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EXCAVATIONS AT CATHOLE CAVE, GOWER, SWANSEA

by

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ABSTRACT

The discovery of an engraving in Cathole Cave in 2010 led to a decision to grille the cave. In 2012 excavations took place in the cave ahead of the grilling. Two areas of the cave were excavated; Trench A demonstrating that the cave held a faunal occupation dating to MIS 3, at a time, or times, between 50,000 and 30,000 BP. Two flint blades of Upper Palaeolithic appearance were discovered along with a faunal assemblage from within the shallow deposits across the line of the grille. The work demonstrated that the earlier excavations in the cave by Col. E.R. Wood were extensive and at this point in the cave he excavated to bedrock. The standing section (Area B) which he left exposed further along the main cave passage was also cleaned, recorded and sampled. The deposits contain a faunal assemblage dominated by microfauna, but no cultural artefacts were found. The dating of key animal bones, the analysis of the microfauna and the sedimentological analysis have together enabled a picture to be developed of the changes in this section from the mid-Devensian to Late Glacial and Holocene.

INTRODUCTION

Cathole Cave is located in an inland dry valley, Green Cwm, Gower, Swansea, (NGR: SS 53764 90011; Figure 1). The cave lies in a fractured and weathered limestone cliff above the valley in which the Neolithic Severn Cotswold tomb of Parc le Breos Cwm is sited. Cathole Cave became the focus of recent research following the discovery of a ‘deer-like’ motif engraved in a recess at the rear of the cave by George Nash and a team in 2010 (Nash *et al*. 2012). The cave was subsequently surveyed using 3D laser scanning and traditional surveying techniques (Nash and Beardsley, 2013). Following this work and the subsequent vandalism of the engraving it was decided that the remaining deposits within the cave needed to be protected by grilling the inner section of the cave. To achieve this it was necessary to excavate a slot across the cave width at a predetermined point within the cave into which a metal grille could be bolted into bedrock. In June–July 2012 a narrow trench was placed across the main cave passage in the position deemed to afford best protection to the archaeology and bats whilst still providing some access to visitors. The opportunity was also taken to record and to sample the cave’s standing section left by earlier excavation activity in the main cave passage and to assess the potential for the survival of *in situ* deposit further into the cave. The results of this work are presented here.

ARCHAEOLOGICAL BACKGROUND

Cathole Cave, Gower, was first excavated *c*. 1864 by Colonel E.R. Wood of Stout Hall, Reynoldston, Gower. The finds from his work mostly entered the collections of the Natural History Museum, London (Roberts, 1888, 18). Some additional specimens have been found in the collections of Swansea Museum and that of the former Cardiff Museum, the latter now in the Department of Natural Sciences, National Museum Wales. Wood did not publish his

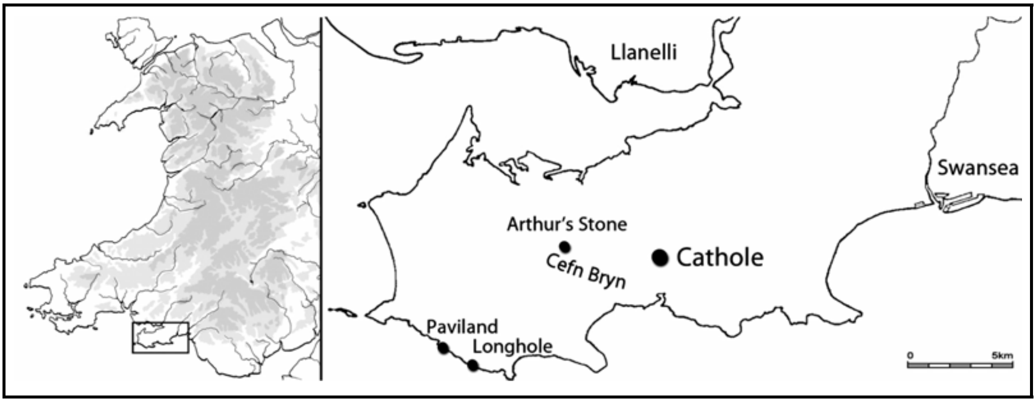

Figure 1. *The location of Cathole Cave, Gower and the relative position of Cefn Bryn and Arthur's Stone, Gower, Swansea*

work and most other researchers at the time also do not appear to have been aware of his activities; the only publication being a short note published at the end of Lubbock's report about discoveries at the tomb at Parc le Breos Cwm (Vivian, 1887). A copy of Vivian's report was expanded upon in a paper John Roberts read to the Swansea Scientific Society July 16, 1887 (Roberts, 1888). Roberts' note indicates that an abundant Pleistocene mammal assemblage was recovered from the cave that included lion, cat, bear, cave hyaena, red fox, mammoth, woolly rhinoceros, horse, reindeer, giant deer, red deer and voles. There are also records of later domesticated animal species including pig, sheep, and goat, a stone hammer, bronze axe, pottery sherds and worked flint implements. Two human skulls and some skeletal elements were also reportedly found near the surface. The find spots of these are sketched on a plan published by Vivian (1887, 200). Garrod (1926, 65) identified a *Font Robert* point, or tanged point, a tool form now attributed to the early Gravettian and dated to around 28,000 BP amongst the lithic artefacts (Jacobi and Higham, 2011a, 210). She also recorded a Cheddar point, a burin and some end-scrapers (Garrod, 1926, 65–66). These latter tools are now generally attributed to the earlier part of the Late Upper Palaeolithic period in Britain at a time shortly after 12,600 BP (Jacobi and Higham, 2011b, 229). Wood's work appears to have been extensive, as standing sections of cave deposit close to a metre in height inside the cave demonstrate.

Professor Charles McBurney undertook excavations at Cathole Cave in 1958 and 1959. He opened up trenches of four feet (1.2 m) square on a grid on the platform just outside today's cave entrance. His few published drawings show that his excavations were of approximately 1.70 m in depth at their southern end. He recorded a stratigraphy comprising Wood's spoil-heap, a later prehistoric horizon that included some human remains and some Bronze Age potsherds, a fine grained layer (C) that blurred into a layer of yellowish thermoclastic scree (B). The 280 lithic artefacts he found came from layer B and the blurred interface of layers B/C. Beneath this layer was silt that overlay bedrock. His preliminary interpretation of the lithic finds was that they represented a Late Upper Palaeolithic assemblage amongst which he found parallels with Gough's Cave, Cheddar, Somerset and caves at Creswell Crags, Derbyshire. He also recognised a Mesolithic aspect to the assemblage. His faunal list comprises reindeer, red deer, horse, rhinoceros, bovid, sheep, roe deer, brown bear, arctic fox, arctic hare, badger and northern lemming (McBurney 1959). The excavation notes, photographs and all finds from this largely unpublished work are in the collection of the National Museum Wales (NMW acc. nos. 74.35H; 80.55H and 83.99H).

In 1968 a research student of McBurney's, John Campbell, included Cathole Cave amongst a number of sites he reinvestigated. He opened up two trenches with the goal of retrieving well-stratified material for dating (Campbell, 1977). One trench was placed just outside the south-western entrance to the cave which uncovered nothing but two worked flint flakes in the topsoil and a sequence of weathered deposits above thermoclastic scree, overlying silty sand on bedrock. He also extended McBurney's original trench to the south. Here he identified the layers recorded by McBurney and refined their definitions through an analysis of the sediments. He was able to make a clearer distinction between McBurney's layers B and C with a clearer vertical separation of the layer containing Mesolithic artefacts and that with Late Upper Palaeolithic artefacts. Campbell undertook pollen analysis of the sediments and generated a number of detailed reports based on a re-interpretation of McBurney's work and his own (Campbell, 1977). He also published a plan showing the locations of McBurney's and his excavation trenches (Campbell, 1977, vol. 2, figure 15, 165). The archive from Campbell's work is deposited in the National Museum of Wales (NMW acc. no. 2007.48H).

In September 2010, Dr George Nash from the University of Bristol along with students and members of the Clifton Antiquarian Club, discovered an engraved 'deer-like' motif hidden in the recesses of the cave. A research team from The Open University extracted four samples for uranium series disequilibrium dating. One sample was taken from the surface on which the engraving is placed and two from younger speleothem deposits which partly cover the engraving. One sample, close to the nose of the carving gave a preliminary age of 12,572 ± 660 BP (GN-10 GHS2; Nash *et al*. 2011). A further date obtained from flowstone to the left of the engraved muzzle provided a result of 14,505 ± 560 BP (CAT 11#4; Nash, 2012, 113). Part of this engraving was subsequently vandalised late August or early September 2011. During 2011 the first full detailed survey of the cave, including a 3D laser survey, was undertaken (Nash and Beardsley, 2013).

THE 2012 EXCAVATIONS

Following the vandalism of the rock art representatives from Cadw and the landowner, Natural Resources Wales, deemed it necessary to grille the cave to exclude visitors from entering the rear chamber and cave passages. The lead-author (EAW) was invited to draw up a project design to undertake the necessary archaeological investigations ahead of the fitting of a steel grille across the main cave passage. Funding for the archaeological investigation was provided by Cadw grants and by Amgueddfa Cymru – National Museum Wales; the grille was paid for by Natural Resources Wales.

The primary purpose of the excavation was to facilitate the erection of a grille within the cave. To achieve this it was necessary to remove deposits that lay along the line of the proposed metal grille in a careful and controlled manner through the excavation of a slot trench (Trench A) across the entire width of the cave location to bedrock. The intention was to record a full section across the cave in order to seek to understand and to interpret any surviving deposits and to obtain further environmental, dating, sedimentological data and artefactual samples for future detailed laboratory analysis.

The opportunity was also taken to clean up a 50 cm wide strip of deposit through the standing section in the main cave passage left exposed following Wood's excavations (Area B). This was the first time that full recording and sampling for environmental and sedimentological analysis of this section had been undertaken and was aimed at obtaining a better understanding of the surviving deposits within the cave (Figure 2).

Methodology:

The location of Trench A was chosen to afford both archaeology and bats the best protection, whilst still giving visitors an opportunity to enter the cave entrance. A slot trench of 75 cm width which ran the full width of the cave was excavated (Figure 3). This trench was excavated to bedrock, recording and removing all *in situ* deposits by metre square, by context and by spit. All finds were 3D recorded into the site grid using a total station instrument. All potential and all *in situ* deposit was roughly wet-sieved through 10 mm and 1 mm mesh sieves either on site or later by Cardiff University students at St Fagans, National History Museum. All sieve residues were bagged and re-washed through a 0.5 mm sieve in the Museum laboratory before being hand-picked.

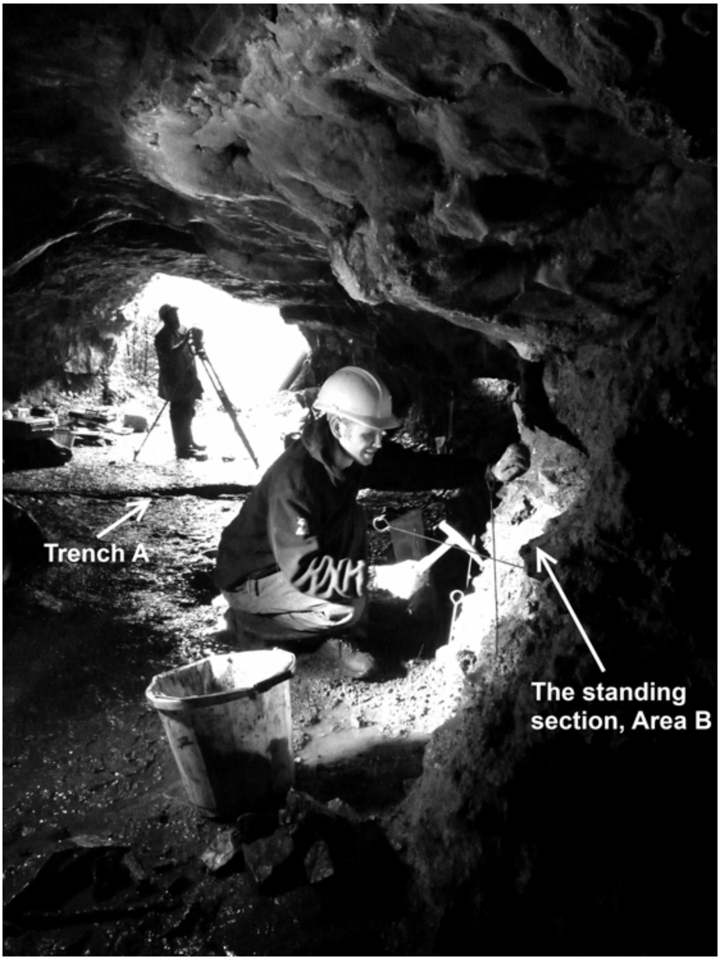

Figure 2. *The location of 2012 excavation areas within Cathole Cave. View looking out of main cave entrance to the south-west.*

Area B was a 50 cm wide area of the standing section which was given an initial surface clean, was recorded and then cleaned back further whilst being bagged by context and spit before the section was re-recorded (Figure 3). Every individual bone fragment removed was 3D plotted using the total station. All sediment was sub-sampled before all remaining samples were wet-sieved in the Museum laboratory through a 1 mm mesh sieve and hand-picked.

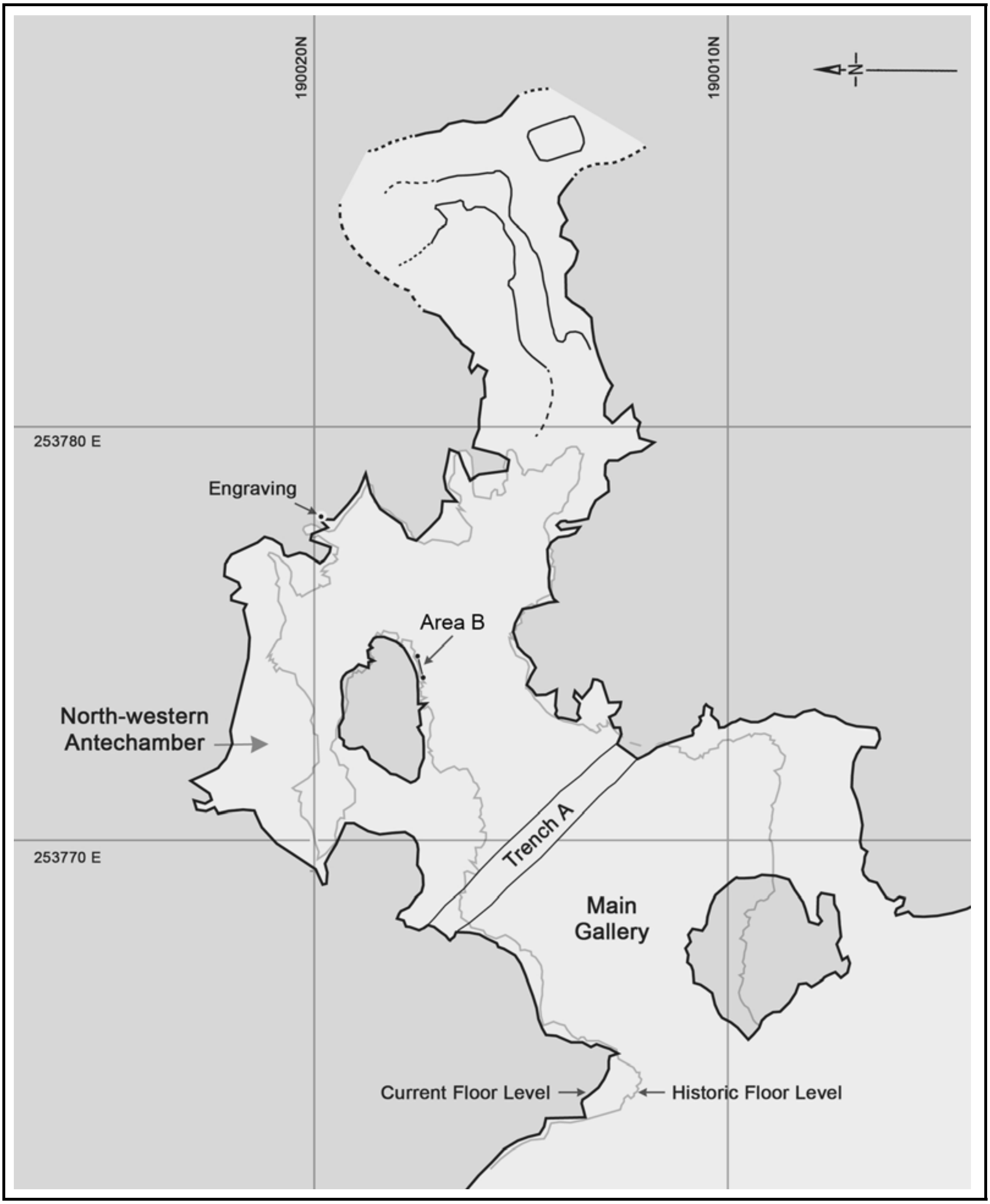

Figure 3. *Composite plan of the cave.*
Incorporating data from Nash and Beardsley (2013).

