Mynydd Llangattwg Caves

[SO16 16]–[SO21 12]–[SO20 15]

Highlights

The caves beneath Mynydd Llangattwg form one of the two most extensive integrated systems in Britain, containing exceptionally large karst conduits containing important sediment sequences. The network of ancient and active passages records a very long history of karst drainage modification in response to surface downcutting.

Introduction

The Llangattwg cave systems include Agen Allwedd, Daren Cilau and Craig a Ffynnon, all lying beneath a moorland escarpment at the eastern end of the North Crop (Figure 6.1). Mynydd Llangattwg is a peat-covered upland formed by the Basal Grit dip slope overlying the Carboniferous Limestone; it is almost a plateau, as the dip is only 2–3°. The Grit dips south beneath a cover of Namurian shales and sandstones followed by the Lower Coal Measures. Scarp faces to the north and east have steep screes and quarried crags in the limestone, overlooking the Old Red Sandstone floor of the Usk Valley. Along the southern margin of the plateau the River Clydach flows east through a steep gorge tributary to the River Usk. Input drainage to the caves is through numerous small sinks and percolation into the outcrops of both the limestone and the fractured and permeable Basal Grit. Pwll y Cwm is the largest of the multiple resurgences along the floor of the Clydach Gorge.

All the main cave passages are developed in the 50 m of Chadian oolitic limestones and dolomites within the Abercriban Oolite Group: the most cavernous unit is the Blaen Onneu Oolite (Wright, 1986a). These are overlain by the thin impermeable mudstones of the Arundian Llanelly Formation, and the Holkerian Dowlais Limestone which contains very little explored cave under Llangattwg. Palaeokarstic horizons, with associated mudstones or palaeosols, are developed at several levels in the oolites, and also at the junction of the Dowlais Limestone with the overlying Basal Grit. The limestone dips 2–3° to the southwest, with minor flexures producing local dips up to 15°. The area is traversed by a number of faults, mostly trending ENE or NNW, and there are well developed joint sets trending NNW and NNE.

A wealth of publications refer to Agen Allwedd, but the main passages of Daren Cilau have only been explored since 1984 and therefore largely await the scientific study that they warrant. The cave geomorphology has been comprehensively assessed by Smart and Gardener (1989), and the passage details and hydrology were described by Stratford (1995), Stevens (1992) and Gascoine (1989). Detailed accounts cover the succession of major new discoveries in Ogof Agen Allwedd (Leitch, 1960, 1973; Jenkins, 1963; Gardener, 1983; Tomalin, 1987; Abbot and Murgatroyd, 1988; Price, 1988), Ogof Daren Cilau (Gardener, 1984, 1985, 1986; Gardener and Westlake, 1985; Farr, 1985, 1986, 1993) and Ogof Craig a Ffynnon (Parker, 1978; Gascoine, 1979). Agen Allwedd has also been a prime site for research on the environments and paleomagnetism of clastic cave sediments (Bull, 1975, 1976a, 1978, 1981; Noel *et ed.,* 1979, 1981; Noel, 1983, 1986, 1988).

Description

More than 65 km of cave passage have been explored under Mynydd Llangattwg, in three major cave systems, Ogof Agen Allwedd, Ogof Daren Cilau and Ogof Craig a Ffynnon, together with several smaller caves and isolated sections of larger systems (Figure 6.14). Morphologically these constitute a single cave system, but links have not yet been explored between the three main caves. Each has its own single dry entrance, though Daren Cilau can also be entered through the flooded passages at the resurgence.

Ogof Agen Allwedd

This is the most westerly of the three major caves, was the first to be explored, and now has more than 34 km of mapped passages (Figure 6.15). Its main stream drains from the Remembrance Series under the northern tip of Mynydd Llangattwg, along Turkey Streamway and the lower part of the Main Streamway, into Maytime Series where active phreatic loops link sections of vadose streamway. The water then flows into the lower reaches of Daren Cilau. The streamway steadily increases in size downstream; many sections are 5–10 m high and wide, and the downstream passage is a massive phreatic tunnel now partially drained. Vadose trenches are discontinuous as they are mainly incised through the crests of low phreatic loops.

