful southwest to northest-trending compression belt. There are several associated faults, the most significant of which are the Pwll Byfre Fault and the Henrhyd Fault, as compression between these faults has developed a series of asymmetrical low amplitude southward plunging anticlines and synclines. These were first recognised by Charity and Christopher (1977) and are also recognisable within the cave: they coincide with the major high level series of passages. The result of this is that the dip is highly variable, a far cry from the average figure of 15° quoted by Glennie (1948) and accepted and used by Railton (1953) and O'Reilly (1967).

The dominant alignment of the passages is N–S, with secondary E–W, NE–SW and NW–SE alignments following the joints, many of which have been infilled with calcite. A block of limestone with its long axis W–E, subjected to strike slip compression, would develop such a series of N–S anticlines together with minor faults and fractures on these alignments. It is therefore no coincidence that the basic network of the cave was laid out upon these small joints, fractures and faults. It is also significant that the upper sequence in which the main passages occur has suffered extensive solutional compression as evidenced by the extensive occurrence of stylolites. These became areas of higher porosity that allowed primary phreatic circulation (inception processes) to begin and then to develop conduits guided by the pre-existing joint pattern.

Ogof Ffynnon Ddu is a mature developed phreatic cave developed at several levels in response to a falling base level and therefore heavily modified by vadose erosion. OFD I has the best examples of down-dip phreatic passages exhibiting only small amounts of vadose modification. In contrast, the Top Entrance to OFDII has an extensive series of vadose modified abandoned phreatic dip tubes. Three elements of morphology can be identified in the phreatic stage: down-dip phreatic passages, strike integrators and cross joint risers. The Main Stream Passage appears to have developed by strike capture of the lowest points in the drained phreatic tubes in response to substantial base level lowering as shown by the nick point at the Top Waterfall.

Stalagmite dating in the cave has yielded the oldest date as 267 Ka, of a relict flowstone cap, on a deposit of, presumably, Anglian age that has long since removed (Christopher *et al*., 1996). Other dating results were either Ipswichian or younger. The results date the extensive clastic deposits of Top Entrance as Devensian and indicate the severity of the flushing to which the cave has been subjected. Entrenchment rates of 20–122 cm per 1000yrs have been measured during this study. The higher figure is clearly anomalous as a vadose entrenchment rate of 5–20cm per 1000yrs is considered acceptable. Applying a midpoint value to an estimate of the amount of vadose incision in the Traverses and OFD III streamway of 78m gives an age of c. 0.8Ma BP for the vadose part of development (Smart and Christopher, 1989) and probably an equal or longer length of time for phreatic development. This age is not greatly at variance with the age quoted above based on stratigraphical criteria.

Our studies suggest the cave developed from high level inception in the top of the limestone sequence into a phreatic network located on a pre-existing joint network, then lost stratigraphic height by vadose incision (drawdown) by strike capture after phreatic drainage, following base level lowering, until the bottom of the sequence was reached in Main Stream Passage. It therefore exhibits features of Inception Horizons, a watertable, and a vadose drawdown cave which has developed over the past 1.8–2.5 Ma BP. Very old stalagmite (>350Ka) has not been found, either because it was not deposited or because it has been removed by the severe erosion at the end of the Devensian glaciations.

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Recent research on the archaeological material from Goat's Hole, Paviland, Gower.

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Goat's Hole at Paviland is the most abundant Early Upper Palaeolithic archaeological site in Britain. From the beginning of the 19th century until the end of the 20th century the cave was the subject of several periods of invasive work (see Swainston and Brookes, 2000). The two most notable periods of excavation were those by William Buckland in 1823, during which the decorated burial of an Early/Mid Upper Palaeolithic male hunter was recovered (referred to, confusingly, as the "Red Lady of Paviland"), and in 1912 when William Sollas recovered the majority of the stone tool assemblage known to come from the site. The collection from the site continues to be the main reference point through which occupation of Britain by its first modern human inhabitants can be understood. Over the past decade new methodologies of radiocarbon dating, reconstruction of past climates and stone tool analysis have been applied to the archaeological assemblage from Goat's Hole, and these are outlined here.

The age of the Red Lady burial and possibly associated bone and ivory artefacts has until now been the subject of much debate. Jacobi and Higham (2008) have recently re-dated the Red Lady burial and several bones thought to be associated with it using a more refined method of radiocarbon dating than previously possible. Their results indicate that the Red Lady was buried earlier than previously thought, c.29,000 ^{14}C BP or c.34,000 (calendar) years ago and during a warm climatic period identifiable in the ice core records of Greenland. This renders him the oldest decorated burial in western Europe, and raises intriguing questions regarding the archaeological culture to which he belonged.

The stone tool assemblage from the site has also been the subject of recent re-analysis. Amongst the results of this work is the identification of an Aurignacian bladelet production technique particularly characteristic of the site's assemblage, referred to as the "Paviland burin" technique (Dinnis, 2008). This technique is also present at Kent's Cavern (Devon) and in several cave assemblages in Belgium, but is absent from Aurignacian assemblages in northern France. When considered against the wider picture of Upper Palaeolithic occupation of Britain this observation is good evidence that the first modern humans to occupy Britain came from Belgium to the east, rather than from France to the south.

In conclusion, potential routes for future archaeological analysis of the cave's assemblage are suggested.

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The archaeological potential of the caves of Bishopston Valley, Gower.