During the field season the cave walls were scanned systematically for any further rock art or bear claw scratches by George Nash. On-site surveying was undertaken by Neil Phillips, A.P.A.C. Ltd. Two temporary survey points were created within the cave for use during excavation. A fixed point, one of those used for the 3D survey undertaken prior to the project, was identified amongst the fallen limestone blocks outside the cave entrance and was used as a permanent point. In addition two further survey points were created in order to enable the on-site survey to be located into the National Ordnance Survey Grid and these were used to link the 3D laser survey and the field season surveys together.

Trench A:

The excavation of Trench A identified three contexts; Figure 4 shows the full section across the trench:

Layer 1 was a modern layer containing modern glass, plastic, recent humic material and charcoal. The depth of this layer varied across the trench. In places it lay directly on bedrock whereas in others it overlay a second layer.

Layer 2 was a reddish-brown silty deposit with abundant angular limestone clasts. This layer was very thin at the south-eastern end of the trench, but thicker at the north-western end. In places it was just found in crevices in the bedrock beneath the modern layer 1. Modern material was mixed in with this layer, and glass and copper alloy wire were identified during its excavation indicating that it is a mixed context. All of layer 2 was wet-sieved.

Layer 3 was only present at the north-western end of the trench. A deep crevice in the bedrock resulted in a good depth of this deposit at this point. This deposit is described as a reddish-brown silty deposit in which there are fewer limestone clasts than in layer 2 above. The boundary between the two layers was indistinct in parts of the trench. One flint blade was found at the base of the layer. During excavation it was thought that this was *in situ*, although this has since been found not to be the case. All the deposit from this context was wet-sieved.

Bedrock was reached at a variable depth across the trench. At its deepest this was 60 cm from present-day ground surface.

Area B, the standing section:

The recording of the standing section was intended to provide a record of the full stratigraphic sequence through the deposits removed by Wood during the 1860s. The surface was given an initial robust clean to remove surface flowstone and to identify the stratigraphy beneath. An initial series of context layers were attributed visually during recording of the section. These layers were later discussed in detail with Dr David Case, who modified some, provided context descriptions and undertook sampling (Figure 5). All large bone fragments discovered during the limited cleaning of this section were individually bagged and their positions 3D recorded.

STRATIGRAPHY AND SEDIMENTOLOGY OF THE CAVE FILL DEPOSITS
(Richard Mourne and David Case)

The June-July 2012 archaeological excavations undertaken at Cathole Cave provided an opportunity to log and sample the exposed cave sediments. The main aim of the investigation was to describe and characterise selected sediment units in terms of clast and fines particle size, clast lithology, clast shape and clast surface weathering, organic and carbonate content; and to interpret the data in order to elucidate provenance and sedimentary environment.

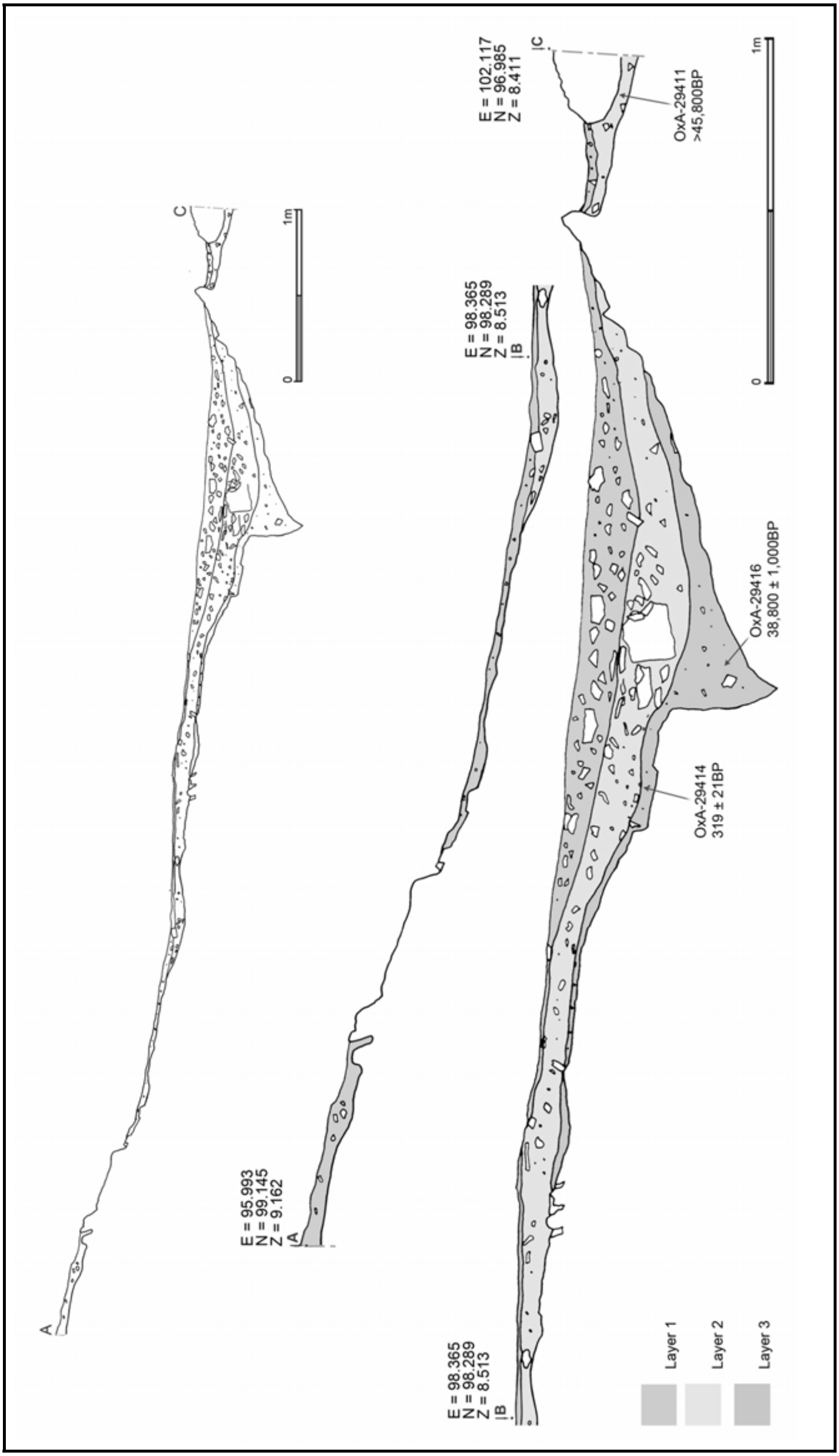

Figure 4. *North-east facing section through Trench A.*

Geomorphological context:

Cathole Cave cuts into the north-east side of a north-west to south-east aligned dry valley cut into Carboniferous Limestone. The valley, Green Cwm, has steep slopes and a flat bottom, characteristic of a melt water channel. The valley, and its one major tributary, source in low land (~70 m OD) to the north of Cefn Bryn, a significant upland ridge cresting at between 150 m and 186 m OD, founded on Devonian sandstone, running north-west to south-east across west Gower (Figure 1). At Parkmill, Green Cwm joins Ilston Cwm, draining through to the sea at Three Cliffs Bay via Pennard Pill, a relatively steep-sided, deep valley that cuts southwards through the eastern end of Cefn Bryn, the alignment of Pennard Pill coinciding with a fault in the Black Rock Limestone.

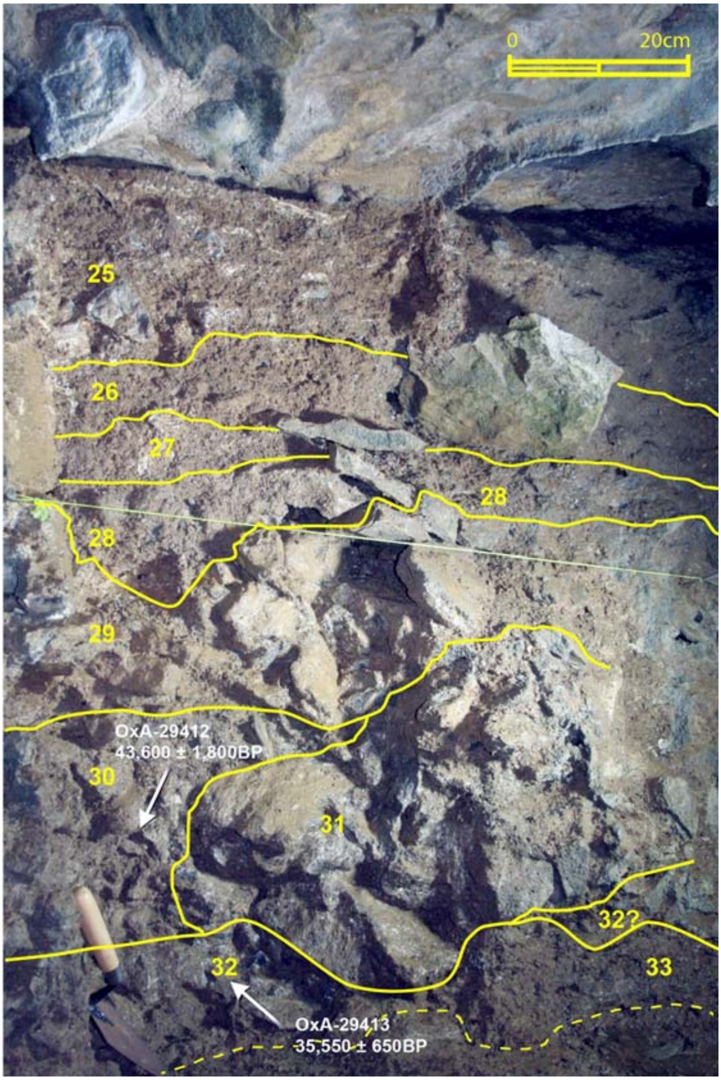

Figure 5. *Area B section. View looking north.*

The age of the valley is indeterminate. It has the geomorphological characteristics of a melt water channel, which could have developed under more than one episode of glaciation. There is evidence for ice sheets overrunning Gower during Marine Isotope Stages (MIS) 16 and 12 (~620,000 BP and ~430,000 BP) (Bowen, 1989; Bowen *et al.* 2000). During the final stages of the last glaciation, the Devensian (MIS 2) the Devensian Last Glacial Maximum limit in this area was controlled by Cefn Bryn, there being no evidence of ice overtopping the ridge at this time (Figure 6). A ^{36}Cl age from the giant erratic boulder of Arthur's Stone dates the Last Glacial Maximum on Gower at 23,272 BP. (Bowen *et al.* 2002). Much of the valley would have been under ice, the current valley form being the product initially of sub-glacial and subsequently extra glacial melt water erosion. The valley would therefore have been a conduit for pre-Devensian relict sediments, and Devensian sediments brought by the ice and melt water, as well as locally derived post ice Late Devensian periglacial and Holocene deposits.

Cave fill sediment sources:

There are six main sources of sediment which could have contributed to the sediments in the caves, including deposits from three glaciations (Bowen, 1999; Bowen *et al.* 2000, Mourne *et al.* 2000).

Carboniferous Limestone is exposed in the immediate valley sides. Frost shattering of exposed limestone under periglacial conditions would have generated angular limestone gravels which moved downslope throughout the Devensian, as described by Bowen (1973), contributing to the Pennard Formation (Bowen, 1999). The main limestone formations into which Green Cwm has cut are: Black Rock Limestone, High Tor Limestone, Gully Oolite (locally dolomitised) and Oxwich Head Limestone.

Triassic rocks are mapped by the British Geological Survey as an outlier at Port Eynon, and as a gash-breccia at Mewslade. Ubiquitous pockets of Triassic Marl occur on the plateau surface (*pers. comm.* T.N. George to D.Q. Bowen). These red marls and their weathered residues contribute to the colluvial basal layer of the Slade Member (Marine Isotope Stages 4/5b, d) (Case, 1993; Bowen, 1999). They could potentially contribute to cave earth deposits and the matrices of clast rich cave sediments.

The earliest glaciation recorded in the area (MIS 16) (Bowen *et al.* 2000) deposited till of Irish Sea and Central Welsh provenance on Gower (Bowen, 1970; Campbell and Bowen, 1989). This 'Mixed Drift' may indicate 'a re-advance of Welsh Ice subsequent to local deglaciation of the Irish Sea ice sheet' (Bowen, 1973) and was subsequently reworked by interglacial seas and incorporated into the MIS 7 and 5e beaches.

The Llandewi Formation (Bowen, 1999) represents the glaciation of Gower by Welsh ice from the north (MIS 12). The Paviland Moraine which occupies the plateau surface to the south of Cefn Bryn marks a stillstand during retreat (Bowen *et al.* 2000). The evolution of the Slades along the south-west coast of Gower has dissected the plateau and led to a release of drift material through the Slades and onto the beach platform, as described at Western and Eastern Slade (Bowen, 1977). It would not be unreasonable to assume that Green Cwm existed at this time along with its seaward extension, Pennard Pill channelling sediments in the same way as the coastal Slades. The Llandewi Formation would therefore have the potential to contribute directly to cave sediment fill, its composition being represented by Millstone Grit (Namurian) quartzites, conglomeritic quartzites, quartz sand, Coal Measure sandstone and shale fragments and minor quantities of coal, flint, basalt and rhyolite (Bowen, 1999; Bowen *et al.* 2000).