The major active tributaries are two vadose streamways which drain in from the north. The first is a stream from the entrance in the northern escarpment, which collects other inlets and forms the upper part of the Main Streamway, above the junction with the larger Turkey Streamway. The second is the long narrow canyon of Southern Stream Passage. The active streamways provide the links between the Main Streamway and the major abandoned passages which lie further north-east. Largest of these are the old phreatic tunnels of Summertime Series and Main Passage, which are mostly 10 -20 m high and wide. They are now partly blocked by enormous collapse piles, boulder chokes, and thick sequences of clas-tic sediment; deep profiles have been cut through the fills, notably at the south-eastern end of Main Passage. Smaller passages off these trunk routes are numerous and at various levels, and some connect with fragments of other large trunk passages; the Trident and Priory Road tunnels are blocked with sediment before they reach the passages of Daren Cilau.

Thick clastic sediments are conspicuous in much of Agen Allwedd, and completely fill some of the older passages. The fill in Main Passage includes a capping horizon of fine lacustrine silt, whose laminations are remarkably consistent along the passage (Bull, 1981). Calcite speleothems are present at only a few places in the cave, as inflows of percolation water are severely curtailed by the impermeable cover rocks over these deeper zones of the escarpment (Figure 6.15). However, there are very fine stalactites, extensively overgrown by helictites, in the high-level passage into Maytime. Mud formations with drip features are more widespread in the old passages, and some clay banks are thickly covered by bladed gypsum crystals. In a few places, gypsum crystals have caused tabular roof collapse by growing in the limestone bedding planes.

Ogof Daren Cilau

The 30 km of passages explored from the Daren Cilau entrance lie at the heart of the Llangattwg cave system, though its passages are currently isolated from the continuations in Agen Allwedd and Craig a Ffynnon by the incidental distribution of impenetrable boulder collapses and sediment chokes. The main caves of Daren Cilau consist of sections of very large old conduit linked by smaller passages, both active and relict (Figure 6.15). Sections of three streamways are encountered, and all eventually converge to enter the terminal sump, where an active phreatic loop extends to the Pwll y Cwm resurgence; this loop reaches a depth of 217 m below the highest point in the cave.

The Entrance Series has a small vadose passage into a rift and a short section of large, old passage blocked at both ends by collapse. Beyond this, a series of rifts and muddy, abandoned passages extends to a large chamber and a major junction. To the east, Epocalypse Way is a major old trunk route, up to 8 m wide, with smaller vadose passages leading off into Antler Passage and Busman's Holiday. To the west, a complex series of rifts and high-levels leads to the Time Machine. This is a massive tunnel so heavily modified by vadose undercutting and block collapse that its phreatic origins are barely recognizable (Figure 6.16); much of it is 30 m high and wide, making it the largest cave passage in Britain. The Time Machine divides at its southern end, but the main route continues into the high-level Kings Road, beyond the Hard Rock series of small rifts and larger chambers entering from the west. Kings Road continues to the lower streamway which feeds to the Terminal Sump into the flooded connection to the resurgence. From this open streamway, several flooded sections guard the major inlets from the west. Water from Agen Allwedd drains down the large vadose streamway of San Agustin, but a short flooded section has not yet been explored to make the final link. The much longer tributary inlet of Agua Colorado carries a smaller stream, and near its head provides access to high-levels which reach chokes very close to the similar Priory Road passage in Agen Allwedd.

Thick sequences of clastic sediments occur in many of the large old trunk passages of Daren Cilau. Calcite speleothems are restricted beneath the impermeable cover on the plateau, but are more common in the eastern sector. Passages

around Epocalypse Way contain some very fine displays of straws, helictites, stalactites and stalagmites, beside a spectacular profusion of multi-coloured aragonite anthodites up to 40 mm long (Kendall, 1988).

Ogof Craig a Ffynnon

Lying east of Daren Cilau, nearly 9 km of caves in Ogof Craig a Ffynnon are reached through a passage truncated in the side of the entrenched Clydach Gorge (Figure 6.15). A first section of large old abandoned tunnel ends at the Hall of the Mountain Kings, but much of the continuation breaks into series of long, straight, parallel rifts, some of which link down to short sections of active streamway. The cave is broken by five areas of massive collapse; some of these contain large blocks of sandstone and lie directly below collapse dolines on the moor over 100 m above. Craig a Ffynnon now lies well clear of the impermeable cover on the limestone, and percolation drainage has deposited many excellent calcite speleothems; the older passages also contain extensive clastic sediments.

Minor caves

There are few open stream sinks on the plateau moorland. Llangattwg Swallet takes the largest flow into a collapse doline in the cap of Basal Grit. Other dolines reach down into the Dowlais Limestone, but none can be followed to depths greater than 40 m. Sediments in Pwll Gwynt were deposited with reversed magnetic polarity, indicating an age greater than 780 000 years. Of the smaller caves around the escarpment rim, Eglwys Faen is the longest with passages which start large, only to terminate in major collapses. In the Clydach Gorge, the most important caves are the Pwll y Cwm resurgence and its flood overflow through the narrow rifts of Elm Hole, and Ogof Capel, a vadose streamway well decorated with calcite dripstone (Gardener, 1988).

