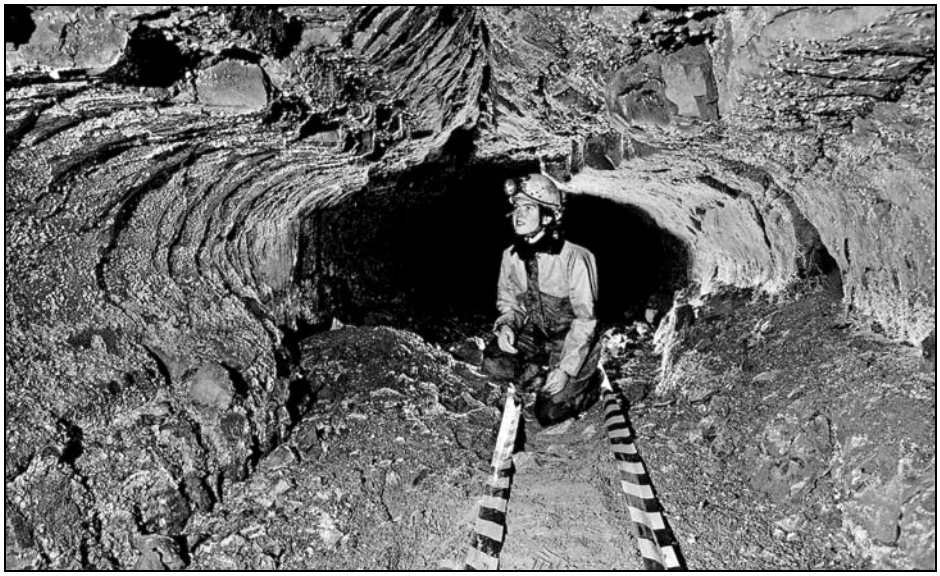
Science in Ogof Draenen

Cave and Karst Science 38(1) was a special issue devoted to Ogof Draenen. In his regular reviews, Charlie Self gives layman's summaries of this issue.

Cave and Karst Science **38**(1) is a theme issue devoted to a single topic – the cave Ogof Draenen in South Wales. Perhaps I am turning into an old codger, but my first thoughts were to make a comparison with earlier single-topic publications on major caves in South Wales. Dan yr Ogof (DYO) was the theme in 1977 for a double edition of BCRA Transactions (a previous name for our present C&KS). Ogof Ffynnon Ddu (OFD) was the subject in 1969 of a special publication of the South Wales Caving Club. These two early publications have multiple authors, but are what we should call monographs – an integrated work devoted to all aspects of a single subject. This issue of C&KS is quite different, in that it is a collection of separately authored papers on specific topics related to the cave Ogof Draenen. It does not pretend to be the complete story, which is why I will return DYO and OFD to the 'cave' part of my bookshelf while this issue of C&KS will be filed with the journals.



Pippa Rogers in Gone in the Head Passage, Ogof Draenen. Photo: Ben Lovett.

Ogof Draenen: an Overview of its Discovery and Exploration

Ben Lovett

This short report describes the discovery and exploration of what has now become the longest cave in the British Isles. The breakthrough came after four years of regular Thursday evening digging by the Cardiff-based Morgannwg Caving Club — and what a breakthrough it was!

Fleur Loveridge with speleothems in Grotto Passage, Dollimore Series, Ogof Draenen. Photo: Ben Lovett.

In the first two months, 20km of new cave was explored. In only two years, Ogof Draenen overtook the Lancaster-Ease Gill System to become Britain's longest cave. Its surveyed length is currently just over 70km.

However, the best thing about the exploration of Ogof Draenen was not its speed, but its care. Many tens of kilometres of marking tape were laid in the cave, often on the day of discovery, to confine subsequent visitors to a narrow trail. Thanks to this forethought, cavers today can still enjoy the pristine sediment floors and delicate gypsum speleothems that the original explorers marvelled at more than a decade ago.