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The caves of the Gower peninsula are known to contain Late Pleistocene as well as Holocene sedimentary deposits and are therefore of particular interest to Quaternary scientists, including archaeologists specialising in the Palaeolithic period. The Gower can boast archaeological cave collections of national importance, in particular for the period of initial modern human occupation of Britain c.37-33,000 years ago. Notable archaeological collections include the largest assemblage of Aurignacian material in Britain and the famous Early/Mid Upper Palaeolithic "Red Lady" decorated burial (from Goat's Hole, Paviland: Aldhouse-Green, 2000) and the largest number of Gravettian stone tools known from a single British site (from Cathole: Jacobi, 2007). Intact cave deposits on the Gower should obviously therefore be viewed as a valuable scientific resource.

One area of the Gower which has been the subject of little archaeological sampling is Bishopston Valley. The only "excavation" of note was of Kittle Hill Cave, carried out by workmen during construction of the Swansea-Pennard road in 1926 (Riches, 1926). Material removed from the cave included probable Late Pleistocene *Ursus arctos* and large accumulations of charcoal which are surely testament to the presence of archaeological material. Unfortunately by the time the material was brought to the attention of the scientific community only sparse sedimentary deposits remained intact, and it is thus unknown precisely what was present in the cave prior to it being emptied.

Here the results of a walk-over assessment survey of the caves of Bishopston Valley undertaken in March 2010 are reported. Although many of the valley's better known caves are subjected to seasonal flooding, certainly clearing them of any archaeological deposits, several less conspicuous and less well-documented caves on the valley sides have the potential to contain archaeological material. Historic and ongoing disturbance of the deposits of these caves by humans and animals was apparent. In one case, this disturbance had resulted in an archaeological bone of late prehistoric or early historic age being removed from its original context within the cave fill. This bone not only demonstrates the archaeological nature of this particular cave, but also highlights the loss of scientific information if disturbance of the valley's caves continues unchecked. In light of the survey's results (Dinnis *et al*., 2010), it is recommended that selected sites warrant further archaeological and palaeontological investigation.

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'Speleothem' deposits on open cliff faces: their occurrence and potential for palaeoenvironmental reconstruction.

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Speleothems (stalagmites, flowstones and related cave deposits consisting mainly of secondary carbonate minerals) have been widely used as archives of palaeoenvironmental conditions. In deeper and more isolated caves, annual temperature cycles are averaged out so that longer-term changes in environmental conditions are reflected in speleothem composition. These characteristics, combined with recent progress in speleothem dating techniques, have led to major advances in identifying and dating significant regional climatic shifts.

Stalactites, flowstones and related secondary carbonate deposits of up to many meters in length are also found on overhanging (non-cave) cliff faces in many parts of the world. Their mode and rate of formation may be similar to speleothems in *sensu strictu,* however, to the author's knowledge, no detailed examination on speleothem-like deposits on open cliff faces has been carried out to date. The objective of this paper is to present a range of examples of these features from different regions and to stimulate discussion on their origin and potential palaeoenvironmental significance.

The cliff faces exhibiting these features are in some cases former cave walls that have been exposed following cave collapse or quarrying activities. In most cases, however, the cliff faces appear not to have a speleogenetic origin and their speleothem like features would have been formed under ambient atmospheric conditions. The features are particularly common on limestone cliffs in humid tropical and Mediterranean regions, but a few examples also exist in humid temperate regions such as the UK. The evidence available suggests that they can form on overhanging cliff faces irrespective of aspect and even where only little overlying bedrock and soil cover is present. Their colour, morphology, density and surface texture is similar to genuine speleothems. In only in few cases does their appearance suggest a significant role of biota in their formation, as, in contrast, is the case in many waterfall tufa deposits. Some of the stalactites and flowstones appear to be growing today. In comparison to their counterparts in isolated caves, their formation will have occurred under the much more fluctuating temperature and humidity conditions of the open atmosphere. However, the partial pressure of CO_2 would be expected to be less variable than that in some cave systems and their growth would have not been affected by submergence as may occur during flood events in caves. In contrast to tufa deposits from paludal and pool environments, they would not be expected to show significant detrital contamination. These characteristics may provide for some complex, but potentially useful palaeoenvironmental archives in these deposits, that could complement the insights gained from studies using conventional speleothems.

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Aerosol contributions to speleothem chemistry.

POSTER

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Speleothems offer a multiproxy palaeoclimate resource; many proxies have been investigated and utilised for palaeoclimatic reconstruction. Traditional investigatory geochemical techniques often combine stable isotope analysis and, increasingly, trace element analysis with disequilibrium dating. The contribution of aerosols to speleothem chemistry and their applicability for reconstructions remains untested and the extent of their value as an addition to palaeoclimate sciences unknown.

The term "Aerosols" encompasses the suspension of both fine solid or liquid particles within a gaseous medium. The troposphere contains approximately 90% of the atmosphere by mass and therefore contains most the atmosphere's water and aerosols. Aerosols become suspended into the earth's atmosphere through a multitude of processes, both natural (e.g. volcanic eruptions, wind-blown sands, forest fires) and anthropogenic (e.g. biomass burning, vehicle emissions, constructions etc). Aerosols enter the cave network as a result of cave ventilation processes and are either deposited or cycled and removed from the system. Consequently, through aerosol incorporation, speleothems have the ability to preserve a record representing a multitude of processes not yet constrained by previously investigated proxies. Aerosols used in combination with more traditional speleothem proxies will add an extra dimension to palaeoclimate reconstructions.