The Brecknockshire Formation (Bowen, 1999) represents glaciation by Welsh ice during MIS 2, the Devensian. The ice limit reached the coast in East Gower at Langland Bay where the stratotype for the Formation crops out on the east side of the bay. The source area for the ice was the slopes of Fforest Fawr, the Cynon, Nedd and Tawe valleys. The drift is characterised by Upper Palaeozoic erratics of Millstone Grit, Carboniferous Limestone, and particularly Devonian Old Red Sandstone. In West Gower the ice limit was held against the north side of Cefn Bryn.

In addition, post Last Glacial Maximum periglacial conditions potentially contributed locally derived limestone breccia, colluvium and loess (Case, 1993).

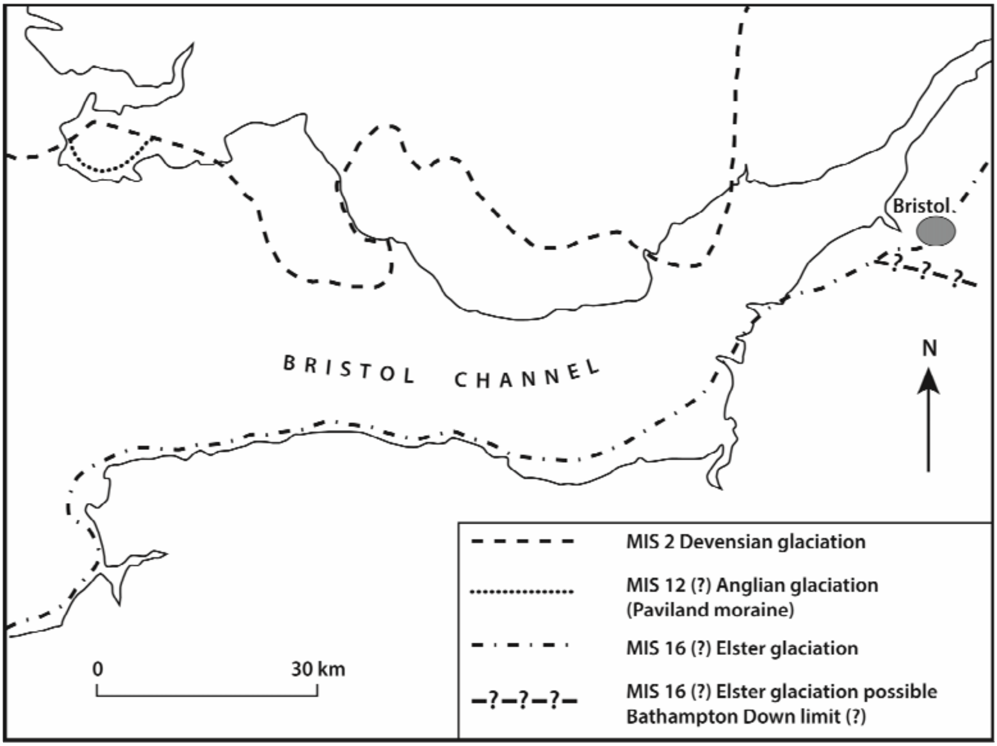

Figure 6. *Ice limits in the Bristol region and the Bristol Channel.*
After Bowen *et al.* 1986; Campbell *et al.* 1998; Bowen 2005.

The Pennard Formation is coextensive with marine deposits (MIS 7 and 5e) and overlying colluvial and periglacial deposits (MIS 5d to 2) that form the coastal drift terraces of south and south-west Wales. Members of this Formation of possible significance to Cathole Cave are:

- *The Slade Member* (Bowen, 1999) includes limestone breccia, diamict containing glacial erratics, and relict soil material moved downslope by colluvial processes onto the beach platform (Ball, 1960; Bowen, 1970; Case, 1993). This material contributes to the red fine grained basal layer of the Slade Member as well as the matrix of the clast rich facies of the Slade Member and the Pennard Formation. It could potentially contribute to cave earths and the matrices of clast dominated cave deposits.
- *The Rhossili Member* (Bowen, 1999) comprises head derived from the Devonian rocks of Rhossili Down, the equivalent of which could have accumulated at the base of Cefn Bryn.
- *The Horton Member* (Bowen, 1999) comprises Middle to Late Devensian loess which contributes to the matrices of the Pennard Formation gravels, and forms a discrete Late Devensian (post Last Glacial Maximum) layer capping many of the coastal drift terraces and limestone plateaux.

Sediment analysis:

Sedimentary units were identified and recorded through excavation. Figure 5 shows the Area B (standing section) excavation. The major units were sampled and analysed in terms of clast and fines particle size, clast lithology, clast shape and clast surface weathering, organic and carbonate content. The nature of the exposure, and the degree of induration of the units resulted in small sample sizes, smaller than the 10+ kg sample sizes (~300 clasts) recommended for lithological analysis by Bridgland (1986).

Particle size: sample was subdivided into the following size ranges by sieving; <1 mm (fines); 1 to 2 mm, 2 to 4 mm, 4 to 6.7 mm, 6.7 to 14 mm, and >14 mm. Clasts greater in size than 14 mm were examined but the physical size of the sample was not great enough for the characteristics of these larger size fractions to be representative of the materials sampled.

Fines particle size analysis was determined from a subsample of material smaller than 1 mm which was gently disaggregated with a rubber pestle prior to the addition of 100 ml of 4% calgon solution to deflocculate the clay/silt fraction. The sample was occasionally stirred before being put through a Malvern Mastersizer (Laser particle size instrument).

Clast lithology: Each clast >4 mm has been examined. It was not always possible to identify the lithology of each individual clast, especially for the smaller size fractions. However, the following lithologies have been identified in the erratic (non-carbonate) component: sandstone, ironstone, flint, vein quartz, and an igneous clast (possibly dolerite).

Clast shape: The Powers visual comparison chart has been used in describing clast shape (Powers 1953). Six classes of roundness/angularity are represented on this chart: very angular, angular, sub-angular, sub-rounded, rounded, well-rounded.

Condition of clasts: A scheme for describing the weathering of limestone clasts has been used which identifies five degrees of alteration/corrosion (Al):

1. weak	little or no alteration, fresh
2. weak-moderate	lightly corroded, discoloured
3. moderate	tiny perforations, whitish surface
4. moderate-extreme	very perforated, ‘powdery’ surface
5. extreme	very rotted, broken shell, core exposed, friable

Organic matter and carbonate content: Loss on ignition at 550°C and 950°C was used to determine organic matter (O.M.) and equivalent carbonate ($CaCO_3$) content as percentage by weight according to the procedure of Heiri *et al*. (2001).

Field and Laboratory Description of Sediments

In the laboratory analysis ‘fine gravel’ refers to clasts 4–14 mm in size, ‘coarse gravel’ refers to clasts greater than 14 mm in size. The c:f ratio refers to the weight of the 14–1 mm fraction to the weight of the fines fraction (<1 μm AI refers to the degree of corrosion/alteration. Full loss on ignition (O.M. content and $CaCO_3$ content) data are lodged in the site archive.

Trench A.

Layer 3.

No field description.

Lab analysis: c:f = 0.20. Coarse gravel fraction dominated by angular and sub-angular limestone (AI2). Fine gravel mostly secondary carbonate and limestone, and erratics (4%)

comprising ironstone and one flint clast, 11% bone fragments. Fines are silt dominated, median grain size 21.7 µm. Organic matter LOI = 6.4%, $CaCO_3$ LOI = 5.1%. As this section is now regarded as disturbed it will be given no further sedimentological consideration.

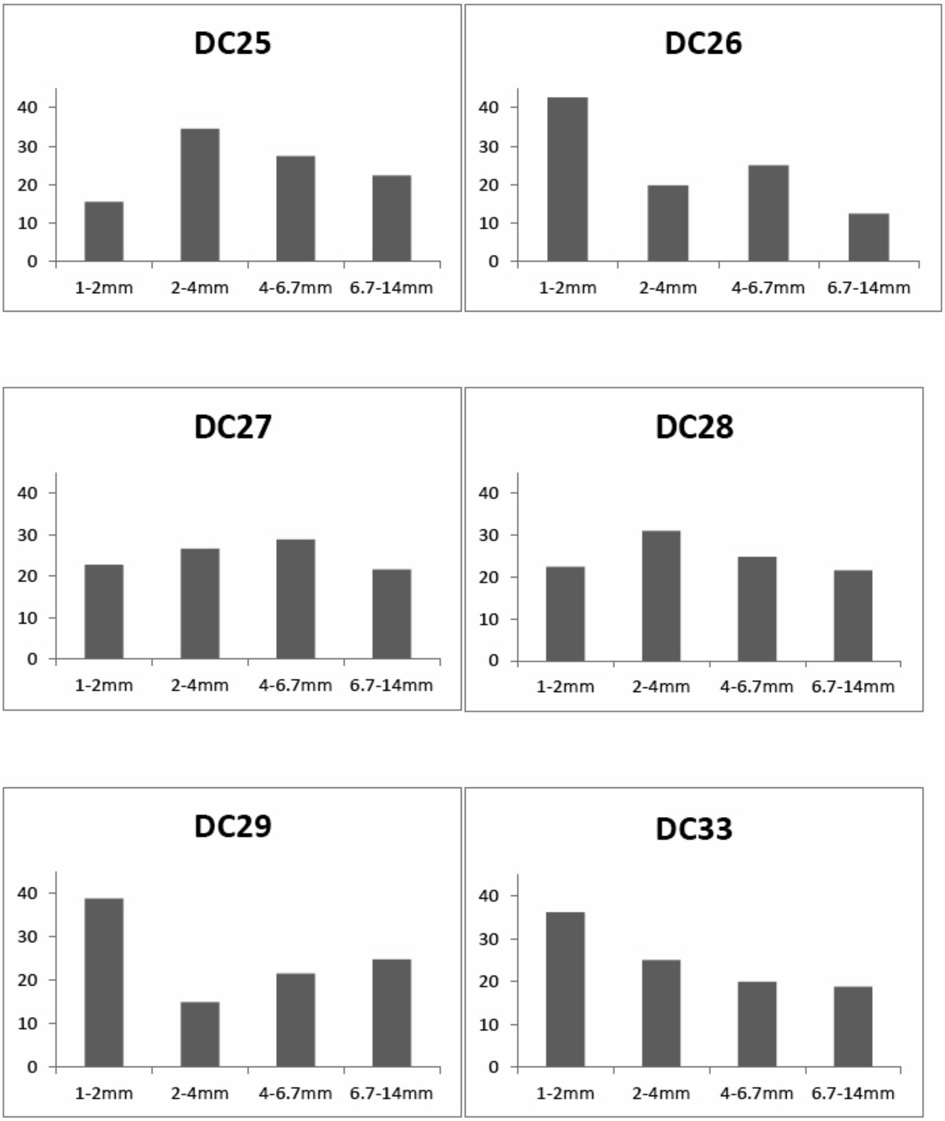

Figure 7. *Area B clast particle size (% by weight; 1–14mm).*

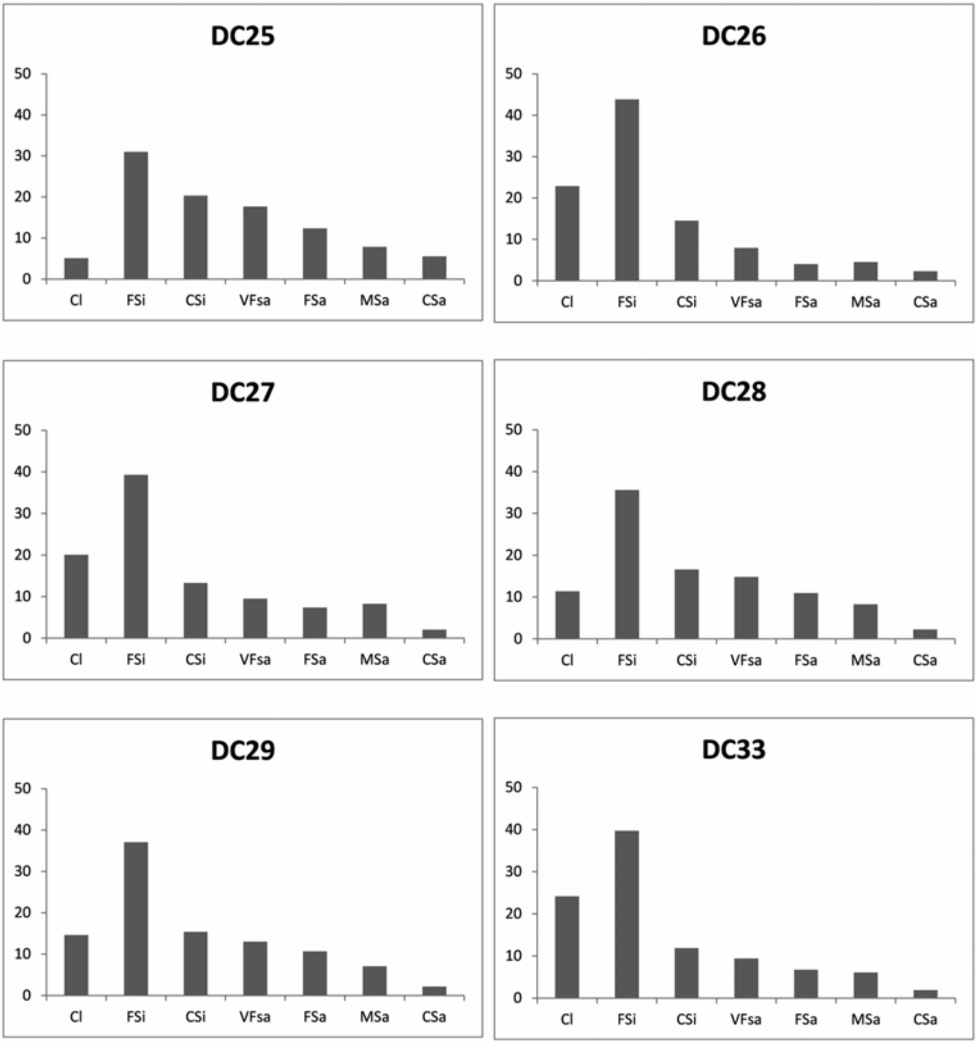

Figure 8. *Area B fines particle size (% by volume; <1mm). Cl = Clay (0–3.9µm); FSi = Fine Silt (3.91–31µm); CSi = Coarse Silt (31–62.5µm); VFSa = Very Fine Sand (62.5–125µm); Fsa = Fine Sand (125–250µm); MSa = Medium sand (250–500µm); CSa = Coarse Sand (500–1,000µm).*

Area B (standing section, Figure 5).

Layer 25 (Figures 7 and 8).

Red brown silty clay with sand and grit. c:f = 0.42. Coarse gravel fraction has two clasts heavily coated with 'honeycomb' secondary carbonate (one angular limestone, one angular erratic). Fine gravel mostly angular limestone/secondary carbonate, with a few small rounded gravel clasts up to 1 cm, and erratics (10%) comprising one sandstone and one vein quartz clast. Indurated with $CaCO_3$, with clear white/grey layers enriched with stal. The stal. layers indicate bedding with an apparent dip at 10º towards the mouth of the cave (242º) with a further low dip vector (not measurable) towards the north. It was not possible to measure the true dip, but this would be somewhere in the direction of 320º with a dip of 10º+. Fines are silt and very fine sand dominated, median grain size 49.9µm. Organic matter LOI = 9.4%, $CaCO_3$ LOI = 1.0%.