Landscape Evolution in Southeast Wales: Evidence from Aquifer Geometry and Surface Topography Associated with the Ogof Draenen Cave System

Michael Simms and Andrew Farrant

This is a difficult paper about a difficult subject, not made easier by the fact that the mainly cave-based evidence is contained in a sister paper by the same authors later in this journal. Would it have been easier to follow if the papers had been printed in reverse order? I am not sure it would, but readers downloading from the web can make their own choice. Certainly the two papers should be read in conjunction.

To discover so much about the long-term evolution of the local landscape is an impressive piece of detective work – and like all good detective stories, it is fiendishly complicated. Where did the water sink? Where did the water then go? There are three suspects: Usk, Clydach, and Lwyd. With names like these, you just know they must be guilty.

Now here is where it gets complicated: right at the start. A million or so years ago, Lwyd was miles to the south of any exposed limestone and there was no Clydach at all! The water sank where the Clydach gorge is now, then flowed to springs on the side of the River Usk. Megadrive was one of the cave passages thus formed. At this early time, both the hills and the valleys were at a much higher altitude than they are now. The River Usk dominated the landscape, determining the base level for water both above and underground. One of these above-ground watercourses was a downstream tributary of the Usk called Lwyd that cut down in its bed to eventually expose the limestone. Cave water from the Clydach sinks now had a new outlet to the south.

Over the following millennia the river Lwyd cut deeper into the bedrock, exposing more and more limestone. The resurgence of Ogof Draenen moved further south with each loss of altitude, creating new passages in the cave attuned to each of these new resurgences. Meanwhile, upstream to the north, wind-blown snow was accumulating in north-east-facing corries (cirques) during the colder periods of what popular culture calls the 'Ice Ages'. This caused severe erosion and one of these corries became a great embayment, which attracted surface water and became the River Clydach.

Glacial erosion works much faster than fluvial (river) erosion, so a new resurgence soon appeared in the Clydach valley, fed through Gilwern Passage. The effects of

this new resurgence were soon felt throughout the cave. The sinks now feeding this system were in the upper Lwyd valley and the west flank of the River Usk – so there was a complete reversal of drainage for all Ogof Draenen, from south to north. By a stroke of bad luck (a geological fault), the River Clydach found it impossible to develop new resurgences at a lower altitude as it deepened its valley. Slowly and patiently, the River Lwyd continued to excavate its bed until its altitude was low enough to recapture the main drain, which today is seen in the Beyond a Choke streamway. New resurgences came into being, far to the south in the Lwyd valley near Pontnewynydd.

Three-way relationships are always complicated — but until reading this paper, I never realised that this also applied to geography.

On the Occurrence & Distribution of Bats in Ogof Draenen

Rhian Kendall and Tim Guilford

This paper is a collation of all the records of bat sightings in Ogof Draenen since the cave was discovered in 1994. In a beautifully scientific presentation, the authors have managed to reconcile the unsystematic content of these records. Cavers know that they should not shine their lights on roosting bats, so most of the accurate counts were made on specific bat study trips. On other occasions, cavers would have a quick look around and estimate the number. Bats roosting in a main through-route will be seen, while those in a side passage will not. Horseshoe bats like to hang from the cave roof and are easily visible; other species like to hide in cracks. Apart from live bats, there is evidence from bat guano (poo) and the occasional bat skeleton.

The data may be of variable quality, but there is sufficient quantity collected over enough years for conclusions to be reached. The overwhelming majority of sightings are of Lesser Horseshoe bats, with occasional Greater Horseshoe and *Myotis* species also seen. Sightings are concentrated in dry relict passages that lie close to the scarp of the hillside, such as Megadrive. There is a well-known winter bat roost at Siambre Ddu, a gritstone collapse chamber on the hillside above the cave. The probability is that bats in the Siambre Ddu roost move deeper underground (into Ogof Draenen) during periods of very cold weather. Bat droppings can be found throughout the dry parts of the cave, while pollen analysis of ancient guano deposits suggests that bats formerly used the cave in both summer and winter.