Interpretation

The overall drainage trend in the Llangattwg limestone is to the south-east, to resurgence positions determined by the surface topography. This direction is almost across the low SSW dip. There has, therefore, been a long history of vadose inlet drainage roughly downdip to join phreatic trunk conduits along the strike; the latter have shifted progressively downdip in response to valley downcutting and lowering of resurgence levels, leaving parallel abandoned caves north-east of the active drains. Both vadose and phreatic components of the cave system have been constrained to a zone of limestone only 50 m thick, wherein they have been subject to strong directional control by tectonic fractures. The influence of joints and faults on the passage details is evident in the rectilinear patterns in many parts of the cave system. The strong influence of two sets of joints on a strike phreatic passage is clearly seen in the modern stream route into Maytime; the cave's zigzag pattern through the joint grid includes downdip loops which are still flooded between updip segments which are now drained.

Palaeokarst and palaeosol horizons have influenced the stratigraphic positions of passage development, acting as aquicludes or inception horizons and also limiting the extent of upward collapse stoping; hence many passages are roofed by these beds. Stratigraphy has also exercised broader controls. Inlets to the overlying Dowlais Limestone drain along the shales and calcite mudstones of the Llanelly Formation for considerable distances before finding routes through fractures into the cavernous limestones below. The impermeable cover, of Namurian and younger clastics, has largely excluded percolation water from the caves, and there are few calcite and aragonite speleothems, except in the uncapped passages of Craig a Ffynnon. Some very delicate speleothems appear to have been formed by evaporation of water which was intergranular seepage through the Grit. The Namurian shales are pyritiferous, and may have been the source of the sulphate which has formed so much gypsum in parts of Agen Allwedd.

Smart and Gardener (1989) interpreted the isolated sections of very large trunk passage as parts of ancient systems of essentially strike-orientated phreatic conduits. Major streams flowing off the Old Red Sandstone dip slope entered sinks into vadose passages which drained downdip, or obliquely along the joints, to feed the trunk cave drainage; this was orientated ESE towards presently unknown resurgence sites along the eastern outcrop of the limestone (Figure 6.17). The main sinking drainage was then captured by the River Usk whose valley was deepened, fluvially and glacially, along the outcrop of the softer rocks around the Devonian/Carboniferous boundary. The beheaded trunk passages were largely

choked by collapse and sediment infill, while new, smaller vadose caves developed obliquely downdip under joint control, and in many places cut across the older, strike-orientated, phreatic trunks. New trunk drains at lower positions, down the dip, were originally phreatic, but resurgence lowering left them in the vadose environment except for the lower phreatic loops. They have since undergone extensive vadose modification, with considerable entrenchment at the crests of phreatic loops. The vadose passages developed in the lower beds of the limestone, and some have subsequently entrenched into the underlying shales, while the phreatic caves had lifting segments which took them and the early resurgences to the top of the oolitic limestones just beneath the Llanelly Formation (Figure 6.17).

The complexity of the Llangattwg cave systems, with the variation in size and morphology of their passages, reflects a long and complex history extending well back into the Pleistocene. The very large sizes of the old trunk caves is incompatible with the modern drainage to the limestone. The oldest passages were fed by headwaters of the River Usk, but this river was then entrenched below the plateau sinks. Glaciers breached the Old Red Sandstone escarpment to flow down the Usk Valley: they could have supplied large flows of sediment-charged, aggressively acidic meltwater to the high-level marginal sinks in the limestone. Some of the Llangattwg caves may therefore be unusual in having been active largely during the glacial stages of the Pleistocene. During the interglacials, water charged with biogenic carbon dioxide had less effect because of the very small flows reaching the elevated limestone outcrops. This concept is supported by the glacial ancestry of much of the cave sediment (Smart and Christopher, 1989; Bull, 1976a, 1980), but the sediment sequences in the main caves have not yet yielded a framework of absolute dates.