For speleological studies, the aerosol component of interest is that which deposits within the cave network and is available for incorporation into precipitated calcite. The deposition of aerosols will be collected using surrogate surface techniques that are currently being investigated and tested through controlled experiments. Aerosols will be detected, identified, characterised and ultimately quantified to determine their prominence in the karst system. Aerosols will be investigated on a case study basis, searching for suitable proxies from emissions of environmentally significant processes. Processes include: Palaeofires at Yarrangobilly Cave Australia and anthropogenic emissions at Gibraltar and Cheddar Gorge. Monitoring will allow for the temporal and spatial determination of aerosol in the karst network. Speleothem samples will be analysed in combination with in-situ monitoring to determine incorporation factors and record preservation. By understanding how aerosols are transmitted within the cave and ultimately incorporated into speleothems, a record of aerosol event frequency, intensity and timing can be produced and directly correlated with changing palaeoclimate.

Flowstone genesis and record interpretation complications: a 500ka flowstone record from Gibraltar.

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Speleothems represent possibly the best opportunity to obtain highly detailed continuous terrestrial records (Fairchild and Treble, 2009). The majority of speleothem based palaeoclimate studies involve the analysis of stalagmite samples for obtaining climate proxy data. The growth dynamics of flowstone often results in a record of complex stratigraphy punctuated with hiatuses resulting in added complexities to the record interpretation. Consequently, flowstones are rarely utilised in comparison to stalagmite samples for palaeoclimate investigations. But flowstone provides a potentially abundant resource of terrestrial proxy data due to the abundance of flowstone formations in cave locations across the globe.

High resolution trace element and stable isotope analysis of a flowstone core (Gib08a) sampled from New St Michaels Cave, Gibraltar, displayed evidence that flowstone specific processes are likely to significantly influence sample geochemistry. Results display the potential significance of flowstone specific local processes on isotopic fractionation, which is of key importance for palaeoclimate interpretations. Often local geochemical altering processes correlate to periods of $\delta^{18}O$ and $\delta^{13}C$ synchronicity. Through the combination of trace element and stable isotope composition changes these events can be recognised and potentially deciphered from the climatic signature.

Long term millennial time scale climate changes display an overriding control on the isotopic composition of the flowstone samples. Importantly, glacial terminations are preserved in the isotope record. Proxy data therefore maintains an interpretable record for palaeoenvironmental reconstructions as verified by the correlation of the Gib08a record with established isotope records SPECMAP and Devils Hole. Flowstone, if interpreted with adequate knowledge of formation processes with growth constrained by considered dating of sufficient temporal resolution, presents an opportunity to obtain long records of palaeoclimate change from locations which do not provide stalagmite samples.

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The hydrogeology and hydrochemistry of Taff's Well thermal spring.

POSTER

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Taff's Well spring is located just north of Cardiff, South Wales. The spring has received little attention since the early 1980s [1]. Better known, more profitable thermal springs in Buxton [2] and Bath [4,5,6,7] have received the lion's share of attention and subsequent scientific investigation. A data logger, deployed by Environment Agency Wales, collected >20,000 temperature readings over a two year period. This is the first hi-frequency temperature record from Taff's Well spring. Recent temperature data and chemical analysis, in conjunction with data from other thermal springs in the UK, are used to refine the local and regional conceptual understanding. Taff's Well thermal spring [8&9] is the fourth hottest thermal spring area in the UK and Ireland. The water temperature is generally constant, with a mean of 21.6°C +/- 0.5°C (over 10°C higher than average Carboniferous Limestone groundwater temperature in Wales of 11.3°C). Short-lived reductions in temperature are rare and associated with large rainfall events and high river stages. The chemistry of the waters is also constant, with CFC/SF6, tritium and ^{14}C suggesting an age of several thousand years. In comparison with other thermal springs Taff's Well has one of the lowest discharges (~1.5 l/second) and is also the only thermal spring in the UK not to be part of a known complex of warm springs. Future work will focus on ecology of the thermal waters as they provide a unique and unstudied groundwater dependant ecosystem in Wales [10].

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An Introduction to the Geology and Caves of South Wales and a Report on the Designations of Cave Sites as Regionally Important Geological Sites (RIGS) within the South Wales RIGS Project.

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The caves of South Wales are developed in a classic structural basin which has been modified with faulting and through the action of valley developments. This presentation provides an overview of the regional geology and geomorphology of the area, and an overview of the key caves of South Wales as a framework for other presentations.

The British Geological Survey has in recent years revised the terminology for the Carboniferous of South Wales. Since many of the classic texts on Welsh caves use the classic terminology a summary of the current terms as used by BGS and the older terminology as used in most caving literature will be presented.

Caves sites have been considered for inclusion within the South Wales RIGS project. A review of the methods of selection, the sites selected and the reasons for inclusion and the process of scheduling and the benefits of scheduling will given, along with an overview of where the South Wales RIGS project ties in with the overall Wales and UK RIGS projects.

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The aquatic fauna of caves and other groundwater habitats: ecology, distribution and current research.

POSTER and DISPLAY

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Within the last decade there has been a revival in interest in the fauna of subterranean groundwaters in Britain and Ireland, leading to the publication of several papers and a review of our current knowledge of the subterranean (hypogean) Crustacea that dwell within them. The hypogean Crustacea recording scheme has been active since 1998 in collating records for the obligate subterranean freshwater (stygobitic) macro-Crustacea species (including *Antrobathynella*, *Niphargus* species, *Crangonyx subterraneus* and *Proasellus cavaticus*) from groundwater habitats across the UK and the Republic of Ireland. Habitats from which records have been obtained include boreholes, wells, springs and the hyporheic zone of rivers and streams, as well as mines and caves. It is proposed to present a poster and demonstration exhibit at the symposium showing specimens of the various species as well as presenting information on their ecology, both within cave systems and other groundwater habitats and their distribution within the British Isles and Ireland. It is also intended to highlight recent projects that have either taken place or are on-going that have provided important insights into our knowledge of this elusive group of organisms.