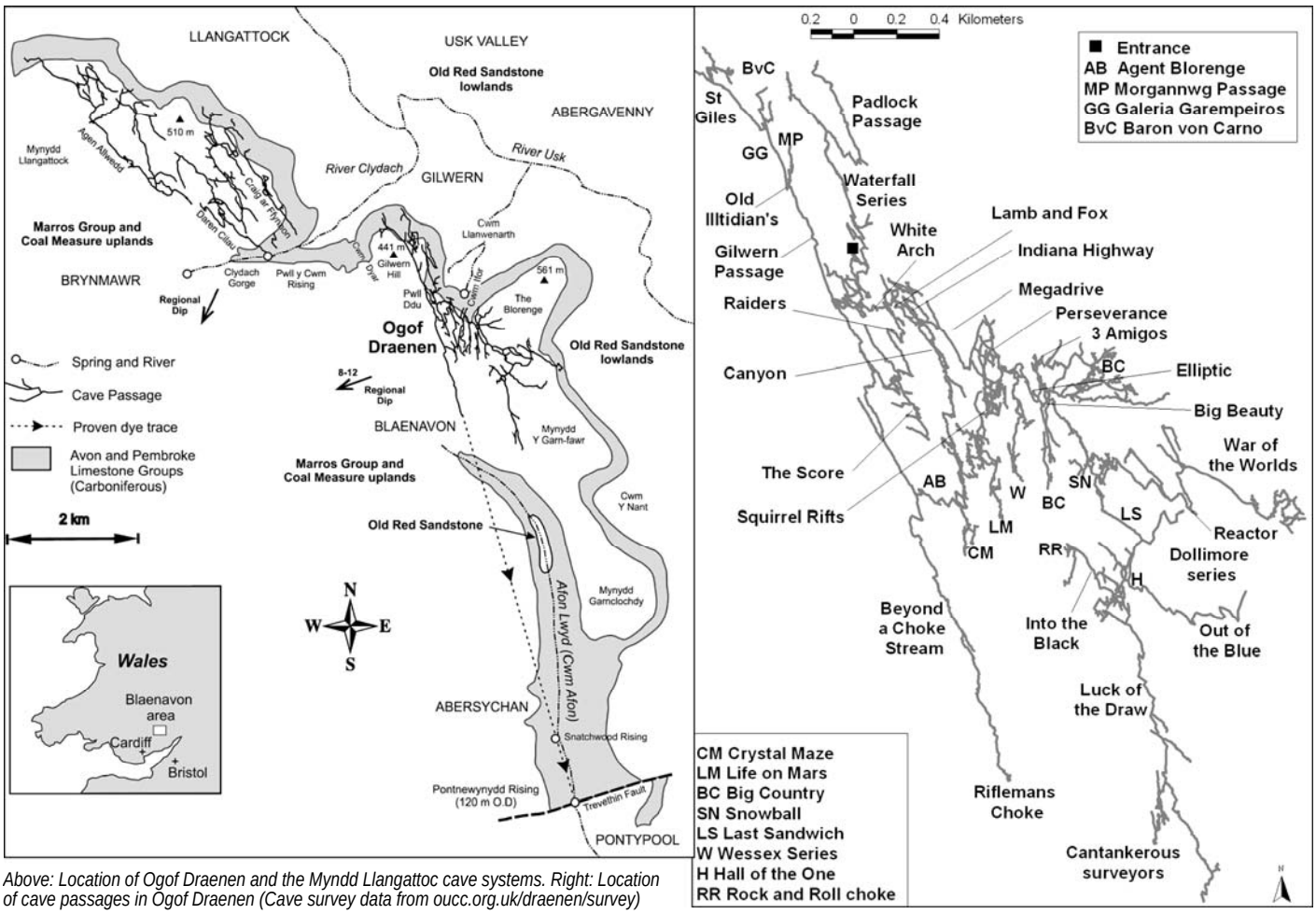
The Hydrogeology of Ogof Draenen: New Insights into a Complex Multi-catchment Karst System from Tracer Testing

Lou Maurice and Tim Guilford

The modern hydrology of Ogof Draenen at first seems relatively straightforward. At the northern end of the cave (Gilwern Passage), the cave stream flows north to resurge in the Cwm Dyar valley, a tributary of the Clydach. All the rest of the cave drains south to both Snatchwood and Pontnewynydd springs in the Lwyd valley. Sinking streams on the Foxhunter escarpment (which lies south of the main part of the cave) flow to other springs in the Lwyd valley without mixing with the Ogof Draenen water.