Layer26 (Figures 7 and 8).

Red brown silty clay with sand and grit. c:f = 0.25. Coarse gravel fraction comprises 4 angular limestone clasts (AI2) with 'honeycomb' secondary carbonate coatings and three secondary carbonate concretions (could be corroded stal./tufa?). Fine gravel is mostly angular limestone (AI2) and secondary carbonate clasts, and erratics (10%) comprising sandstone, ironstone and an igneous clast, possibly dolerite. Slightly indurated with $CaCO_3$. Fines are fine silt and clay dominated, median grain size 14.7µm. Organic matter LOI = 4.8%, $CaCO_3$ LOI = 4.6%. Diffuse boundary with layer 25.

*Layer 27 (Figures 7 and 8)***.**

Matrix rich gravel. c:f = 0.25. Angular, limestone 'flags' up to 170 cm, and angular blocky limestone clasts up to 70 cm (AI2), with honeycomb secondary carbonate coatings, and one secondary carbonate concretion. Limestone 'flags' show some alignment with the long axis of the cave, with a slight dip to the north, but accurate fabric measurements are not possible due to the slight induration making it impossible to loosen and remove clasts. Fine gravel dominated by secondary carbonate concretions with limestone clasts, and erratics (6%) comprising sandstone and ironstone. Matrix fine silt and clay dominated, median grain size 19.4 µm, slightly indurated with $CaCO_3$. Organic matter LOI = 4.8%, $CaCO_3$ LOI = 4.6%. Diffuse boundary with layer 26 where there is only matrix, clear boundary where clasts present.

Layer 28 (Figures 7 and 8).

Matrix rich gravel. c:f = 0.51. Coarse gravel fraction comprises 2 sub angular limestone clasts (AI2), with secondary carbonate coatings. Fine gravel dominated by secondary carbonate concretions and limestone (most AI2, some AI3), and erratics (9%) comprising sandstone. Fines are silt and fine sand dominated, median grain size 35.2 µm. Organic matter LOI = 6.3%, $CaCO_3$ LOI = 4.7%.

Layer 29 (Figures 7 and 8).

Limestone gravel. c:f = 0.43. Coarse gravel fraction comprises angular limestone clasts up to 160 cm long axis (AI1/2), with secondary carbonate coatings. 1 erratic clast. Fine gravel dominated by secondary carbonate concretions with occasional limestone (AI2), and erratics (3%) comprising sandstone. Some rounded stal. fragments. Slight clast alignment with long axis of the cave, but induration prevents fabric measurement. Very little matrix, which is a yellow brown silty clay with sand and grit, median grain size 28.9 µm. Clear boundary with layer 28. Organic matter LOI = 8.9%, $CaCO_3$ LOI = 5.9%.

Layer 30.

Limestone gravel. Angular clasts up to 6 cm, most around 4 cm. No clear alignment, or bedding. Little matrix. Very indurated with $CaCO_3$, cannot be sampled. Clear boundary with layer 29.

Layer 31.

Limestone gravel. Clasts up to 160 cm+, Most are 'flag' shaped broken stal. relicts. Very little matrix. Very indurated with $CaCO_3$, cannot be sampled. Clear lateral boundary with layer 30, unclear boundary with layer 29.

Layer 32.

Limestone gravel. Rounded, odd angular, clasts up to 80 cm. Appears to be mainly stal. material. Very little matrix. Very indurated with $CaCO_3$, cannot be sampled. Clear boundary with layers 30 and 31.

Layer 33 (Figures 7 and 8).

Red brown silty clay with sand and grit. c:f = 0.34. Some fine rounded gravel up to 1 cm. Fine gravel dominated by limestone (AI2) and secondary carbonate, with erratics (25%) comprising sandstone. Coarse gravel fraction comprises angular to sub rounded limestone clasts

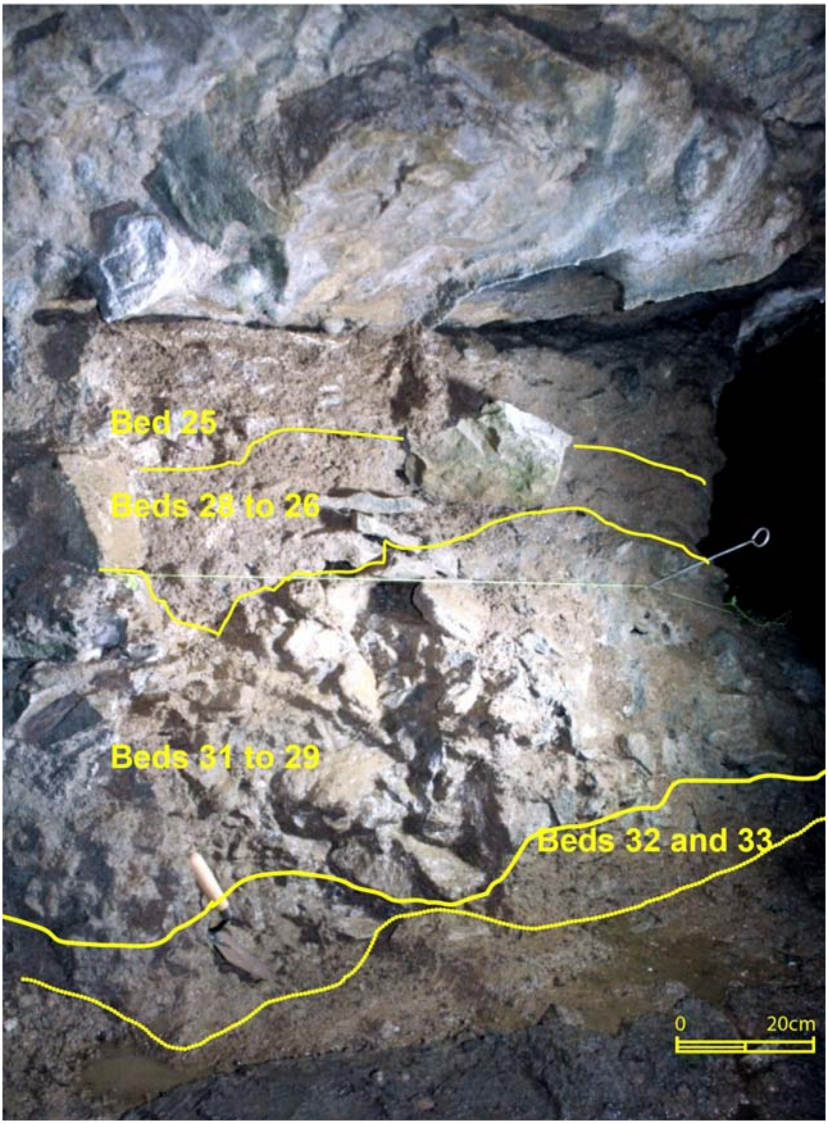

Figure 9. *Sub-division of the Area B section layers into sedimentologically similar groupings. View looking north.*

(AI2), clasts lack the heavy secondary carbonate coating of units above. The coarse gravel includes erratics (8%) comprising sandstone. Fines are fine silt and clay dominated, median grain size 14.7 μm. Organic matter LOI = 9.2%, $CaCO_3$ LOI = 5.0%. Some fragments of stal./tufa, but not indurated. Clear boundary with layer 32.

Interpretation and Conclusions

The interpretation is confined to Area B (standing section) due to the disturbed nature of Trench A layer 3. The recorded and sampled layers (Figure 5) are grouped into four sedimentological units for the purpose of interpretation as shown in Figure 9.

Layers 33 and 32 are predominantly fine grained sediments with a low clast content. The clasts that are present comprise fine rounded limestone gravel with some sandstone erratics, along with coarser angular to sub-rounded relatively fresh limestone and fragments of stal./tufa, and sandstone erratics. The sedimentology suggests the in-wash of material into the cave from a fluvial environment without, the floor of the valley with stream channel therefore having to be at or close to the level of the cave fill, as well as colluvial processes operating on the valley slopes mobilising soil material. The limestone would be sourced locally, the sandstones being derived from older drift deposits on the surrounding plateaux surfaces such as the Llandewi formation. Layer 33 has a relatively high organic matter content (9.2%) which could represent the incorporation of soil material within the in-washing sediments.

Layers 31 and 30 are characterised as gravels, but the clast content is predominantly fractured stal. material indicating a within cave provenance. Jennings (1985, 170) refers to the work of Lozek (1965) who observed layers of loose tufa in rock shelters in the Carpathians. The origin of these layers of tufa clasts were ascribed to collapse from the walls. Sedimentologically layers 31 and 30 could represent the onset of colder conditions, flowstone that had accumulated during a previous (undated) temperate episode being gradually broken under developing periglacial conditions and incorporated into finer material being washed into the cave. The geometry of layer 31 (Figure 5) suggests a sediment contribution from the collapse of the cave roof. Layer 29, an angular limestone gravel, indicates the accumulation of local frost shattered material in the cave, and therefore the probability of more severe periglacial conditions. The frost shattered material may have moved into the cave as a debris flow, or accumulated as part of a cave mouth debris cone, the latter process explaining the high organic matter content (8.9%) the movement of soil material downslope being recorded along the coast during the onset of periglacial conditions and archived in the Pennard Formation.

The Pennard Formation records a similar sedimentological-environmental change in the Gower coastal drift terraces to that between layers 33/32 and layers 31 to 29. The Slade Member comprises a basal fine unit overlain by a limestone angular gravel (breccia). The basal fine unit (Pwll Ddu Red Layers), has been interpreted as eroded pre Devensian soil developed upon and derived from the coastal limestone plateau surface, and washed downslope/cliff onto the surface of the MIS 5e (Last Interglacial) beach during the early Devensian (MIS 5d and 5b) (Case, 1993). The onset of more severe and prolonged periglacial conditions during MIS 4 resulted in the frost shattering of the local limestone and the accumulation of extensive limestone breccias on top of the basal red layers, although red layer material continued to be mobile as it contributed to the matrix of the breccia.

	Sedimentological Environment	Possible Chronology
Stage 1	Fluvial conditions within the environment of the cave at the onset of cold conditions (layers 32/33).	Early Devensian MIS 5
Stage 2	Periglacial activity with the accumulation of locally generated limestone breccias and reworked older drift (layers 31 to 29).	Middle to Late Devensian MIS 4 to 2
Stage 3	Periglacial activity with the accumulation of fines essentially derived from loess.	Post Devensian Late Glacial Maximum MIS 2
Stage 4	Temperate condition with stal. accumulation and 'soil' formation within the environment of the cave.	Holocene

Table 1. *Summary of the Area B sedimentological units by possible age.*

Layers 28 and 27 show a reduction in the accumulation of clastic material relative to an increase in fines, these layers being described as matrix rich gravels. Layer 26 is described as a silty clay with some sand and grit, with only a small number of clasts. The clasts are predominantly angular limestones, but all of the layers contain erratic sandstone, with some ironstone and an igneous clast (dolerite) in layer 26. The reduction in clasts could be due to a reduction in clast production outside the cave, the higher erratic content suggesting a reworking of older drift deposits. Alternatively the reduction in clasts could relate to the gradual blocking of the cave mouth. The fine component of layers 27 and 26 are dominated by silt and clay (Figure 8), and this would be comparable with the sedimentological characteristics of the Horton Member (loess dominated) of the Pennard Formation, suggesting that these layers were accumulating during the Late Devensian.

Layer 25 is a silty clay with sand and grit, and few clasts. What clasts are present are limestones with the odd erratic sandstone and vein quartz. The presence of white stal. enriched layers, and a relatively high organic matter content (9.36%) sets layer 25 apart from layer 26 (organic matter content 4.37%). The organic matter content could indicate soil formation in the environment of the cave suggesting a temperate environment, the Holocene. The presence of the stal. layers (flowstones?) would add further support to this interpretation, and the percolation of carbonate rich waters down through the whole sequence would have significantly contributed to the tufa within and induration of the older layers.

There are no clear hiatus within the Area B sequence. There are no obvious erosion surfaces or sharp changes in organic matter content or carbonate content between the layers. The surfaces of the limestone clasts show little sign of alteration (AI 1–2 throughout). There is a paradox between the lack of clear hiatus and a sequence which, from the suggested chronology below, could span 100,000 years. The sedimentological evidence is of a receiving site, not an erosional site so hiatus would be marked by breaks in deposition. In a sub aerial environment such breaks would be marked by evidence for weathering and soil formation, but the cave environment would not be conducive to such change. Locally, hiatus could be marked by the accumulation of fine silt and clay in pools, but there is no evidence of this within the limited Area B section.

In summary it is suggested from the sedimentology that the Area B layers can be equated with established stratigraphies around the coast of Gower, including the coastal caves (Table 1; Bowen, 1999). It is to be noted that this summary interpretation is based upon a limited section and very small sample sizes and these interpretations do not take account of the ^{14}C dates. The organic matter and $CaCO_3$ methodology also makes a number of assumptions about the changes that take place during ignition. The full clast lithology data is lodged in the site archive.

THE LITHIC ARTEFACTS
(Elizabeth A. Walker)

Five lithic artefacts, all made of flint and all pieces of knapping debitage, were discovered during the excavation. Four of these were found within Trench A, the fifth was found unstratified, lying on the cave floor during the survey towards the rear of the cave.

A blade fragment was found in disturbed deposits in Trench A, layer 1 (2012.18H/1; Figure 10.1). It had broken into three pieces where it lay in the ground. The blade is not retouched and therefore it is not diagnostic. It is of a length and width (18.2 mm) that would be acceptable to suggest it may be Upper Palaeolithic in date. It is, however, impossible to say with any certainty whether this is of Early or Late Upper Palaeolithic age.

A further blade was discovered during wet-sieving sediments from the base of layer 3, overlying bedrock in Trench A (2012.18H/2; Figure 10.2). The blade is unworked, but is heavily patinated. Its lack of distinguishing characteristics makes it impossible to determine whether or not this is of Early or Late Upper Palaeolithic age.

A cortical flint flake fragment (2012.18H/3) and a small flint spall (2012.18H/4) were found during wet-sieving within the mixed deposits of Trench A, layer 2. Both are pieces of flint knapping debitage without any distinguishing characteristics that would enable them to be placed in any specific period of prehistory.

A surface find (2012.18H/5) discovered at the rear of the cave is a mid-section of an undiagnostic flint blade. The proximal end has a recent break suggesting it has lain on the surface for some time. The distal end is patinated and so is an ancient break.

None of the lithic artefacts are tools, and it is only the two blades which hint at an attribution to an Upper Palaeolithic age on the basis of their appearance.