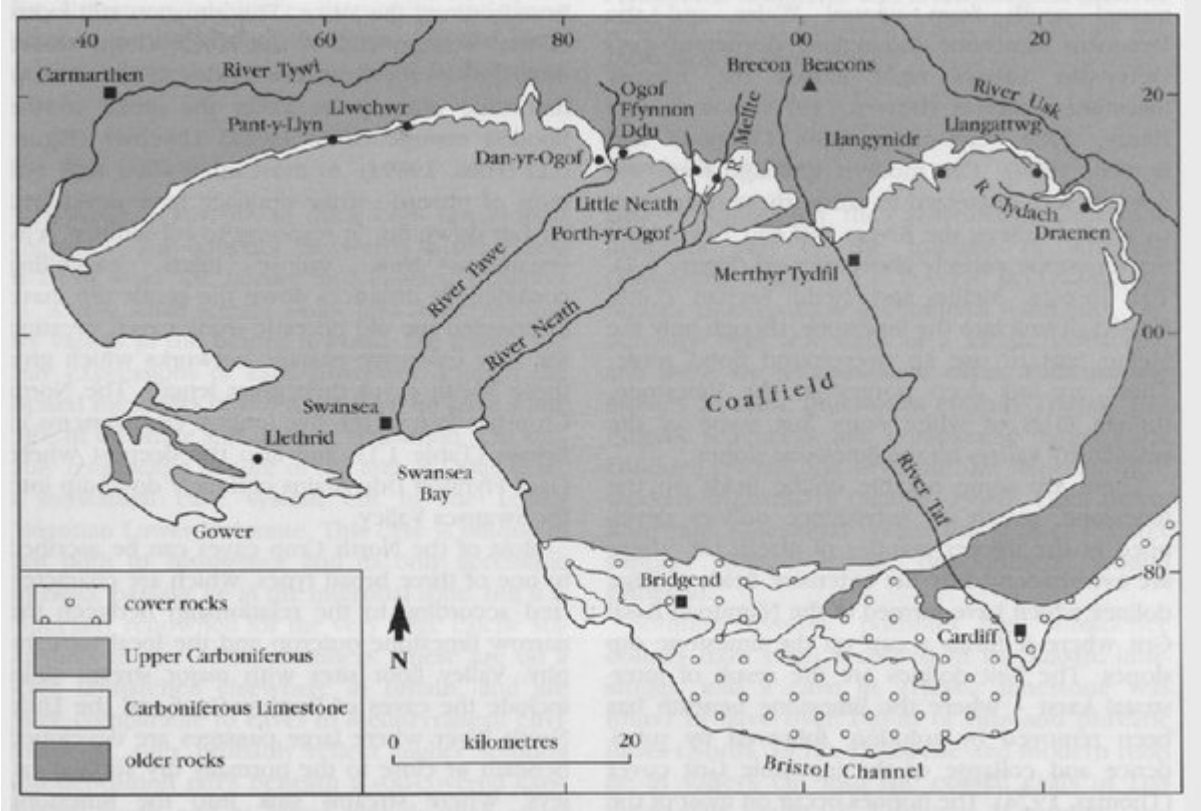
While the upper end of the cave system was being modified in response to entrenchment of the Usk, the lower end was rejuvenated as the Clydach Gorge retreated into the limestone escarpment. The ages of the earliest trunk passages are not yet known, but they appear to predate much of the glacial excavation of the Usk Valley, and probably date from the early Pleistocene. Early resurgences could have been close to the mouth of a proto-Clydach valley. The chronology of entrenchment of the Clydach Gorge is debatable. South of the Clydach, Ogof Draenen contains some old abandoned cave passages which were formed by northward drainage into the Clydach Gorge, thus indicating its considerable age (see (Figure 6.18)). Draenen has no passages large enough to represent the downstream continuations of the old Llangattwg trunk conduits, truncated by a younger Gorge, but these could lie downdip of the known cave system. The age of the Clydach Gorge therefore remains uncertain, but current evidence suggests that it is older than most of the caves.

Unlike other systems of comparable size and complexity, such as the Ease Gill caves and Ogof Ffynnon Ddu, the Llangattwg cave system appears to have experienced a major change in drainage pattern at some point in its development. Establishing the nature and cause of this change is fundamental to understanding the geomorphological history of this area.