However within the cave, the hydrological pattern is much more complicated. The reason for this is the presence of many large passages formed during earlier hydrological cycles. Small modern streams enter these relict passages as inlets, cut across them or simply flow along them for a while before disappearing through boulders in the floor. By dye tracing, the authors found a hydrological divide in the far eastern part of the cave, where inlet streams took two different routes out of the Prisoners of War maze before combining much later.

The main part of the paper details the dye tracing of the Into the Black and Big Country streams (which with the Beyond a Choke stream form the three main underground watercourses). One of the difficulties involved in dye tracing is natural variation in background fluorescence of the springs being monitored. After rain, the flow rate increases; fluorescence increases (because of more organic particles in suspension) while specific electrical conductivity (SEC) decreases because of dilution. Graphs show a direct linear relationship between background fluoresc-



Above: Location of Ogof Draenen and the Myndd Llangattoc cave systems. Right: Location of cave passages in Ogof Draenen (Cave survey data from oucc.org.uk/draenen/survey)

ence and SEC, specific to each spring. In this study, the SEC of springs was monitored before, during, and after the dye traces. In this way, the positive traces to Snatchwood and Pontnewynydd springs were shown to be genuine, while a fluorescence spike at a spring to the north proved to be a 'false positive' due to a flood pulse. This case study shows how SEC monitoring is a useful refinement of tracer testing of cave streams.

Ogof Draenen: Speleogenesis of a Hydrological See-saw from the Karst of South Wales

Andrew Farrant and Michael Simms

This is the major paper of this issue of C&KS, comprising 22 pages of text and diagrams. The paper places great emphasis on geology, as this is the key to understanding the formation of the cave.

Ogof Draenen has developed in Lower Carboniferous limestone, as have most of the major caves in the British Isles. In Yorkshire, the dip of the limestone is less than the gradient of the landscape, so streams on the upland fells sink down through the limestone sequence to reappear as springs in the valleys. On Mendip, the limestone is steeply dipping so the situation is reversed; upland streams sink into the base of the limestone and progress through steadily younger rocks before emerging in the valleys as springs at the top of the limestone sequence.

The northern outcrop of Carboniferous limestone in South Wales is sufficiently steeply dipping that the caves should follow the Mendip pattern. This is exactly what happens in the western part of the outcrop in the Brecon Beacons (e.g., the caves OFD and DYO).

But at Ogof Draenen in the east, the situation is very different. Here, the limestone is seen as a narrow band in the steep north- and east-facing scarp of the hills. In the down-dip direction (south-west), the limestone is overlain by impervious rocks of the South Wales coalfield, so there are no outlets for groundwater. The water therefore uses joints in the rock to flow sideways along the strike as it travels beneath Gilwern Hill. With impermeable Upper Carboniferous sandstones above the cave and impermeable Devonian sandstones beneath, this is a fine example of interstratal karst.

A further geological constraint is the presence of impermeable beds within the limestone, which has caused the cave to develop almost entirely within Clydach Valley Subgroup rocks of the middle part of the limestone sequence. As a result, the hydraulic gradient is unusually shallow and small changes in relative erosion rates of the surface valleys can reverse the direction of drainage of underground streams.