THE FAUNAL ASSEMBLAGE
(Claire Ingrem and Jennifer R. Jones)

The faunal assemblage comprises a total of 1,445 fragments of large mammal bones of which 172 specimens are identifiable (Table 2). A further 4,630 microfaunal fragments were studied, with 3,872 specimens fragments from Trench A grid square G, and a further 758 available from Area B (Table 3). Of these 2,081 specimens (45%) were identifiable either to species, genus, or family level. Within the identifiable microfaunal specimens 1,647 (42%) were identifiable from Trench A grid square G, and 434 (57%) were identifiable from Area B. The results of the analysis suggest mixing is widespread with only layer 3 in grid square I and the deposits from Area B potentially intact. The bones were initially studied and grouped by Claire Ingrem who analysed the large mammals; the microfauna identifications and analysis was undertaken by Jennifer R. Jones and Julia Best identified the bird bones. The full reports and tables (including the detailed methodology) are lodged in the site archive.

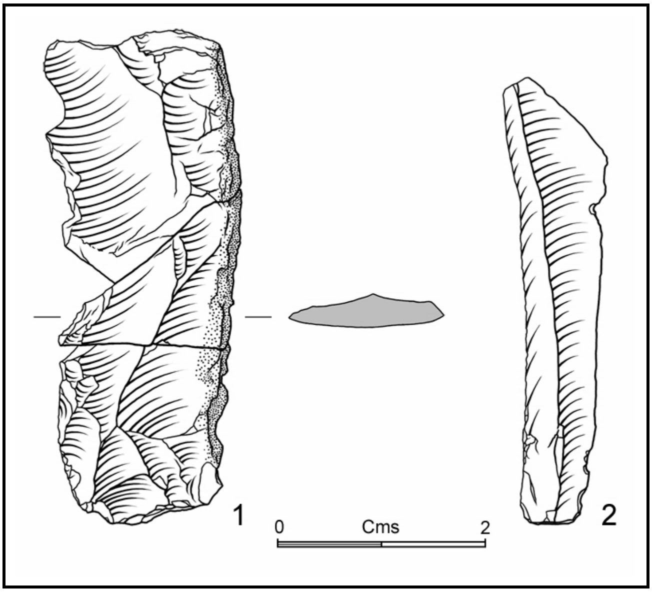

Figure 10. *Two Upper Palaeolithic flint blades. 1 = blade fragment (2012.18H/1); 2 = blade (2012.18H/2).*

Anatomical elements were identified to species or family level where possible. However, as a result of the small size of the majority of the material many specimens could not be identified with total certainty. This is particularly the case with bones belonging to closely related species such as members of the deer, fox and lagomorph families as their morphological similarities renders identification to species level extremely difficult. Evidence of burning, gnawing and butchery were recorded along with the agents considered responsible. Other surface modifications such as root damage and colour were also recorded for the larger mammals. The characteristics necessary to allow the calculation of the fracture freshness index of limb bones were recorded (Outram, 2001).

Overall, a very wide range of mammals are represented including both domestic and wild taxa. Sheep are the most numerous, followed by pig. Specimens belonging to wild mammals are also relatively well represented especially those belonging to fox (*Vulpes/Alopex* spp.), deer, lagomorphs and badger (*Meles meles*). Of particular note are a few specimens belonging to woolly rhinoceros (*Coelodonta antiquitatis*) and spotted hyaena (*Crocuta crocuta*) as these animals have been extinct in Britain since the last glaciation. A total of thirty pieces of bird bones were recovered from Trench A, layers 2 and 3, most of which belong to passerines (Table 4). The most commonly identified microfaunal species was *M. agrestis*, with high proportions of *R. temporaria, A. terrestris*, and *B. bufo* (Table 3, Figures 11 and 12). The next commonly occurring species were *A. sylvaticus, M. glareolus* and *S. araneus*. The presence of *S. minutus, M. minutus* and *T. europaea*, and *N. fodiens* was also identified within the assemblage. A high proportion of *Rana temporaria* was found throughout the Area B sequence.

Trench A Layer 1:

A single specimen was recovered from layer 1: a lower third premolar belonging to a juvenile spotted hyaena.

Trench A Layer 2.

Layer 2 produced the largest assemblage consisting of 97 identifiable specimens with a wide range of taxa represented (Table 2). Sheep (*Ovis*) are the dominant species represented

	Trench A Layer			Area B all contexts	Total
	1	2	3		
Horse			1		**1**
cf. Coelodonta antiquitatis		1	1		**2**
Bovididae spp.			1		**1**
*cf.Bos/*bison spp.				1	**1**
Sheep		3			**3**
Sheep/goat		18	13		**31**
Sheet/goat/roe deer		1			**1**
cf. Sheep/goat		1	1		**2**
Pig		12	7		**19**
cf. Pig			1		**1**
Rangifer tarandus		3	2	1	**6**
cf. Rangifer tarandus		1	1	1	**3**
Cervus/Megaloceros spp.		2			**2**
Cervidae spp.		6	3		**9**
cf. cervidae spp.		1			**1**
Dog		2	2		**4**
Canis lupus		1			**1**
Canis spp.		1	3		**4**
cf. Canis spp.			1		**1**
Vulpes vulpes		6	1		**7**
Alopex lagopus		1	4	2	**7**
cf. Vulpes/Alopex spp.		12	5	1	**18**
Crocuta crocuta	1	1	1		**3**
Carnivore			1		**1**
Cat		3	1		**4**
cf. cat			1		**1**
Meles meles		7	4		**11**
Mustela putorius			1		**1**
Mustela spp.			1		**1**
Oryctolagus cuniculus		1	1		**2**
Lepus timidus		3	2	1	**6**
cf. Lepus timidus		1			**1**
Lepus spp.		1	1		**2**
Lagomorph		7	2	1	**10**
Fish		1	3		**4**
Large mammal		8	2	5	**15**
Medium mammal		19	4	2	**25**
Small mammal		11	2		**13**
Unidentifiable		623	566	31	**1220**
Total	**1**	**758**	**640**	**46**	**1445**
Total identified	**1**	**97**	**66**	**8**	**172**
% Identified	**100**	**13**	**10**	**17**	**12**

Table 2. *Taxa representation according to context (NISP).*

	Trench A Square G Layer 3	Area B All contexts
Microtus agrestis Field Vole	**470**	**143**
Rana temporaria Common Frog	**374**	**155**
Arvocola terrestris Water Vole	**95**	**20**
Bufo bufo Common Toad	**93**	**29**
Apodemus sylvaticus Wood Mouse	**20**	**3**
Myodes glareolus Bank Vole	**20**	**2**
Sorex araneus Common Shrew	**15**	**0**
Sorex minutus Pygmy Shrew	**9**	**0**
Micromys minutus Harvest Mouse	**6**	**1**
Talpa europaea Common Mole	**8**	**0**
Lacerta sp.	**3**	**0**
Neomys fodiens Water Shrew	**2**	**0**
Vipera sp.	**0**	**1**
Arvocolinae/Muridae	**226**	**23**
Arvicolinae	**210**	**35**
Soricidae	**28**	**1**
Muridae	**68**	**21**
Amphibia	**319**	**78**
Small mammal	**1858**	**239**
Mammal	**48**	**7**
Totals	**3872**	**758**

Table 3. *Summary listing of microfaunal remains.*

by elements from most parts of the skeleton, some are juveniles. Twelve specimens of pig (*Sus*) include three unfused 2nd phalanges from animal(s) that died in their first year. Deer are represented by twelve specimens. Three reindeer (*Rangifer tarandus*) teeth and one metatarsal; one adult red/giant deer molar and a small fragment of a roe deer (*Capreolus capreolus*) metatarsal are identifiable to species the other remains are identified as of large cervid. Thirteen lagomorphs remains include arctic hare (*Lepus timidus*) incisors and a mandible along with a radius of a rabbit (*Oryctolagus cuniculus*). The other remains could only be assigned to the general lagomorphs category. A tooth fragment belonging to rhinoceros, most probably woolly rhinoceros (*Coelodonta antiquitatis*) came from cleaning deposit against the cave wall.

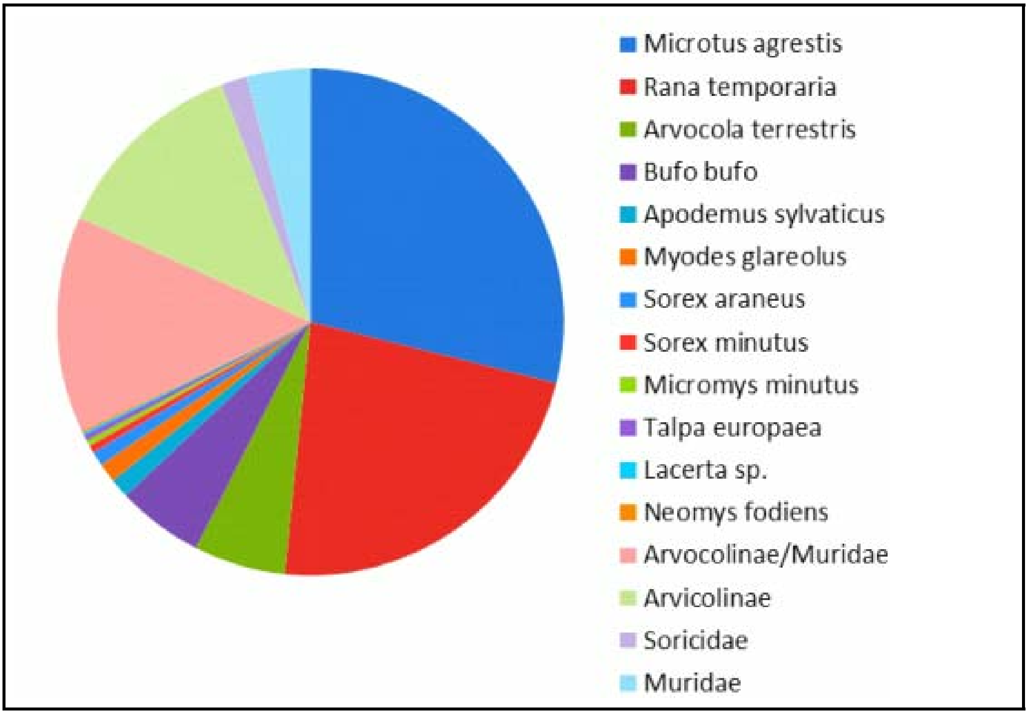

Figure 11. *Percentage representation of all total identifiable microfaunal remains from the entirety of material from Area B.*

Three remains of dog (*Canis* spp.) include a probable wolf (*Canis lupus*) patella. A single hyaena (*Crocuta crocuta*) canine tooth with slight wear is also present. Seventeen specimens belong to fox, including three coprolites assigned to fox, rather than dog, on the basis of the small animal remains contained within them. A small humerus belongs to arctic fox (*Alopex lagopus*). The other specimens are consistent in size with the larger red fox (*Vulpes vulpes*). Domestic cat (*Felis catus*) is represented by three humeri. Badger (*Meles meles*) is represented by four teeth and three foot bones (2 phalanges and a carpal).

Ten pieces of bird bones were recovered including a coracoid and two conjoining fragments of an ulna belonging to domestic fowl, and a proximal phalanx of the major digit belonging to duck (*Anas/Aythya* spp.) The remainder were only identifiable as bird with the exception of a passerine, probably starling (*Sturnis vulgaris*) humerus. The layer also contains a single fragment of a fish basioccipal bone.

Species such as rhinoceros, reindeer and spotted hyaena are not found in Britain today but were present prior to the Last Glacial Maximum. The single woolly rhinoceros specimen came from grid square I, an area of the site that produced a specimen belonging to arctic hare which is also likely to have a Pleistocene origin. However, the presence of species including

	Trench A		
	2	**3**	**Total**
Small wader		1	**1**
cf. Wader		1	**1**
Duck sp.	1		**1**
Domestic fowl	*2	1	**4**
Large Galliform		1	**1**
Blackbird		1	**1**
Blackbird/Starling sized small Passerine		2	**2**
Small Passerine *cf*. Blackbird/Starling		1	**1**
Small Passerine *cf*. Finch		3	**3**
Small Passerine *cf*. Starling	1	1	**2**
Small Passerine *cf*. Tit		1	**1**
Small Passerine		3	**3**
Small/tiny Passerine		1	**1**
Small bird *cf*.Passerine		1	**1**
Medium bird	2	1	**3**
Medium/large bird	3		**3**
cf. Bird	1		**1**
Total	**11**	**19**	**30**

Table 4. *Representation of birds according to context (NISP). * = conjoining fragments.*

sheep, pig, rabbit and domestic cat indicate that mixing has taken place. The date of the badger, duck and probable starling remains recovered from this area is uncertain although the condition of most of the badger bones suggests they are of modern origin. Almost half of the identifiable remains came from square F although square E also produced a good number of specimens. Other squares produced only small samples comprising less than twenty specimens. A hyaena tooth and specimens belonging to reindeer came from grid squares E and F but these areas similarly produced specimens belonging to domestic animals so must have suffered mixing. Grid square I produced a woolly rhinoceros, an arctic hare and a pig bone so this indicates a mixed deposit. One domestic cat humerus was broken with conjoined pieces originating from grid squares A and E further confirming mixed deposits.

The incidence of taphonomy is shown in Table 5. Four specimens including the probable wolf patella and a fox scapula preserve evidence for canid gnawing. A deer tibia and two medium mammal limb bone fragments have been burnt.

Trench A Layer 3.

The assemblage of large mammal bone recovered from layer 3 consists of 60 identifiable large mammal specimens. As with layer 2, a wide range of taxa is represented with modern domestic species such as sheep and pig relatively numerous. The sample of wild mammals includes a few specimens belong to woolly rhinoceros and spotted hyaena.

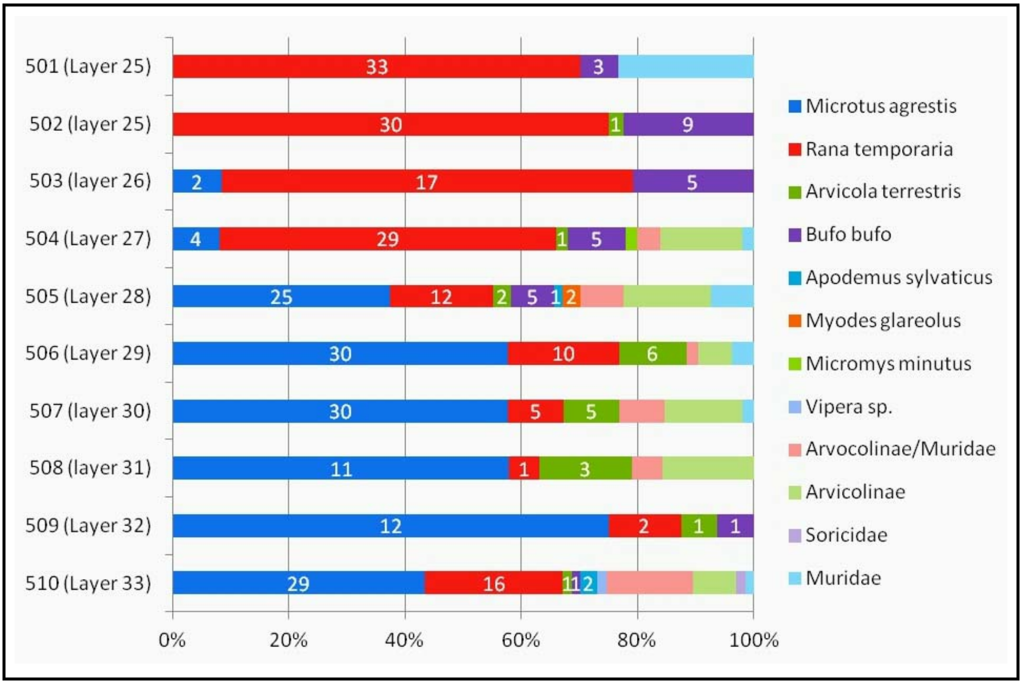

Figure 12. *Species representation within each sample within Area B.*
**Numbers denote NISP values observed.*

Horse is represented by a fragment of femur. Sheep are more numerous, with thirteen specimens, more than any other taxa and these include juvenile animals. Seven pig specimens include juveniles. Two lower molars, a small piece of femur and a 2nd phalanx belong to reindeer. The proximal femur is unfused so belonged to an immature animal. One of the five lagomorph specimens, a pelvis, belongs to arctic hare and it is probable that the hare metapodial is also from the arctic form. The rabbit is represented by one specimen with two further bones assigned to the general lagomorph category. Two small metapodials indicates they belong to domestic dogs whereas an incisor, mandible and tibia fragments could belong to wolf. Two small phalanges are likely to belong to arctic fox with six specimens attributed to fox. A lower molar recovered from grid square I is the only evidence for spotted hyaena. Cat is represented by an upper canine tooth. Four badger specimens and a polecat (*Mustela putorius*) fibula are also recorded. Nineteen bird bones include a humerus belonging to a small wader (*Charadrii-forme* spp.), a domestic fowl scapula and a blackbird (*Turdus merula*) premaxilla. Most of the other bones belong to small passerines.