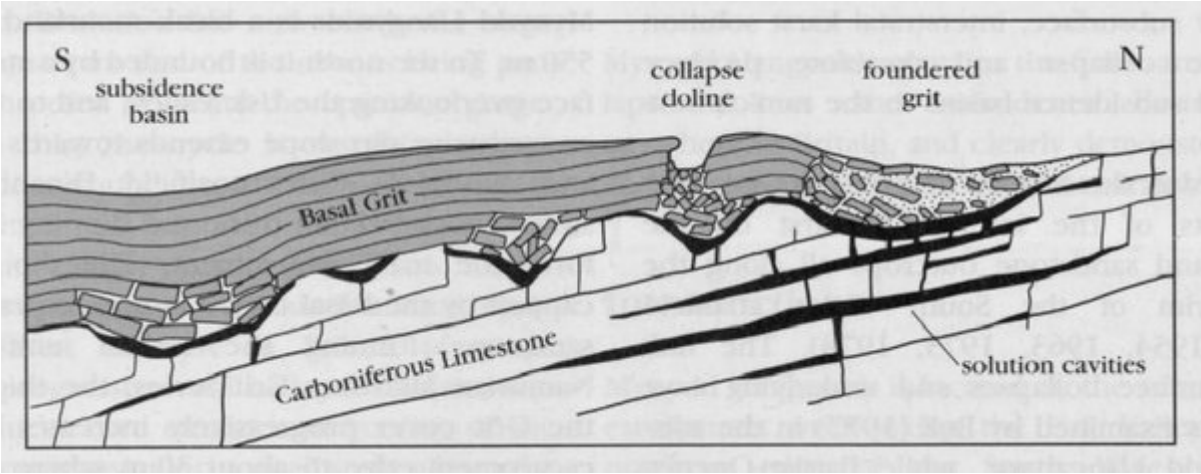
Conclusion

The caves of Llangattwg form one of the most extensive systems in Britain, which developed largely beneath an impermeable cover. They record the evolution of a massive karst drainage system over a very considerable timespan, during which the surface drainage underwent major changes and captured much of the early sinking water. Subsequently these caves were modified by smaller percolation flows and possibly by episodic invasion by glacier marginal drainage. The much greater underground flows of the past formed trunk drains, one of which is now the largest single cave passage in Britain. The old caves contain exceptional clastic sediment sequences of great stratigraphic value, and some unusual speleothems of calcite, aragonite and gypsum.