These recent projects have included: on-going recording from groundwater habitats across the UK; a survey of springs and caves across Ireland; the setting up of a study aquarium in a cave within the Higher Kiln Quarry SSSI; the inclusion of the endemic *Niphargus glenniei* on the Biodiversity Action Plan list of priority species, the first "cave species" to be so listed in the UK; a recent survey of the aquatic fauna in Swildon's Hole (to be published in a future edition of *Cave and Karst Science*); recent investigations being carried out by staff at the British Geological Survey; and the Groundwater Fauna-UK study. This latter project is a multi-disciplinary project, involving collaboration between Roehampton University, the British Geological Survey, Paul Wood of Loughborough University, Simon Rundle of Plymouth University, the Freshwater Biological Association and the Hypogean Crustacea Recording Scheme. The project aims to examine the distribution of the British stygobitic Crustacea across Devon and Dorset in relation to local geology and general groundwater chemistry. A further element of the study involves comparing the occurrence of fauna on either side of the Devensian glacial limit, within the Chalk and the Magnesian Limestone of northern England.

The Trang An Project: Caves, Ecology and Humans.

POSTER

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The aim of the Trang An archeological project is to understand hunter-gatherer mobility at the end of the last glacial maximum (Rabett *et al.,* 2010). Research into ecological changes during this time is of key importance in understanding hominid movement and cultural development. This data can then be integrated with cultural and dietary information deduced from archaeological finds (Rabett *et al*., 2010). The fossil record of past ecological response to environmental change is often used as a proxy for wider climate change. For example, palynological (pollen) records are widely used to determine vegetation change; however preservation, transport and unidentifiable taxa can bias the data. This project pioneers the use of a novel approach to determining vegetation history.

Lipid biological markers, are produced when organic matter is released during decomposition. Previously lipids have been extracted from sediments and interpreted as evidence for past ecological and environmental change. However lipids have never been extracted from clastic cave sediments. Caves are chemically stable which may provide an ideal environment for lipid biomarker preservation. Within caves, sediments will accumulate, through aeolian or fluvial deposition, with relatively little further digenesis or post-depositional alteration. It is therefore hypothesised that lipid biomarkers from local flora will be transported into caves and preserved.

Two caves in the Ninh Bình province of Vietnam; Hang Boi, and Hang Trong have been chosen as the study sites. A trench has been dug at each site to allow for sampling: Hang Boi approximately 4 metres and Hang Trong approximately 2 metres deep, bulk sediment samples were taken from each stratigraphic layer, where determinable, alternatively in 10 cm spits progressively down the trench. Hang Boi is an open cave situated at 78 m a.s.l. Radiocarbon dates, derived from charcoal, indicate the sediment ranges from 12,100cal. yrs. b.p. to 12,400cal. yrs. B.P. at the base, over approximately 1 m depth. The second site, Hang Trong, is situated 142 m a.s.l. and features two openings on opposite sides of a karst tower, making it a good site for the investigation of airborne deposition. Radiocarbon dates from charcoal indicate the immediate sub-surface sediment is recent whilst at approximately 1.5m from the surface it dates to 18,500yrs. b.p.

These sites are dominated by anthropogenic shell middens which are interspersed with aeolian sediments and bed-rock break down. This is the first comprehensive investigation of lipid biomarkers from plants preserved in clastic cave sediments. The study will reconstruct the local vegetational history using both palynological and lipid biomarker analyses. The lipid biomarker time series can then be compared with the palynological record to determine the effectiveness of the method, providing key insights into the local paleoenvironmental conditions. The lipid analysis technique developed during this project will support established methods and provide information from sites where existing techniques are unsuitable.

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Ways of living with caves: an ethnographic example from the Kras region of Slovenia.

POSTER

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Local villagers from the Kras region of Slovenia have been actively and practically engaged with their karstic landscape. Their ways of living with the caves situated near their villages have been observed through an ethnographic study which has explored:

1. The position of local caves within a topological network of socially constructed places;
2. The relation of caves to everyday activities;
3. The construction of personal, historical and ritual meanings associated with the caves;
4. Folklore surrounding caves;
5. The contribution of caves to the personal and social identity of villagers.

The research has shown that caves had been commonly used in the annual cycles of herding and transhumance, as pens for animals or shelters for herders. Whereas in the 19th and first decades of the 20th Century, some of the caves had been used for storage of ice, the habit of using certain caves for dumping animal carcasses has persevered until today. On the other hand, several of the caves have been imbued with a liminal potency which is revealed through folk narratives depicting caves as: the entrances to the underworld or otherworld; the dwellings of dwarves, fairies, dragons, devil or female demonic beings; the places where suicides were committed; or places of chthonic rites. However, contrary to the commonly employed dichotomy between natural / material (*i.e.* subsistence activities connected with caves) and cultural / mental (*i.e.* rituals and folklore on caves), this ethnographic research aims to show that both demonstrate primarily complementary aspects of dwelling in a landscape perforated by caves and shafts.

Cave burial in the Mesolithic and Neolithic of Wales.