Almost two-thirds of the assemblage was recovered from grid square G. Grid square F produced a smaller sample and a few pieces are from grid squares E and I. As was the case in layer 2, all areas appear to have suffered from a degree of mixing with the possible exception of grid square I since none of the fauna from this location is of certain Holocene date. However, it is likely that the badger remains are present as a result of modern day animals burrowing.

	Layer 2		Layer 3
	Burning	**Gnawing**	**Gnawing**
Horse			1
Cervidae spp.	1		1
Canis spp.		1	
Vulpes spp.		1	
Large mammal		2	1
Medium mammal	2		
Total	**3**	**4**	**3**

Table 5. *Incidence of taphonomy (NISP) Trench A, Layers 2 and 3.*

A pig vertebra appears to have been split through the middle of the centrum although no blade marks are visible. Both the horse and large deer femora display evidence for canid gnawing. A fox mandible found in this layer, but from a square where the layer was shallow, has been radiocarbon dated and has generated a post-medieval age of 319 ± 21 BP (OxA-29414), other dates obtained are mid-Devensian and come from the basal deposits in grid square G and for a hyaena tooth from the deposits against the cave wall in square I (Table 6). Some of the material is black but none of the identifiable material could be assigned to the burnt category with certainty due to the difficulties in differentiating charred remains from those stained by other processes. Most of the material from layer 3 consists of small fragments of bone and loose teeth. Fragmentation analysis indicates that the shaft circumference of most limb bones remains intact but few specimens have more than 50% of their original length present.

Area B (standing section).

Five identifiable mammal specimens came from Area B (Table 2). Cervids are represented by an upper molar and a carpal, fox by a caudal vertebra, lagomorph by a molar tooth and a large mammal tibia most probably belongs to cattle (*Bos*/bison spp).

Microfauna are exceptionally sensitive in terms of the habitats that they can survive in. They can therefore prove to be very sensitive environmental indicators. Although frequently deposited via a range of non-human predators, the presence of microfauna in archaeological deposits can be invaluable in providing an understanding of the local environmental conditions that would have been present in the environments surrounding the cave. This in turn can inform what localised resources were available to the past human populations who may have inhabited these environments. The assemblage from Area B provides a valuable opportunity to identify potential changes in environment within a complete sequence of deposits (Figure 12). The sample sizes for each of these levels is small, and patterns observed can be heavily influenced by small differences in the quantities of specimens identified, consequently the data has to be viewed with some caution. The appearance or disappearance of species within each layer can provide information about small environmental differences between them.

Within the uppermost samples taken from the section from layers 25–27 *R. temporaria* dominates the identifiable species present, whereas below this, in layers 28–32, there is a predominance of *M. agrestis*. In layer 33 the trend switches again with *R. temporaria* being the most commonly identified species, and there is a reappearance of *A. sylvaticus* within the assemblage. These trends can be observed to greater degrees when considering the individual samples within Area B (Figure 12), allowing the more nuanced understanding of changes in past environmental conditions to emerge. *B. bufo* are present in greater numbers higher up the section. This indicates that there must have been large, permanent bodies of water nearby in order to provide a sufficient habitat for these individuals to survive (Beebee and Griffiths 2000, 102). The smaller numbers of *B. bufo* lower down in the sequence could be indicative of drier conditions. This is supported by the general trend for an increase in *R. temporaria* specimens observed running down the sequence which, despite having less specific environmental requirements than *B. bufo*, still require wet environments for spawning. The increased numbers of *A. terrestris* between layers 29 and 30, indicates that there must have been water sources available at this time, as this species inhabits areas within 2 m of the water's edge, however, they are able to survive in marshy environments (Harris and Yalden, 1991, 114), and therefore are generally less specialised in their habitat preferences than *B. bufo*.

Within layer 25 no *M. agrestis* were identified within the deposit. Occasional fragments of *M. agrestis* were identified within layers 26 and 27. Between layers 28–32 there are increased proportions of *M. agrestis* relative to higher up the sequence. This suggests that there is a change in environment between these earlier and later phases, causing a great abundance of *M. agrestis* to be present in the local environment, potentially linked to reduced levels of water. These species thrive predominantly in rough, ungrazed grassland, indicating that these environments may have been more plentiful at this time. One *M. minutus* specimen in layer 27 and *M. glareolus* in layer 28 are also species which thrive in grassland conditions, and could be indicative of increased areas of grasses of shrubland in the locale of the cave at this time.

Discussion, interpretation and dating of the faunal assemblage

Pleistocene:

The assemblage of large animal bone recovered from Cathole Cave during the 2012 excavation is small but noteworthy because of the presence of a few specimens belonging to taxa that have not been present in Britain since the Pleistocene period. Unfortunately the co-presence of domestic animals indicates that mixing has occurred in most parts of the excavated areas. The only possible intact deposits come from Trench A grid square I, layer 3 and from Area B.

The presence of woolly rhinoceros and spotted hyaena point to a date during Marine Isotope Stage 3 (*c.* 60–25 kyr BP) since both species are common components of cave assemblages from this period but are scarce, if not absent, from assemblages of Late Glacial date (Currant and Jacobi 2001, 1713)[1]. A hyaena tooth from Trench A layer 3, grid square I generated a radiocarbon result in excess of 45,800 BP (OxA-29411). Dating of three reindeer specimens also generated results which fall within this same period (Table 6). The presence of this mid-Devensian fauna is not surprising since the earliest excavation at Cathole Cave, by Wood (Roberts 1888, 19), produced an abundant Pleistocene mammal assemblage. Additionally

[1]The decorated woolly rhinoceros bone from Pin Hole Cave, Creswell, although probably engraved in the Late Upper Palaeolithic, was engraved over and incorporates post depositional marks on the bone - i.e. it was made on an old bone found in the cave. (J. Cook, *pers.comm.).*

spotted hyaena and probable woolly rhinoceros were also recovered during work by McBurney (1959) in the mid 1950s. More recently, excavations in 1968 outside the cave by Campbell (1977, 121) produced large mammal remains thought to be present as a result of the actions of a large carnivore such as hyaena, or possibly Early Upper Palaeolithic humans. Wolf, red fox, arctic fox, polecat, wild horse, giant deer, reindeer, *Bos*/bison and arctic hare are commonly found at sites dating to this period (ibid) in England and Wales including Pinhole Cave, Derbyshire (Ingrem, 2009) and Coygan Cave, Laugharne (Aldhouse-Green *et al*. 1995).

With the exception of woolly rhinoceros, spotted hyaena and bison, most of the taxa recorded at Cathole Cave are also found at sites of Late Glacial date (MIS 1/2) and evidence for a human presence at Cathole Cave during this period is well-documented. Campbell's excavations (1977, 35) recovered Late Upper Palaeolithic artefacts and associated large animal remains from Cathole Cave including bones belonging to arctic fox (*Alopex lagopus*) and cave bear (*Ursus arctos*). Earlier work by McBurney (1959) on the platform outside the cave entrance, produced artefacts of Late Upper Palaeolithic type and a faunal assemblage comprising badger, fox, bear, horse, red deer, roe deer (*Capreolus capreolus*), reindeer, sheep, cattle and hare which appear to have suffered considerable mixing (Campbell, 1977, 121). In addition to the artefactual evidence, a Late Glacial human presence is indicated by the discovery of the engraving. Four samples have been subjected to uranium series disequilibrium dating by the Open University, one sample was derived from close to the nose of the carving and this returned a preliminary age of 12,572 ± 660 BP (Nash *et al*. 2012).

Cut marks are numerous on animal bones recovered from Upper Palaeolithic deposits at sites of MIS 2/1 age including Gough's Cave, Cheddar, Somerset where cut marked bones belonging to horse, red deer, hare and humans have been found (Parkin *et al*. 1986). There is substantial evidence for the exploitation of arctic hare at Robin Hoods Cave, Creswell, Derbyshire, with five radiocarbon dates on cut marked arctic hare bones giving a pooled mean of 12,423 ± 69 BP (Charles and Jacobi, 1994). The presence of humans at Cathole Cave is clearly attested by the recovery of flint artefacts and the presence of cave art, however, in the absence of cut or percussion marks indicative of deliberate breakage for marrow it is impossible to know if humans were responsible for accumulating any of the animal remains.

A few bones preserve evidence for carnivore gnawing including a specimen belonging to a large mammal recovered from grid square I in layer 2, a possible red/giant deer femur from grid square G in layer 3 and a horse femur from grid square E also in layer 3. It was not possible to determine the agent responsible but there is plentiful evidence for hyaena involvement with animal bones from British cave sites where most of those with faunal assemblages dated to MIS 3 functioned as hyaena dens at some time in their history (Ingrem, 2009, 232). The recovery of a juvenile hyaena tooth suggests this may well have been the case at Cathole Cave and it is probable that other carnivores such as wolves and foxes also used the cave from time to time. Bird remains are fairly common at some Late Glacial sites (Campbell, 1977, 110). Foxes, both red and arctic, prey on birds and small mammals and so it is likely that they were, at least partly, responsible for bringing the bird bones into Cathole Cave.

The range of rodent species present is characteristic of the Late Upper Palaeolithic, particularly in the uppermost sequence of deposits found in Area B, with *Microtus agrestis, Arvicola terrestris, Apodemus sylvaticus* and *Myodes glareolus* being typical of this period although no *Lemmus lemmus* or *Microtus gregalis*, which is characteristic of this time, were observed within the assemblage (Harris and Yalden, 1991, 45). The species observed within these deposits are consistent with the small microfaunal assemblages identified by Price from the microfaunal remains recovered from the Late Upper Palaeolithic phases of Campbell's 1968 excavations (Price, 2003, 80). Species such as *A. sylvaticus* and *M. glareolus* are present, which are generally indicative of the warmer conditions associated with human occupation (ibid). Previous analysis of herpetofaunal remains from the McBurney excavations at the site in 1958 identified the presence of *R. temporania*, and *B. bufo* (Gleed-Owen, 1998), both of which were common within the current assemblage. Further afield in Pembrokeshire microfaunal specimens analysed from Priory Farm Cave, which covers a similar date range to Cathole Cave also had evidence of more wooded environmental conditions emerging, with species such as *M. glareolus* and *M. agrestis* present in addition to *A. terrestris* and *A. sylvaticus* present within the assemblage.

Microfauna may enter caves on their own volition, attracted by desirable conditions such as increased food sources (Price, 2003). However, at Cathole Cave, this scenario is unlikely as the environmental niches occupied by species such as *M. agrestis*, *and R. temporaria, Arvicolinae, Soricidae* and *Muridae*, which comprise the majority of the assemblage, are highly distinctive, and for each of these species to be present within the same deposits, other forms of agency must be responsible for their deposition. It would appear that predation by animals that frequent caves is the most likely explanation for the combination of species identified within the Cathole Cave assemblage. Predators such as owls scour the field for prey, which they frequently eat whole, before regurgitating pellets when roosting in cave entrances, and are a common agent for the transportation of microfaunal remains within archaeological cave deposits (ibid). The high number of identifiable fragments within the Cathole microfaunal assemblage, which is indicative of more complete remains, supports the possibility that these remains are a result of owl consumption. Evidence of digestion was also noted on several specimens during analysis, supporting the possibility that this assemblage was formed by owl predation.

Despite the microfaunal remains not being anthropogenically deposited, the presence of these species within Cathole Cave as prey can provide valuable insights into the past environmental conditions within the site locale.

Holocene

In addition to Pleistocene remains, the recently excavated assemblage includes bones and teeth belonging to sheep and pig which are clearly of Holocene origin. Again, this is not surprising given the results of previous work. Bones belonging to domesticated animals, pottery and a bronze axe were recovered by Wood (Roberts, 1888) and Campbell found bones belonging to cattle and sheep in topsoil. Both McBurney and Campbell recovered Mesolithic artefacts some associated with the remains of roe deer (Campbell, 1977, 121) and this may account for the probable roe deer bone amongst the assemblage recovered in 2012. The recovery of remains belonging to domestic mammals such as sheep and pig are a clear indication that the deposit contains material of a much more recent date. The domestic forms of the major food animals (cattle, sheep/goat, pig) were not present in Britain during the Devensian glaciation. They are associated with a more sedentary lifestyle based on agriculture and the exploitation of domesticated animals that developed from the Neolithic period onwards. Consequently the bones of sheep and pig are commonly found at archaeological sites dating to later periods of prehistory as well as the historical periods. The precise date of the Holocene animal remains recovered from Cathole Cave is not known and the samples are too small to be able to provide detailed information concerning husbandry practices. The presence of bones belonging to most parts of the sheep and pig skeleton suggests that whole carcasses may have been originally present in which case it is likely that animals arrived on the hoof. This scenario is supported by the presence of immature individuals as they suggest that livestock were raised in the vicinity of the cave.

According to Roberts (1888, 19), Cathole Cave was the known ‘haunt’ of wild cat during the 19th century and consequently it is likely that the cat bones are also of recent origin. It is also quite feasible that at least some of the fox, badger and lagomorph bones are recent and possibly intrusive given their burrowing habits. This type of activity might also account for some of the mixing that has taken place.

Find no.	*Species*	*Identification*	*δ13C*	*Date*	*Lab No.*	*Context*
Trench A						
2012.18H/42	*Vulpes vulpes*	Mandible fragment	-20.87	319 ± 21	OxA-29414	3
2012.18H/44	*Rangifer tarandus*	Left Molar	-18.80	38,800 ± 1,000	OxA-29416	3
2012.18H/23	*Crocuta crocuta*	Lower left 1st molar	-19.07	>45,800	OxA-29411	3
Area B						
2012.18H/34	*Rangifer tarandus*	Carpal	-18.66	35,550 ± 650	OxA-29413	32
2012.18H/43	*Rangifer tarandus*	Upper 1st or 2nd molar	-17.23	43,100 ± 1,700	OxA-29415	29-33
2012.18H/31	Large mammal	Rib	-21.09	43,600 ± 1,800	OxA-29412	30

Table 6. *Radiocarbon determinations from Cathole Cave.*

RADIOCARBON DATING

Six faunal specimens were submitted for AMS radiocarbon dating at the Oxford University Radiocarbon Accelerator Unit Research Laboratory for Archaeology. The samples were selected prior to the detailed analysis of the fauna and sediments taking place. Three samples originate from bones recovered from the deposits in Trench A and three from locations over the standing section Area B.