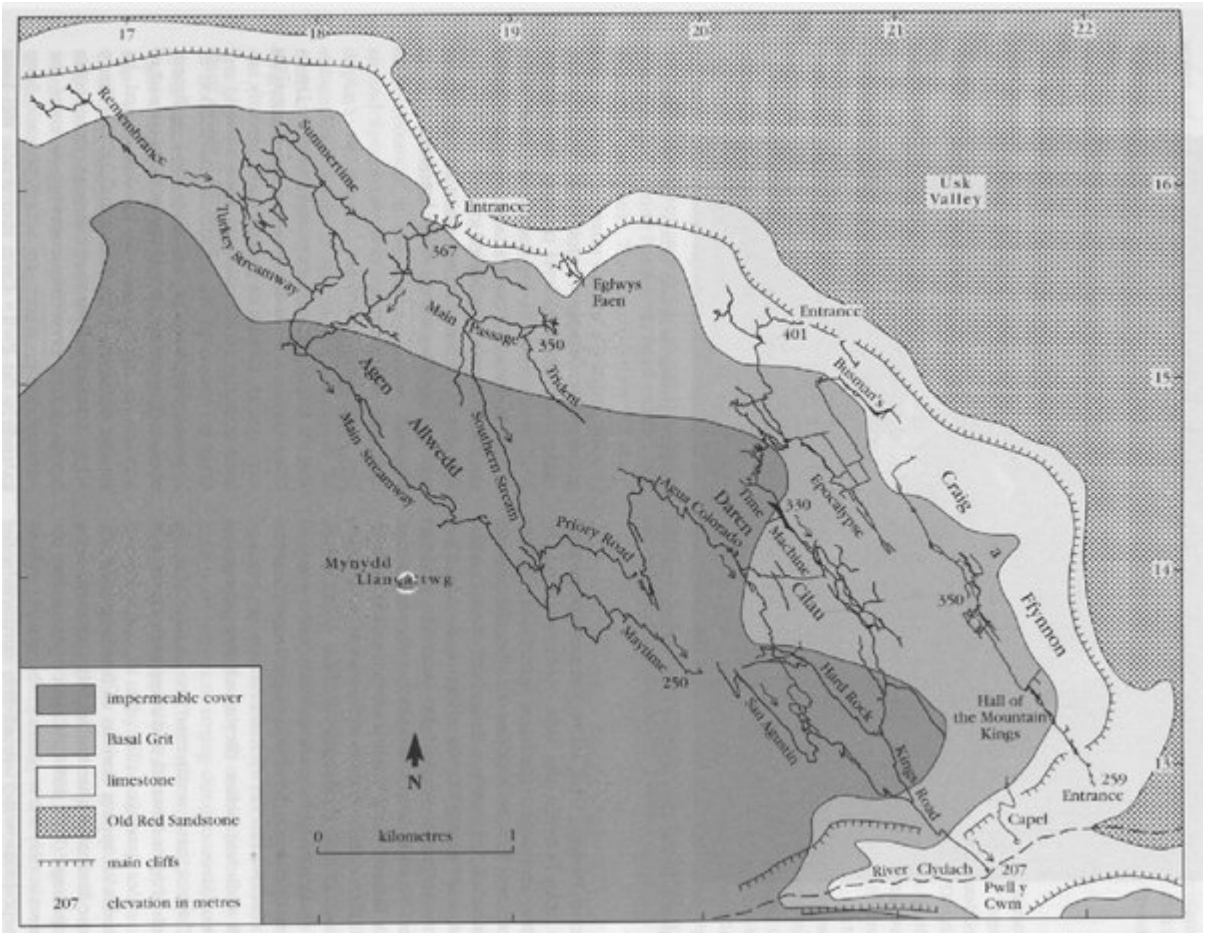
References



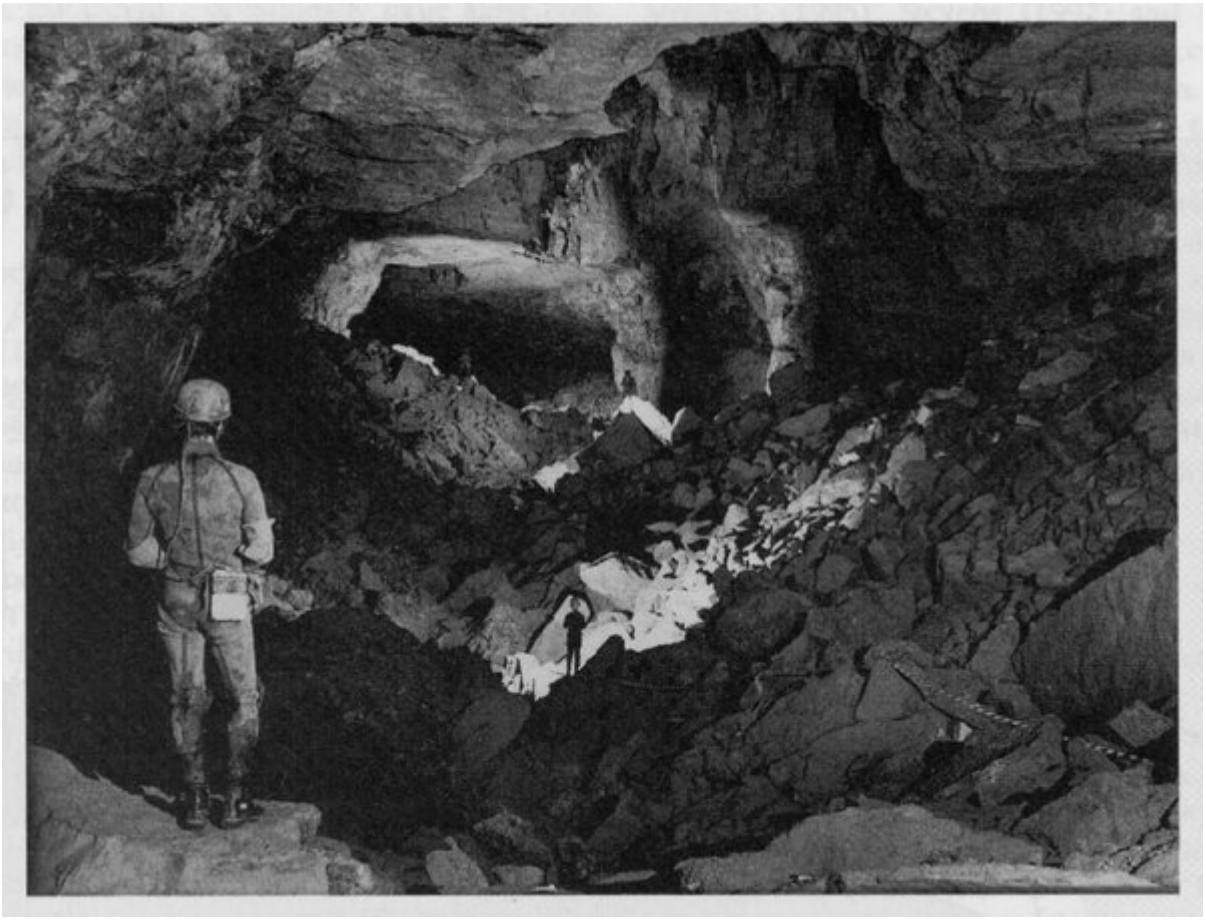
(Figure 6.1) Outline map of the karst areas around the perimeter of the South Wales coalfield, with locations referred to in the text. The cover rocks in the south are Triassic and Jurassic mudstones and thin limestones.