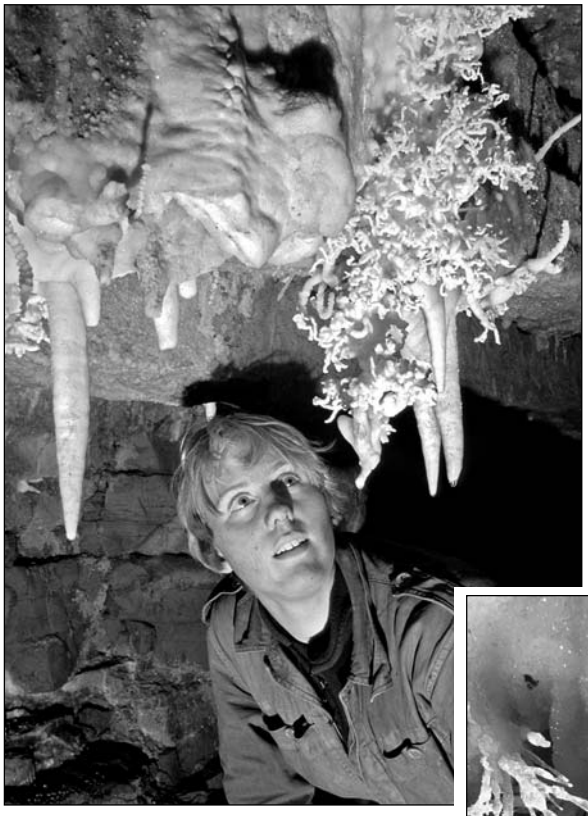
Much of the second half of the paper is concerned with the speleogenesis of Ogof Draenen and how the different phases of development relate to former water-table elevations. Five phases have been identified, with the War of the Worlds conduit thought to be the oldest. The second phase is the Megadrive-Elliptic system, fed by a major stream sink to the north of the known cave (where the valley of the Afon Clydach is now); the likely resurgence (to the south-east) was on the west side of the River Usk.

Phase three is called the Cwm Afon system, this being the local name for part of the upper Lwyd valley. Far to the south of the cave in a mostly sideways (along the strike) but slightly down-dip direction, the River Lwyd excavated its valley until limestone appeared in the valley floor. There was now a new outlet for groundwater at a lower elevation than the Usk resurgence. A new cave passage appeared (Hexamine Highways – Luck of the Draw) carrying the captured streams of the Megadrive system in a more southerly direction. As the Lwyd valley developed, other resurgences were created further south and at lower elevations. New down-dip capture passages were created in the cave, progressively further upstream (and further west), corresponding to this falling base level. Meanwhile, continuing surface erosion decreased the importance of the 'Clydach' sink and new vadose inlets appeared carrying water derived from the eastern escarpment.

Phase four is the Clydach Gorge system and represents a fundamental re-orientation of underground drainage. To the north of the cave, the river Clydach was developing rapidly and soon cut down to the top of the limestone. Eventually, the limestone was eroded to an elevation below that of the Cwm Afon resurgences to the south, reversing the hydraulic gradient throughout the cave and creating a new resurgence at the northern end of Gilwern Passage.

The current phase of cave development is known as the Beyond a Choke Streamway system and follows a second reversal of underground drainage. Far to the south, continuing erosion in the Lwyd valley established new springs near Pontnewynydd below the level of the Clydach spring. These new springs have re-captured all the cave water but for a small stream at the northern end of the system.

This C&KS Explained report in no way does justice to the original paper, which is absolutely stuffed with information. However, be warned. There is so much data that the reader can easily get lost in the detail about individual passages and lose sight of the overall theme, which is the speleogenesis of Britain's longest cave. ■



Above: Pauline Rigby with aragonite speleothems at the High Camp Treasures, near Destiny Inlet in Ogof Draenen.
Right: Needle-like aragonite speleothems (anthodites) in Anthodite Chamber, part of the Wessex Series in Ogof Draenen.
Photos: Tim Guilford.

☞ Further Reading

Coase AC & Judson DM (eds.) (1977) Dan Yr Ogof and its associated caves [South Wales]. BCRA Transactions 4(1), pp245-344.

O'Reilly PM, O'Reilley SE & Fairbairn CM (1969) OgofFfynnon Ddu, Penwyllt, Breconshire. Penwyllt, Swansea:South Wales Caving Club.

More summaries of papers in Cave & Karst Science in the next issue of Speleology.