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Wales is rich in cave archaeology, with many sites containing Mesolithic and Neolithic human remains providing important insights into the archaeology of both periods, including diets, funerary practices, and the timing of the transition to farming. For the Mesolithic, caves provide the only context in Wales from which human remains have been identified (David, 2007; Davies, 1989). While their disturbed nature offers relatively little evidence for mortuary behaviour, they do provide invaluable information on diets at this time, and particularly the use of marine foods, which can be investigated through stable carbon and nitrogen isotope analysis of human bone collagen, giving direct insights into the diets of individuals. In the absence of the Mesolithic coastline due to rising sea levels, and so the loss of contemporary coastal settlements, this is one of the only ways of looking at the exploitation of marine resources (Schulting, 2008; Schulting and Richards, 2002).

Data from the south coast of Wales have contributed to our understanding of the nature and timing of the shift to farming, and suggest that this saw a major change in subsistence that can be contrasted with some recent views of the Mesolithic–Neolithic transition as a gradual affair (Schulting and Richards, 2002). Within the Neolithic, the importance of cave burial as an alternative to chambered tombs has emerged very strongly in recent years, and raises the question of who was being buried in each place (Chamberlain, 1996). One possibility currently being explored through stable isotope analysis is that those placed in caves had subtly different diets than those found in monuments (Schulting, 2007). This paper summarises previous and new research on human remains from caves in Wales.

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Inferring the extent of scarp retreat and valley incision during the development of the Ogof Draenen cave system, south Wales.

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The Ogof Draenen cave system comprises an extensive series of strike-parallel conduits. These developed sequentially down dip as the phreas was progressively lowered in response to the establishment of successively lower resurgence levels in the three neighbouring valleys of the River Usk, the River Clydach, and the Afon Lwyd. Many of these conduits now lie tens, or even hundreds, of metres above the present phreas and testify to considerable incision since their respective resurgences were active. Some of the easternmost passages have been truncated and dissected by scarp retreat and can only have been active when the scarp edge lay significantly further east. Inevitably this raises questions surrounding the extent of topographic change in this region since the Ogof Draenen cave system was first established.

The history of the cave system has yet to be constrained by radiometric dates. Nonetheless, consideration of the outcrop and subcrop geometry of the limestone and its relationship to surface topography and cave passages allows certain inferences to be made concerning relative incision rates, particularly for the Lwyd valley, and also to assess the extent of scarp retreat during successive phases of the system's evolution. Figures obtained indicate that there has been more than 500 metres of scarp retreat adjacent to the northern part of the system (Gilwern Hill and Clydach Gorge), while just a few km further south, the eastern scarp has in places retreated probably less than 100 metres. Putative former resurgence locations in the Afon Lwyd valley indicate up to 100 metres of incision since this valley first became the destination of the Ogof Draenen drainage.

Five successive resurgence levels, spaced at ~10 metre vertical intervals and draining to putative risings in the northern part of the Lwyd Valley, suggest lowering of the phreas in response to discrete episodes of incision. Each resurgence level shift corresponds to ~5 metres of surface incision. We interpret this pattern as analogous to terrace staircases formed during glacial-interglacial cycles (Bridgland and Westaway 2008), with each representing a period of incision (interglacial) followed by aggradation (glacial). Extrapolating from these figures suggests that the highest risings in the Lwyd valley may have been active more than a million years ago, whereas the oldest of Ogof Draenen's conduits, located up-dip in the extreme east of the system, are well in excess of 1.5 Ma old.

The vertical spacing between putative resurgence levels in different valleys, more specifically the switch from the Lwyd to the Clydach valley and then the switch from the Clydach back to the Lwyd valley, is significantly greater (20–30m vs. 10m) than that seen between resurgence levels within the Lwyd valley. This suggests that there is significant 'inertia' associated with the reversal in drainage direction necessitated by this south–north–south switching sequence. In contrast, the putative resurgence level for the latest conduit (Megadrive) draining south-east into the Usk valley is virtually the same as that for the oldest conduits (Luck of the Draw) draining south to the Lwyd valley.

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Quantifying landscape evolution in carbonate terrains using U-Pb dating of speleothems.

POSTER

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Much of the success of speleothems as archives of palaeoclimatic information and chronological markers in landscape evolution is due to their suitability for dating by U-series disequilibrium methods, specifically via the U-Th decay chain, which has allowed for highly robust dating of carbonate materials up to 500 ka. Beyond this threshold, the usefulness of speleothem records was previously limited, due to a lack of reliable and precise alternative chronometers. However, recent research into U-Pb dating (Richards *et al*., 1998; Walker *et al*., 2006; Woodhead *et al*., 2006; Polyak *et al*., 2008; Cliff *et al*., 2010) has demonstrated significant potential to extend the practical dating range of carbonates to many millions of years.

We intend to quantify rates of landscape evolution in a variety of karst terrains where base level rates of incision can be determined using the ages of well-preserved speleothem and sediment samples. Dating will be conducted primarily using the U-Pb technique; however supplementary methods (including U-Th, palaeomagnetism and cosmogenic dating) will also be used where applicable. We have selected a series of sites from the UK (Mendip, Forest of Dean and Usk Valley) and Canada (Nahanni National Park Reserve) for initial investigation and are currently refining MC-ICP-MS U-Th-Pb techniques at the Bristol Isotope Group using an unusually U-rich flowstone sample (72030 – up to 80 $\mu g\ g^{-1}\ {}^{238}U$) from the Grotte Valerie system in the McKenzie Mountains, North-West Territories, Canada. The sample was divided into 10 sub-samples, based on the original age estimates and growth layers identified by Harmon *et al*. (1977). Preliminary results (for sub-samples representing ~0.4 mg) are significantly older than those of previous work, when sub-samples were >10 g. Some sub-samples have a particularly high ${}^{230}Th/{}^{232}Th$ atomic ratio (> 3), which demonstrates that the Th isotope signal is dominated by the radiogenic component. We obtain an age and 2σ uncertainty of 355 ±12 ka (33 mm above base, 1.5 mm below top); however, U-Th ages for older sub-samples between 8.5 and 30 mm above base (72030-A8.5 to A30) are not finite and > 500 ka. This material is therefore ideal for further analysis using the U-Pb technique.