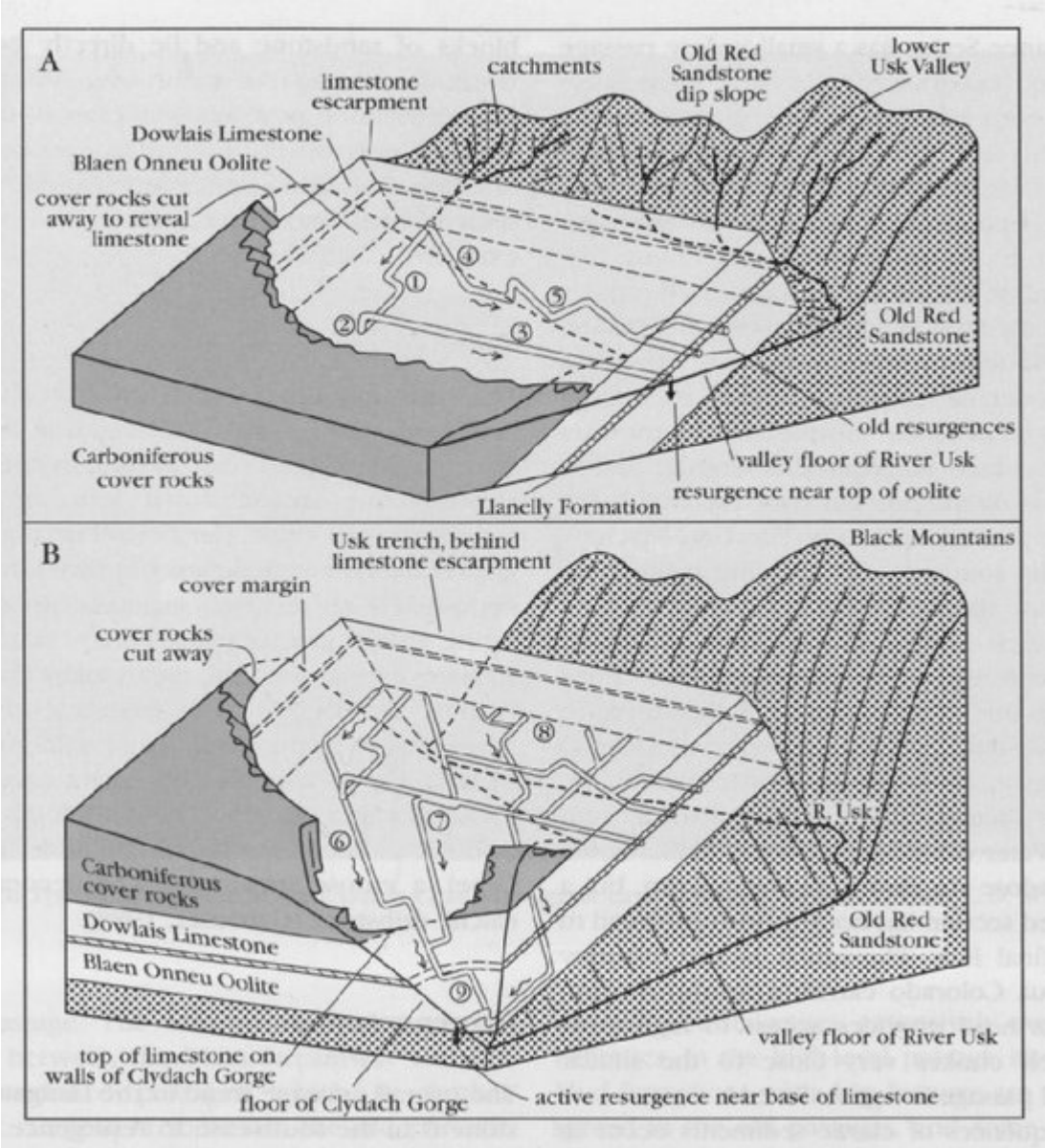
(Figure 6.14) Diagrammatic cross-section through the three types of surface depression formed in the Basal Grit due to solution of the limestone beneath (after Thomas, 1974).