The Trench A samples all originate from bones within layer 3 which, at the time they were submitted, were thought to be *in situ*. These include a hyaena *(Crocuta crocuta*) Lower 1st molar and a red fox *(Vulpes vulpes*) mandible fragment from the upper spit of layer 3 and a reindeer *(Rangifer tarandus)* lower molar from the base of layer 3. The results (Table 6) prove the deposit is very mixed.

Specimens submitted for dating from Area B were a reindeer *(Rangifer tarandus*) Upper 1st or 2nd molar from a location within the main body of the sediments, layers 29–33. A large mammal rib from layer 30 and a Reindeer *(Rangifer tarandus*) carpal bone from layer 32. These specimens confirm the Last Glacial sequence represented in Area B and confirm the mixing, during emplacement of the deposits within this area of the cave.

DISCUSSION

Cathole Cave is one of a handful of sites in South Wales that have generated evidence for a pre-Last Glacial Maximum human presence. At Coygan Cave, Laugharne, Carmarthenshire, three *bout coupé* handaxes and three flakes indicate a Neanderthal presence. The faunal assemblage at Coygan Cave shows that the cave was used as a hyaena den during the middle of the Last Glacial, as characteristic heavily gnawed and digested bone fragments have been found amongst the assemblage (Aldhouse-Green *et al*. 1995). The assemblage is dominated by hyaena bones, along with scavenged bones from woolly rhinoceros and horse (Currant and Jacobi, 2011, 172). Other bones originate from mammoth, reindeer, bison and brown bear, all species typical of the mid-Devensian (Aldhouse-Green *et al*. 1995). The human use of Coygan Cave falls in the period sometime between 66,000 and 38,000 BP and the location of the site, overlooking the plain that is now the Bristol Channel, was perfect as a temporary base and as a lookout for hunting. The original evidence for Neanderthal occupation and use of this cave is, however, obscured by the dominant hyaena activity that took place in the cave.

Other late Neanderthal sites have been identified at Goat's Hole Cave, Gower (also known as Paviland Cave) and at Long Hole Cave, Gower. Limited excavations were undertaken in Goat's Hole by Professor Stephen Aldhouse-Green in 1997 to determine whether *in situ* deposits survive within the cave (Aldhouse-Green, 2000). This work had limited field results, but a full reinterpretation of the archive from earlier work at the site demonstrated that the cave had a number of phases of occupation. The first is identified by the presence of blade-leaf points amongst the lithic assemblage. These are tools now attributed to the Lincombian-Ranisian-Jerzmanowician techno-complex. In Britain a number of studies demonstrate that these tools span a probable chronology *c*.38–36,000 BP on the basis of their dating at Badger Hole, Somerset; Wookey Hole, Somerset; Bench Quarry Tunnel, Brixham, Devon; Pin Hole, Creswell Crags, Derbyshire and Grange Farm, Glaston, Rutland (Jacobi and Higham, 2011a; Cooper *et al*. 2012). A blade-leaf point is also recorded at Ffynnon Beuno, Denbighshire, associated with a large assemblage of mid-Devensian fauna with hyaena, woolly rhinoceros and horse the dominant species (Aldhouse-Green *et al*. in press). At Long Hole Cave, Gower, Campbell recorded a blade-leaf point amongst the lithic assemblage (Campbell, 1977, 121, 145). Blade-leaf points are tools made by late Neanderthals and they therefore provide evidence for a presence on Gower prior to the arrival of anatomically modern humans (Cooper *et al*. 2012).

An evolved Aurignacian technology is recorded from Goat's Hole Cave, Paviland; Hoyle's Mouth Cave, Pembrokeshire, and at Ffynnon Beuno, Denbighshire. The dating of the British Aurignacian is thought to lie between 33–31,000 BP and is believed to equate to the earliest presence of anatomically modern humans (Jacobi and Higham, 2011b; Aldhouse-Green *et al*. in press). Lithic artefacts are cores in the form of *burin busqués* one of which has been found at Hoyle's Mouth Cave (David, 2007, 7) as well as being found with nosed-scrapers amongst the lithic assemblage from Goat's Hole Cave (Swainston, 2000, 100). These tools have been reinterpreted as cores for the removal of carefully pre-prepared micro-bladelets for retouch and modification into barbs for composite hunting tools (Dinnis, 2009; Jacobi and Higham, 2011a). A record of a burin found in Long Hole Cave has also been attributed an Aurignacian age (Garrod, 1926, 69; Campbell, 1977, 146).

Gravettian technologies are present at both Goat's Hole Cave and at Cathole Cave. The early Gravettian is represented by a number of distinctive tanged blades, often attributed to the continental *Font Robert* points (Jacobi and Higham, 2011a, 207). Four are now recorded from amongst the Cathole Cave assemblage; three from Wood's excavations, and a tang fragment from McBurney's excavations outside the cave entrance (ibid, 206). The dating of these tools in Britain is currently poor, but based on parallels with Belgian sites the indications are that they belong to a separate earlier settlement event from that of the burial of the 'Red Lady' in Goat's Hole Cave (ibid, 211). This late Gravettian burial known as the 'Red Lady' of Paviland was discovered by the Reverend Professor William Buckland in 1823. Recent re-dating now gives an age between 29–28,000 BP (Jacobi and Higham, 2008). The 'Red Lady' was a young adult male, buried in a rich grave containing perforated winkle shell beads, ivory rods and rings. The red staining of the remains is now known to have been caused by the deliberate emplacement of red ochre or iron oxide in the grave or on the clothing (Aldhouse-Green, 2000, 235). Parallels for the 'Red Lady' burial exist at a number of continental sites (ibid). Dating of two of the three worked bone knives or spatulae from Paviland Cave originally suggested a much later use of the cave (ibid), however, re-dating of one of these tools (26,170 ± 150 BP OxA-13656) has now placed it firmly back in the late Gravettian providing slightly later evidence for use of the cave after the burial (Jacobi and Higham, 2011a, 213).

The only other evidence for a late Gravettian human presence in South Wales comes from three radiocarbon determinations of a human humerus in the collection of Swansea Museum (OxA-14164, 23,370 ± 110 BP; OxA-11015, 24,000 ± 140 BP and OxA-11543, 23,370 ± 110 BP; Schulting *et al*. 2005). This bone is attributed to Eel Point Cave, Caldey Island, Pembrokeshire, a site which has been investigated many times since the first discovery of bones there around 1840. Jacobi and Higham (2011a, 213) suggest that its exact provenance needs to be treated cautiously due to the fact that the bone has an uncertain history in the Swansea Museum records. They suggest it is safer to consider the bone as originating from 'South Wales' rather than Eel Point Cave (ibid). Wherever in South Wales this bone came from, it currently provides the only certain date for a human presence during this very late phase of the Gravettian in Britain.

A long period of hiatus in the evidence for a human presence in Wales and the rest of Britain lies between the late Gravettian and the return of humans following the Last Glacial Maximum once the climate ameliorated. There are some hints at a faunal presence during this cold period from two Pembrokeshire sites. At Ogof-yr-Ychen, Caldey Island, a radiocarbon determination obtained on a rhinoceros scapula produced a result of 22,350 ± 62 BP (Birm–340; Nédervelde, 1972, 20; Nédervelde *et al*. 1973, 454). Barnacle geese bones found at Little Hoyle Cave have been dated at *c*. 22,800 BP (Green and Walker, 1991, 63). This time would have been very cold as the dating of the Last Glacial Maximum on Gower at 23,272 BP suggests (Bowen *et al*. 2002). The introduction of ultrafiltration techniques to radiocarbon dating now demonstrates that many of the dates obtained prior to its introduction should be treated cautiously (Jacobi and Higham, 2008). Consequently it is very unlikely that these species would have survived at these dates.

Dating of four cut marked wild horse bones, along with a human ulna from Sun Hole, Cheddar, Somerset have provided dates in the region of 12,600 BP which are the oldest yet available for a human presence at the start of the British Late Upper Palaeolithic (Jacobi and Higham, 2011b, 228–229). Parallels may be drawn between assemblages from Somerset which have been well-dated and with the undated, but poorly recorded and often unstratified discoveries from caves across South Wales. Significantly Wood's excavations at Cathole Cave recovered a Cheddar point (Garrod, 1926, 66–67), a tool form which has now been linked to this early Late Glacial human presence by the dating of cut marked bones from Sun Hole and Gough's Cave, Cheddar (Jacobi and Higham, 2011b, 229). Cheddar points are also present in other South Welsh cave assemblages, including Goat's Hole Cave (Swainston, 2000, 109), Hoyle's Mouth Cave, (David, 2007, 48) and Nanna's Cave, Caldey Island (Green and Walker, 1991, 67) suggesting that there was widespread activity taking place across South Wales during the early part of the Late Glacial (Walker in press). There are as yet no dates available for these assemblages, although a reassessment of the Hoyle's Mouth Cave assemblage is currently underway. The presence of the engraving found in a recess at the rear of the cave and its subsequent dating to the early part of the Late Glacial (Nash *et al*. 2011; Nash 2012) further emphasises the presence of Late Glacial hunters at Cathole Cave.

A later Late Glacial presence is also indicated by abruptly-backed blades, scrapers, burins and piercers amongst the tool assemblage which date to the later part of the Late Glacial (Campbell 1977, 167; Green and Walker 1991, 51; Jacobi and Higham, 2011b). The break in the record for wild horse at this time is linked to an expansion of birch woodland across the country (Jacobi 2004, 79). It is possible that the change reflected the need to adapt to new hunting strategies in the denser woodland and spears and darts ceased being used in favour of bows and arrows (Barton and Roberts, 1996, 261–262). Final Palaeolithic penknife point fragments were also discovered during McBurney's excavations at Cathole Cave (1959, 267). Elsewhere similar assemblages have been found in other South Wales caves; in particular at Goat's Hole Cave where a handful of tools, including abruptly-backed points and a penknife point are recorded (Swainston, 2000, 108). Nanna's Cave, Potter's Cave and Ogof-yr-Ychen all on Caldey Island also have assemblages containing Late Glacial and Final Palaeolithic tools (Lacaille and Grimes, 1955; David, 1991, 153). At Priory Farm Cave, Pembroke, four penknife points have been found in association with a Late Glacial fauna (Green and Walker, 1991, 64; Barton and Price, 1999).

After the short hiatus in a human presence caused by the Younger Dryas stadial there was a rapid repopulation of the country. A number of sites of early Mesolithic age have now been identified across South Wales through the presence of distinct broad-blade microlith assemblages (David and Walker, 2004). At Cathole Cave this early Holocene activity is noted by the presence of microliths of obliquely-backed and convex-backed forms of early Mesolithic age as well as later Mesolithic narrow-blade forms (Campbell, 1977, 281; David, 2007, 84).

The human remains found near the surface during Wood's excavations, as shown on Vivian's plan (1887, 200), have recently been studied by Schulting (2007) as part of a wider study of Neolithic burial practices. A radiocarbon date showed that the material overlapped in age with that from the Neolithic Severn-Cotswold tomb, Parc le Breos Cwm, in the valley beneath the cave. Stable isotope comparisons of these finds and others from nearby caves seemed to show that the people interred in the tomb had access to a diet which was by a small but significant extent richer in meat than those in the caves. The date for Cathole Cave cited in this paper has since been retracted on technical grounds, but the sample has been reanalysed and the current accepted date is 4675 ± 39 BP (OxA-16605; mandible NHM M.114) which is essentially the same as that first obtained (Schulting, *pers. comm*.). That Cathole Cave is lacking in artefacts of similar age is not surprising. Ten human individuals dated from Hay Wood Cave, Mendip, Somerset, have generated Neolithic ages, despite the absence of any cultural artefact of such age from within that cave (Schulting *et al*. 2013). Early-Middle Bronze Age artefacts, including a stone hammer, bronze axe, pottery sherds and stone tools are recorded at Cathole (Garrod, 1926, 65; McBurney, 1959, 266). There are also records of domesticated animal species, including pig, sheep and goat.

CONCLUSIONS

The 2012 Cathole Cave excavations were very limited in their scope and only removed a small amount of deposit for analysis. The results of this work have demonstrated that Wood's excavations in the 1860s were extensive and that a greater depth of deposit was excavated than had previously been thought. All the deposits within the entrance chamber and most of those in the main cave passage were removed down to bedrock. McBurney and Campbell located the spoil-heap from this early work where it protected undisturbed sequences of Pleistocene and Holocene deposits on the platform outside the main cave entrance (McBurney, 1959; Campbell, 1977). Despite this, substantial areas of *in situ* deposits still survive. The standing section into which Area B was cut demonstrates that whilst Wood excavated to the cave floor he left some deposit against the cave walls. The remnant deposits at the junction of the new cave grille and the western cave wall in Trench A grid square I also suggest that pockets of undisturbed sediment survive. Further into the cave Nash and Beardsley's survey has demonstrated that substantial deposits survive towards the rear of the main cave passage and within the rear side passages (Nash and Beardsley, 2013).

The deep fissure in Trench A where a depth of deposit of 60 cms was recovered has been proved to be disturbed owing either to the presence of burrowing animals or more likely the re-deposition of deposit removed from the cave following the 1860s excavations. At the time of the recent excavation the presence of a flint blade at the base of this sequence was taken as evidence that this context was undisturbed. The mixed nature of the deposits is now clearly demonstrated by the recovery of bones and teeth belonging to taxa absent from Britain since the Last Glacial Maximum in deposits containing modern domesticate animal remains. The radiocarbon determinations have now led to a revision of this original interpretation with the conclusion that the fauna found within Trench A is entirely disturbed.