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The Emplacement of Erratics in Grikes; a study of the limestone pavements of the Arnside and Silverdale AONB

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536 non-calcareous erratic cobbles and small boulders, emplaced in the grikes of the Arnside and Silverdale areas Carboniferous Urswick (Asbian) limestone pavements, were mapped at Longtail Wood, Hale, Underlaid Wood, Gait Barrows and Warton. Lithologically 95% were Silurian Windermere Group, mostly greywackes, and 5% Borrowdale Volcanic Group. Grike widths at emplacement sites were 45% wider than random grike widths ($p < 0.01$). Erratic density across the five pavements varied 46 fold per pavement hectare and 8 fold by grike density. Underlaid Wood had 20.4 erratics per kilometre of grike and Gait Barrows only 2.5, extremes explained firstly by variations in pavement dissection consequent upon limestone bed structure and secondly by dominant wide southward orientated grikes at Underlaid that favoured erratic emplacement by late Devensian SSW ice flow. These factors, the existence of relict erratic pebbles on a clint at Hale and the orientation of erratics with longest orthogonal axes following grike length and intermediate axes grike depth ($p < 0.01$), favour primary glacial emplacement of erratics into open grikes and onto clints rather than later secondary fluvial transport of glacial till.

The concept of bimodal pre and post Devensian grike populations at Underlaid Wood (Rose and Vincent's 1986) was not confirmed but their contention that many grikes predated the Late Devensian was supported with 7.4% of grike widths >40cms, probably too wide to have formed solely by postglacial dissolution.

Accurate denudation rates for limestone pavements in Silverdale are not known but in a study of erratic pedestal erosion rates in Northern England, Goldie (2005) obtained her lowest recording of 3mm/ka in Silverdale. Since grikes have two walls, Goldie (2009) postulated that, under favourable conditions, a 30cm wide grike could develop in 15ka. However, the lower Silverdale erosion rate of 3mm/ka would create a width of only 10.2cm over 17ka. Since grikes are often flared at surface level, widths recorded at a depth of 15cm are more reliable morphometric guides. At this level, 92% of grike widths at erratic emplacement sites were >10.2cm, further supportive evidence that Silverdale grikes were already formed before the Devensian LGM. Though interesting, these figures must be treated with some caution and are at variance with erosion rates of 10–46mmka^{-1}, reported by Parry (2008), and with possible maximum surface solution rates of up to 0.5mma^{-1} postulated by Faulkner (2009). But those are rates for continuous dissolution by heavy rainfall carrying a CO_2 load at atmospheric pressure, and pedestal lowering denudation rates tell us that optimal conditions could not have been constant since the Younger Dryas.

The only other study in the world literature that partly addresses the emplacement of grike erratic is by Feeney (1996), who had no doubt that pre Wisconsinan grikes exist in the Chaumont Barrens pavements of upper NY State. He recorded erratics aligned along and within grikes and present in depressions, where remaining till was subsiding over grikes. This Silverdale research broadly supports Feeney's model.

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Siberian and Mongolian palaeoclimate: new data from speleothem records.

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We have used speleothems from six caves along a north-south transect in Eastern Siberia and in the Mongolian Gobi Desert to track the evolution of the permafrost and of the desert during the last ~500 ky. Meteoric waters can penetrate into caves and cause formation of speleothems only when cave temperature (which approximates the mean annual surface air temperature) is above 0°C, and the effective precipitation during the humid season is positive. Periods of speleothem deposition therefore provide a tracer for presence or absence of the permafrost in Siberia, and of the arid conditions in Gobi.

The northernmost cave used in this study, the Lenskaya Ledyanaya Cave, is located at 60°22'N-116°57'E, on the southern boundary of a continuous permafrost zone, with no present-day water seepage in the cave and large amounts of ice partially filling its inner chambers. Botovskaya Cave system is located at 55°18'N-105°20'E, in a discontinuous permafrost zone, with water seepage and speleothem growth occurring only in a limited area of the cave. Okhotnichya Cave at 52.08°N-105.29°E near southern Lake Baikal, is located in a zone of island permafrost, with water seepage and speleothem growth occurring in all parts of the cave. The mean annual temperatures vary from -7°C in the area of Lenskaya Ledyanaya Cave to ~0°C in the Okhotnichya cave region, and the present-day vegetation in the area is sub-arctic taiga forest. Three caves of the Gobi Desert: Shar-Khan (45°35'N-108°20'E), Gurvan Ze'erd (42°50'N-107°45'E) and Lovon-Chombo (42°59'N-107°82'E) are located in the area receiving less than 150 mm of annual rain with mean annual temperatures ranging between +3°C and +8°C.