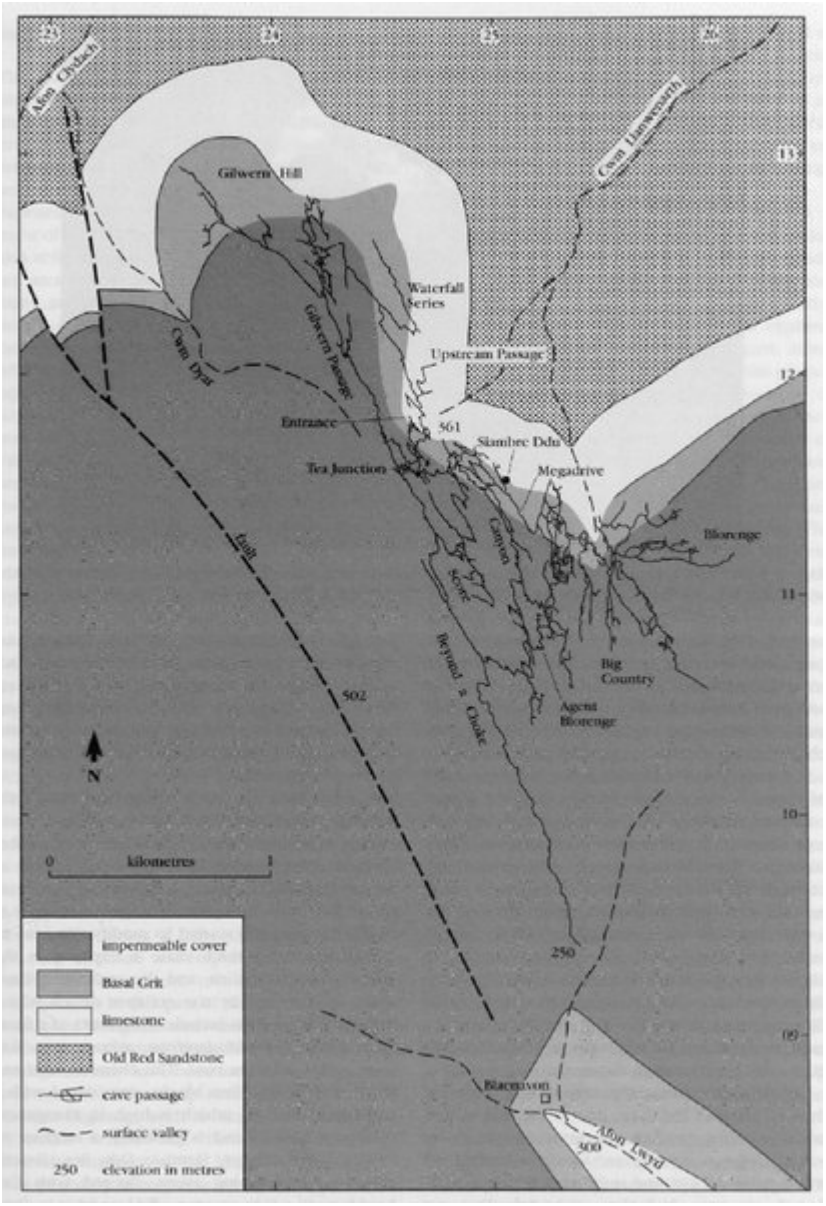
(Figure 6.15) Outline map of the caves under Mynydd Llangattwg (from surveys by Chelsea Speleological Society, British Speleological Association, Cwmbran Caving Club, Cave Diving Group and others).



(Figure 6.16) The Time Machine in Ogof Daren Cilau, the largest cave passage in Britain. (Photo: C.D. Westlake.)



(Figure 6.17) Block diagrams showing stages in the evolution of the Llangattwg caves. (A) In the early stage, the Usk headwaters drain into the cave: 1 = vadose flow downdip; 2 = phreatic lift taking water from the base to near the top of the oolites; 3 = phreatic strike flow; 4 = vadose flow on joints; 5 = phreatic conduit looping along joints. (B) In the later stage, the limestone escarpment is perched above the Usk trench: 6 = main drainage on joints with greater downdip component; 7 = older passages invaded by vadose streams; 8 = vadose inlets from limestone outcrop and from glacier melt during Pleistocene; 9 = limited phreatic development behind resurgence. (After Smart and Gardener, 1989.)



(Figure 6.18) Outline map of Ogof Draenen; this is only a centreline plot of the cave, with no indication of passage widths (from survey by Chelsea Speleological Society).