By linking the results of the 2012 excavations with the published reports of the earlier work at the cave it is now possible to have a better understanding of the nature of some of the deposits and the associated faunal and human activity at the cave. The cave has undergone a long period of use, both as an animal den and with regular episodic periods of human occupation. The first use of the cave appears to have been as an animal den during the mid-Devensian as demonstrated by the presence of the typical MIS 3 faunal assemblage comprising woolly rhinoceros, spotted hyaena and reindeer. The dating of five specimens, one of spotted hyaena (OxA-29411, >45,800 BP), three of reindeer (OxA-29415, 43,100 ± 1,700 BP; OxA-29416, 38,800 ± 1,000 BP and OxA-29413, 35,550 ± 650 BP) and one undetermined large mammal (OxA-29412, 43,600 ± 1,800 BP) all reflect this period of use. None of the excavations have generated lithic artefacts that would provide the evidence for a human use of the cave at this time and cut marks have not been recorded on any of the specimens examined. The new dating programme has therefore dated this mid-Devensian fauna, rather than the human activity at the cave. The study of the sediments indicates that the deposits from lower in the Area B sequence have possible fluvial origins with those of layers 30 and 31 linked with the possible onset of cold conditions. Some of these deposits are mixed and it is possible that older faunal remains could have become incorporated within them. The boundaries between layers are often indistinct. However, there is a clear change noted by both the microfaunal assemblage and in the sediments around the boundary of layers 28 and 29. In the microfauna this is represented by a change from wetter to drier environments and the sediments show a change from periglacial conditions possibly mobilising earlier drift deposits prior to a period of accumulation including fine loessic deposits. The exact timing of this transition has not been determined by the dating programme. On the basis of the sediment analysis it is possible that this boundary could form the transition between MIS 2 and MIS 3 deposits. Athough where the Early Upper Palaeolithic activity, as represented by the presence of early Gravettian *Font Robert* or tanged blades lay within the sequence still remains unclear. The excavation suggests that the Late Glacial deposits may have been within layers 26, 27 or 28. The microfaunal evidence from these is dominated by Common Frog, (*Rana temporaria*) which has been found to be the dominant species in the upper layers of the section. It is believed that the engraving in the cave was also created around this time. If this interpretation of the layers is correct it would have been a challenge to enter the rear of the cave to create it, assuming that the cave passage held an even depth of deposit at this time, based on the height of these layers in Area B and the standing section. A Holocene presence is known from the cave and deposits in front of the main cave entrance suggest that these were once extensive, although in Area B they are only represented by a thin layer. The conclusions to be drawn from this work must necessarily be given with the warning that all sample sizes are very limited given the small areas of *in situ* deposit that this work sampled.

Cathole Cave holds an important role within the context of the British Palaeolithic and Welsh prehistory, holding a long episodic cave sequence of evidence for human use commencing in the early Gravettian and ending during the Middle Bronze Age. The excavation results presented here have highlighted the need for a fuller review of the data, particularly of McBurney's unpublished work, and a detailed full study of the entire faunal, lithic and environmental evidence now available from this and the more recent project.

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REFERENCES

ALDHOUSE-GREEN, S. 2000. *Paviland Cave and the 'Red Lady': a definitive report.* Bristol. Western Academic Specialist Press.

ALDHOUSE-GREEN, S., SCOTT, K., SCHWARCZ, H., GRUN, R., HOUSLEY, R., RAE, A., BEVINS, R. and REDKNAP, M. 1995. Coygan Cave, Laugharne, South Wales, a Mousterian site and hyaena den: a report on the University of Cambridge excavations. *Proceedings of the Prehistoric Society.* **61.** 37–79.

ALDHOUSE-GREEN, S., DINNIS, R. and WALKER, E.A. (in press). The nature of human activity at Cae Gwyn and Ffynnon Beuno caves and the dating of prey and predator presences. In N. Ashton (ed.), *Papers in Memory of Roger M. Jacobi*.

BALL, D.F. 1960. Relic-soil on limestone in South Wales. *Nature.* **187.** 497–498.

BARTON, R.N.E. and PRICE, C. 1999. The westernmost Upper Palaeolithic cave site in Britain and probable evidence of a Bronze Age shell midden: new investigations at Priory Farm Cave, Pembrokeshire. *Archaeology in Wales*. **39.** 3–9.

BARTON, R.N.E. and ROBERTS, A.J. 1996. Reviewing the British Late Upper Palaeolithic: new evidence for chronological patterning in the Lateglacial record. *Oxford Journal of Archaeology*. **15.** 3. 245–265.

BEEBEE, T. and GRIFFITHS, R. 2000. *Amphibians and Reptiles*. London. Harper Collins.

BOWEN, D.Q. 1970. South-east and central South Wales. In C.A. Lewis (ed.). *The Glaciations of Wales and Adjoining Regions.* 197–227. London. Longman.

BOWEN, D.Q. 1973. The Pleistocene history of Wales and the borderland. *Geological Journal.* **8.** 207–224.

BOWEN D.Q. 1977. *Wales and the Cheshire-Shropshire Lowland*. X INQUA Congress Guidebook for Excursion A8 and C8.

BOWEN, D.Q. 1989. The Quaternary rocks and landforms of Wales. In: S. Campbell and D.Q. Bowen, *Quaternary of Wales.* 15–20. Peterborough. Nature Conservancy Council. Geological Conservation Review Series 2.

BOWEN, D.Q. 1999. Wales. In D.Q. Bowen (ed.). *A Revised Correlation of Quaternary Deposits in the British Isles* 79–90. Bath. Geological Society Special Report No. 23.

BOWEN, D.Q. 2005. South Wales. In C.A. Lewis and A.E. Richards (eds). *The Glaciations of Wales and Adjacent Areas*. 145–210. Almeley. Logaston Press.

BOWEN, D.Q., PETTITT, P.B., RICHARDS, M., SYKES, B.C., IVANOVICH, M., LATHAM, A. and DEBENHAM, N. 2000. Radiometric dating, stable isotopes and DNA. In S. Aldhouse-Green *Paviland Cave and the 'Red Lady': a definitive report.* 61–80. Bristol. Western Academic Specialist Press.

BOWEN, D.Q., PHILLIPS, F.M., MCCABE, A.M., KNUTZ, P.C. and SYKES, G.A. 2002. New data for the Last Glacial Maximum in Great Britain and Ireland. *Quaternary Science Reviews.* **21.** 89–101.

BOWEN, D.Q., ROSE, J., MCCABE, A.M. and SUTHERLAND, D.G. 1986. Correlation of Quaternary glaciations in England, Ireland, Scotland and Wales. *Quaternary Science Reviews*. **5.** 299–340.

BRIDGLAND, D.R. 1986. *Clast Lithological Analysis*. Technical Guide 3. Cambridge. Quaternary Research Association.

CAMPBELL, J.B. 1977. *The Upper Palaeolithic of Britain: a study of man and nature in the Late Ice Age* (2 volumes). Oxford. Clarendon Press.

CAMPBELL, S. and BOWEN, D.Q. 1989. *Geological Conservation Review: Quaternary of Wales*. Peterborough. Nature Conservancy Council.

CAMPBELL, S., HUNT, C.O., SCOURSE, J.D. and KEEN, D.H. 1998. *Quaternary of South West England*. Joint Nature Conservation Committee. London. Chapman & Hall.

CASE, D.J. 1993. Evidence for temperate soil development during the Early Devensian in Gower, South Wales. *Geological Magazine*. **130.** 113–115.

CHARLES, R. and JACOBI, R.M. 1994. The late glacial fauna from the Robin Hood Cave, Creswell Crags: a reassessment. *Oxford Journal of Archaeology.* **13.** 1. 1–32.

COOPER, L., THOMAS, J.S., BEAMISH, M.G., GOLDWELL, A., COLLCUTT, S.N., WILLIAMS, J., JACOBI, R.M., CURRANT, A. and HIGHAM, T.F.G. 2012. An Early Upper Palaeolithic open-air station and mid-Devensian hyaena den at Grange Farm, Glaston, Rutland, UK. *Proceedings of the Prehistoric Society.* **78.** 73–93.

CURRANT, A. and JACOBI, R. 2001. A formal mammalian stratigraphy for the Late Pleistocene of Britain. *Quaternary Science Reviews.* **20.** 1707–1716.

CURRANT, A.P. and JACOBI, R. 2011. The mammal faunas of the British late Pleistocene. In N.M. Ashton, S.G. Lewis and C.B. Stringer (eds). *The Ancient Human Occupation of Britain*. 165–180. Amsterdam. Elsevier.

DAVID, A. 1991. Late Glacial archaeological residues from Wales: a selection. In N. Barton, A.J. Roberts and D.A. Roe (eds), *The Late Glacial in North-west Europe: Human Adaptation and Environmental Change at the End of the Pleistocene*. London. Council for British Archaeology Research Report No. 77, 141–159.

DAVID, A. 2007. *Palaeolithic and Mesolithic Settlement in Wales with Special Reference to Dyfed*. Oxford. British Archaeological Reports, British Series 448.

DAVID, A. and WALKER, E.A. 2004. Wales during the Mesolithic. In A. Saville (ed.), *The Mesolithic of Scotland and its Neighbours*. 299–337. Edinburgh. Society of Antiquaries of Scotland.

DINNIS, R. 2008. On the technology of late Aurignacian burin and scraper production, and the importance of the Paviland lithic assemblage and the Paviland burin. *Lithics.* **29.** 18–35.

GARROD, D.A.E. 1926. *The Upper Palaeolithic Age in Britain*. Oxford. The Clarendon Press.

GLEED-OWEN, P.C. 1998. *Quaternary herpetofaunas of the British Isles: Taxonomic descriptions, palaeoenvironmental reconstructions, and biostratigraphic implications*. Unpublished PhD Thesis. Coventry University.

GREEN, S. and WALKER, E. 1991. *Ice Age Hunters: Neanderthals and Early Modern Hunters in Wales*. Cardiff. National Museum of Wales.

HARRIS, S. and YALDEN, D.W. 1991. *Mammals of the British Isles: Handbook* (fourth edition). Oxford. Blackwell.

HEIRI, O., LOTTER, A.F. and LEMCKE, G. 2001. Loss on ignition as a method for estimating organic and carbonate content in sediments: reproducibility and comparability of results. *Journal of Palaeolimnology*. **25.** 101–110.

INGREM, C. 2009. *An investigation of the nature of human presence in Britain during oxygen isotope stage 3 (*c*. 60–25 kyr BP): a zooarchaeological approach*. Unpublished PhD thesis, University of Southampton.

JACOBI, R. 2004. The Late Upper Palaeolithic lithic collection from Gough's Cave, Cheddar, Somerset and human use of the cave. *Proceedings of the Prehistoric Society.* **70.** 1–92.

JACOBI, R M. and HIGHAM, T.F.C. 2008. The "Red Lady'' ages gracefully: new ultrafiltration AMS determinations from Paviland. *Journal of Human Evolution*. **55.** 898–907.

JACOBI, R.M. and HIGHAM, T.F.G. 2011a. The British Earlier Upper Palaeolithic: settlement and chronology. In N.M. Ashton, S.G. Lewis and C.B. Stringer (eds). *The Ancient Human Occupation of Britain*, 181–222. Amsterdam. Elsevier.

JACOBI, R.M. and HIGHAM, T.F.G. 2011b. The later Upper Palaeolithic recolonisation of Britain: new results from AMS radiocarbon dating. In N.M. Ashton, S.G. Lewis and C.B. Stringer (eds). *The Ancient Human Occupation of Britain*, 223–247. Amsterdam. Elsevier.

JENNINGS, J.N. 1985. *Karst Geomorphology*. Oxford. Blackwell.

LACAILLE, A.D. and GRIMES, W.F. 1955. The Prehistory of Caldey. *Archaeologia Cambrensis*. **104.** 85–165.

LOZEK, V. 1965. The formation of rock shelters and foam sinters in the high limestone Carpathians. In O. Stelcl (ed.). *Problems of the Speleological Research.* 73-84. Prague. Academia.

MCBURNEY, C.B.M. 1959. Report on the first season's fieldwork on British Upper Palaeolithic cave deposits. *Proceedings of the Prehistoric Society.* **25.** 260–268.

MOURNE, R., CASE, D. and BULL, P. 2000. The Paviland caves, Gower; the cave sediments. In S. Aldhouse-Green *Paviland Cave and the 'Red Lady': a definitive report,* 81–93. Bristol. Western Academic Specialist Press.

NASH, G. 2012. Brief note on the recent discovery of Upper Palaeolithic rock art at Cathole Cave on the Gower Peninsula, SS 5377 9002. *Archaeology in Wales*. **51.** 111–114.

NASH, G.H. and BEARDSLEY, A. 2013. The survey of Cathole Cave, Gower Peninsula, South Wales. *Proceedings of the University of Bristol Spelaeological Society.* **26.** 1. 73 –83.

NASH, G. VAN CALSTERAN, P., THOMAS, L. and SIMMS, M.J. 2011. Rock around the Gower. *Minerva.* Nov–Dec 2011. 22–24.

NASH, G.N., VAN CALSTEREN, P., THOMAS, L. AND SIMMS, M.J. 2012. A discovery of possible Upper Palaeolithic parietal art in Cathole Cave, Gower Peninsula, South Wales. *Proceedings of the University of Bristol Spelaeological Soc*iety. **25**. 3. 327–336.

NÉDERVELDE, J.van. 1972. Ogof-yr-Ychen (Cave of the Ox), Caldey Island. *Archaeology in Wales*. **12.** 19–20.

NÉDERVELDE J.van., DAVIES, M. and JOHN, B.S. 1973, Radiocarbon dating from Ogof-yr-Ychen, a new Pleistocene site in West Wales. *Nature.* **245.** 453–454.

OUTRAM, A. 2001. A new approach to identifying bone marrow and grease exploitation: why the 'indeterminate' fragments should not be ignored. *Journal of Archaeological Science*. **28.** 401–410.

PARKIN, R.A., ROWLEY-CONWY, P. and SERJEANTSON, D. 1986. Late Palaeolithic exploitation of horse and red deer at Gough's Cave, Cheddar, Somerset. *Proceedings of the University of Bristol Spelaeological Society.* **17.** 3. 311–330.

POWERS, M.C. 1953. A new roundness scale for sedimentary particles. *Journal of Sedimentary Petrology.* **23.** 117–119.

PRICE, C.R. 2003. *Late Plesitocene and Early Holocene Small Mammals in South West Britain*. Oxford. British Archaeological Reports British Series 347.

ROBERTS, J. 1888. Cat's Hole Cave and Park Cwm Tumulus, Gower. *Annual Report and Transactions of the Swansea Scientific Society 1887–8*. 15–23.

SCHULTING, R.J. 2007. Non-monumental burial in Neolithic Britain: a (largely) cavernous view. In: L. Larsson, F. Lüth and T. Terberger (eds.), *Non-Megalithic Mortuary Practices in the Baltic – New Methods and Research into the Development of Stone Age Society*. 581-603. Schwerin: Bericht der Römisch-Germanischen Kommission **88.**

SCHULTING, R.J., CHAPMAN, M. and CHAPMAN, E.J. 2013. AMS ^{14}C dating and stable isotope (carbon, nitrogen) analysis of an earlier Neolithic human skeletal assemblage from Hay Wood Cave, Mendip, Somerset. *Proceedings of the University of Bristol Spelaeological Society.* **26.** 1. 9–26.

SCHULTING, R.J., TRINKAUS, E., HIGHAM, T., HEDGES, R., RICHARDS, M. and CARDY, B. 2005. A mid-Upper Palaeolithic human humerus from Eel Point, South Wales, U.K. *Journal of Human Evolution.* **48.** 493–505.

SWAINSTON, S. 2000. The lithic artefacts from Paviland. In S. Aldhouse-Green (ed.) *Paviland Cave and the 'Red Lady*'. 95–113. Bristol. Western Academic Specialist Press.

VIVIAN, H.H. 1887. Response dated 23rd August 1886 to a note published by J. Lubbock entitled Description of the Park Cwm Tumulus. *Archaeologia Cambrensis*. **42.** 197–201.

WALKER, E.A. (in press). Scratching the surface: new Late Glacial lithic artefacts from south-east Wales. In N. Ashton (ed.), *Papers in Memory of Roger M. Jacobi*.

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