More than 90 horizons from 22 speleothems from these six caves were dated by the U-Th method. The youngest speleothem age in the Lenskaya Ledyanaya Cave was 404 ± 32 ky, corresponding to interglacial Marine Isotopic Stage (MIS) 11, whereas the other 11 horizons in 6 additional speleothems from this cave were older than the dating limit. In Botovskaya and Okhotnichya caves speleothem ages clustered into warmest intervals of the interglacial periods at 420–370 ky (MIS11), 340–300 ky (MIS9), 210–190 ky (MIS7.1), 131–120 ky (MIS5.5) and 10–0 ky (Holocene). No speleothem deposition younger than 550 ky (the limit of the U-Th method) was found in the Gobi Desert.

The results suggest that MIS11 in Eastern Siberia was warmer than today and the permafrost on the 60°N latitude was discontinuous allowing speleothem deposition. Later, the climate became colder, leading to formation of the continuous permafrost at the 60°N latitude, and causing a permanent cessation of speleothem growth in this region. Further to the south, between the latitudes 56°N to 52°N, the climate was warmer and permafrost has melted intermittently during the warmest periods of the interglacials. This data provides some of the first constraints on the evolution of permafrost in the central and southern parts of Eastern Siberia. In the Mongolian Gobi Desert, arid conditions with negative water balance were continuous during the last 550 ky.

Pontnewydd Cave – an early Neanderthal site in North Wales.

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Pontnewydd Cave lies in the Elwy valley in the parish of Cefn Meiriadog near St. Asaph, Denbighshire. The cave was first recorded by the Reverend Stanley (later Bishop of Norwich) when he visited Cefn in 1832 (Stanley, 1833, p53). It was subsequently explored during the 1870s by Prof. William Boyd Dawkins and later by Thomas McKenny Hughes (Hughes and Thomas, 1874). Hughes' work uncovered a human tooth described by George Busk as quite unlike any other human tooth he had previously seen, being much larger in size (*Ibid*). This tooth (now lost) was associated with stone tools and it was this record that led Stephen Aldhouse-Green to commence excavations at Pontnewydd Cave for the National Museum of Wales in 1978. This work continued until 1995 with interim publications in 1984 and 1989 (Green, 1984; Green, 1989). The work will culminate in a full report to be published later this year (Aldhouse-Green *et al*., in press).

Pontnewydd Cave is significant for it has been demonstrated to contain evidence for the earliest human occupation of Wales. The tooth recorded by Hughes and eighteen new hominin finds from the recent excavations have been characterized as an evolutionary early form of Neanderthal (Stringer, 1984). These teeth, believed to be the remains of a minimum of five individuals, range in age from young children to adults (Green, 1989). These are highly significant finds, currently being the only Neanderthal remains so far discovered in Britain. Associated with these remains are over a thousand stone tools. The stone tools comprise a range of tool forms, including bifaces and flake tools, a high proportion of which were made using a Levallois technology. The tools themselves are made on a suite of rocks that mostly have a local origin as cobbles or pebbles transported by ice into the area. These raw materials are mainly volcanic rocks of Snowdonian origin and include rhyolites, ignimbrite and various volcanic tuffs, all of which have poor flaking properties when compared with flint, the usual material of choice at this time (Bevins, 1984; Jackson, 2002).

Faunal remains associated with the hominin fossils and stone tools date to MIS 7, key indicator species being the rhinoceros *Stephanorhinus kirchbergensis*, leopard *Panthera pardus* and a large horse *Equus ferus*. Other species include bear, wolf and bison along with rodents including Norway lemming. Pontnewydd Cave is significant for the preservation of deposits containing remains of such age, given the later glaciations that covered North Wales. It appears that the deposits within the cave were emplaced by a complex series of debris flow events that picked up and washed all material into the cave (Collcutt, 1984). Consequently, there are no *in situ* occupation layers within the cave and all bones have become very heavily fragmented. The hominin fossils, stone tools and MIS 7 animal remains are in a context that was sealed by a thick layer of stalagmite, which has been dated by uranium series dating and provides a *terminus ante quem* for the occupation of the site of 230,000 BP (Green, 1984).

A later breach of the cave deposits by a Last Glacial debris flow brought a mid-Devensian fauna into the cave. This assemblage is dominated by brown bear, wolf and reindeer but it is not accompanied by evidence for a human use of the cave. Pontnewydd therefore remains a highly significant site, unique to Britain for its preservation of early Neanderthal hominin fossils, stone tools, animal bones and deposits of such considerable age.

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Book Review

Tufas and Speleothems: Unravelling the Microbial and Physical Controls

Edited by H M Pedley and M Rogerson. Geological Society Special Publication No.336, 362pp. ISBN 978-1-86239-301-1. 2010. £90 ($180), (GSL Members £45; $90).

This is a compendium of seventeen papers presented on the theme of a research in progress workshop held at the University of Hull in 2008. After an introduction by the editors, contributions were nearly all from Europeans with nothing at all from USA or Australia. Five are concerned with speleothems and twelve with surface deposits and processes. There is a "grey area" between these as many tufa deposits are in streams soon after their resurgence from caves via springs.

The contributions are from bacteriologists and other microbiologists, hydrochemists, geochemists and sedimentologists. The consensus of opinion is that tufa formation is largely mediated by microbial processes which stimulate the precipitation of calcium carbonate at non-thermal temperatures. The microbes vary from single-species to assemblages of cyanobacteria (what we used to call blue-green algae), diatoms, mosses and fungi.

Possibly the most significant paper is concerned with the recognition that microbes can be transmitted from the soil through underlying limestone into caves where they can be enclosed in speleothems. There they can be found as thin organic-rich layers scattered within stalagmites, an observation which has seldom been recorded before, and which indicates that previous geochemical arguments derived from speleothems may need to be re-assessed. Soil-derived carbon dioxide can affect cave concentrations and thus the rate of stalagmite growth.

Other environmental controls on microbes also affect tufa deposition. Cyanobacterial extra-cellular polysaccharides can cause carbonate precipitation in suitable environments, though the extent to which they are diurnally or seasonally controlled is still a matter of controversy. The variable effects result in stromatolitic layering in some tufa deposits. O^{18} values in these layers can be used to estimate relative palaeo-temperature oscillations. Sedimentary textures such as micrite indicate slow growth (though later micritization of coarse components can be misleading) whilst radiating crystalline crusts may signify faster growth. Alternations of micrite and crusts may be the result of changes from biological to non-biological precipitation. Nanofibres appear to represent decayed fungal hyphae.

C^{14} dating of some deposits has enabled correlation with Late Quaternary climatic changes and hence with terrace sequences, spring lines and former water-tables. One contribution noted the phosphorus contribution to tufas as being up to 19%.

The book is liberally illustrated with diagrams and micro-photographs of organisms and textures.

Together the collected papers illustrate a wide range of depositional processes, many a combination of biological and physical interactions. Over time, small variations in water chemistry and biota are proxies to changes in micro-environmental conditions. As the editors conclude *"The next step in this Geobiology research domain is to resolve the dynamic choreography between the subaerial and subterranean karst players"*. The editors are to be congratulated for bringing this complex subject before us.

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Two new papers on glaciations and speleogenesis in the Yorkshire Dales

Anticipating new insights into the Yorkshire Dales and their caves is like waiting for a bus: no sooner does one paper come along, it is then followed rapidly by another. Lundberg *et al*. (2010) is possibly the most important paper yet written about the later Quaternary Period of the Yorkshire Dales. It assimilates information from antiquarian and later studies at Victoria Cave with 23 new TIMS U-Th datings to reveal the succession of glacial – interglacial cycles that the cave has experienced. Interglacials MIS13, 11, 9, 7 and 5e are represented by speleothem, with faunal bone present especially at MIS5e. The extensive glaciations MIS12, 10, 6 and 2 are represented by varve-like sterile brown clay couplet laminations, presumed to have been deposited within Subglacial Lakes when the cave was flooded at glacial maxima under warm-based conditions. Clay deposits were absent at MIS8, although this glaciation is represented by a dirt-lined hiatus within speleothem that grew from MIS9–7. This suggests that the MIS8 icesheet was thinner than the others at Victoria Cave, and therefore either cold-based there, or it did not reach the cave's elevation, which remained frozen in periglacial conditions. The oldest speleothem and its underlying mud sediment is older than 600ka (i.e. probably older than MIS15: 621–565ka). This tells us that the cave has been mostly relict since the later Cromerian glaciations (which might have opened the entrance) and can only have been part of an interglacial phreatic flow route at MIS17 (689–659ka) or earlier. The absence of large mammals during various warm periods is interpreted to show that the entrance was sporadically blocked by screes. This evidence corroborates suggestions by Rose (2009) that the milder MIS8 glaciation probably did not reach East Anglia and that a glaciation at MIS16 may have been comparable in extent to that of MIS12.

Waltham *et al.* (2010) review all the previous U-series datings of stalagmites in the caves of the glacial valley of Kingsdale (many being published in *Cave and Karst Science* or a predecessor) together with the geomorphological evidence of the last (Devensian) glaciation and deglaciation and the new findings of speleothem below water level in the Marble Steps Branch of Keld Head (Cordingley, 2010). The paper is beautifully illustrated with photographs and diagrams that enable the caves to be seen in plan and profile in association with surface features and adjacent valleys. The oldest dated stalagmites are at relatively high levels, in Dale Barn Cave (343.4 +86.0/-47.7ka: probably MIS9) and in the Roof Tunnel of Valley Entrance (324 ±>100ka: also probably MIS9). A scenario is proposed that suggests that higher cave passages were formed earlier and then eroded away by subsequent glaciations. The main development of the U-shaped morphology of Kingsdale is assumed to have occurred during the Anglian glaciation (MIS12: 460–423ka), which truncated the Roof Tunnel passage. Hydraulic flows draining the Kingsdale Master Cave system to lower valleys at Easegill to the west and Chapel-le-Dale to the east are postulated prior to MIS9. Wolstonian glaciations (MIS10–6: 362–128ka) then truncated the Keld Head resurgence passage, although, as found at Victoria Cave, continuing stalagmite growths in other Yorkshire caves hint that the MIS8 glaciation was less severe, as supported by other European evidence and oxygen isotope records. The Devensian glaciation (MIS5d–2: 115–11.7ka) appears to have lowered the bedrock floor of the valley at Keld Head by only 9m. Finally, a scheme is devised to explain the creation of the Thornton Force waterfall and the late Devensian deglacial development at the Raven Ray moraine that nearly blocks the end of the valley, although other interpretations are possible.

These papers make a significant step forward in informing us about the glacial evolution of the Dales and the speleogenesis of some of the caves, so that the future achievement of a comprehensive picture of glacial processes and speleogenesis across all the Yorkshire Dales can now be glimpsed. Both papers acknowledge BCRA as supporting this research through the provision of funds for dating via the Cave Science and Technology Research Initiative (CSTRI). A slight regret is that Lundberg *et al*. (2010) have published in an electronic journal, which is available by subscription, but is unlikely to be found in libraries. Victoria Cave and Kingsdale will be sites to be visited during a Field Meeting in June 2012, which is being planned jointly by BCRA and the Quaternary Research Association.

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