# Priddy caves

[ST 531 513]–[ST 549 501]

## Highlights

The Priddy caves represent excellent examples of predominantly phreatic swallet cave systems which have been rejuvenated, or abandoned, as a result of base-level lowering. The three main caves show evidence for significant differences in the duration of the initial phreatic phase and their ensuing vadose histories, despite all draining to the same resurgence. They provide a striking contrast with the dominantly vadose swallet caves of the Charterhouse area.

## Introduction

The caves lie under the limestone plateau on the south and south-west slopes of North Hill, around the village of Priddy (Figure 5.1). Swildon's Hole, St Cuthbert's Swallet, Eastwater Cavern and Hunter's Hole are all major influent cave systems, though the latter two are now largely abandoned. Allogenic streams flowing from the Old Red Sandstone outcrop of the North Hill pericline cross the Lower Limestone Shales to sink near the base of the Black Rock Limestone, which dips south at 20–40°. All of the water draining through these caves resurges at Wookey Hole (Figure 5.1). The cave systems are formed mostly downdip and their accessible portions are developed largely within the Black Rock Limestone, locally about 280 m thick. The limestone in this area is broken by two important faults and several minor ones.

The Priddy Fault runs roughly east-west across the northern part of the site, passing through the middle of the Swildon's Hole system where a brecciated zone up to 8 m wide is developed. Towards the eastern side of the site a smaller NNE–SSW fault lies very close to the Eastwater Cavern system.

The caves around Priddy have been intensively studied. Various aspects of cave geomorphology have been discussed by Drew (1975b), Ford (1963, 1965a, 1968), Newson (1969) and Irwin (1991). The hydrology has been discussed by Atkinson (1968b), Atkinson *et al.,* (1967), Drew (1975a) and Stenner (1968, 1978). Descriptions of the caves are given in Barrington and Stanton (1977), Irwin and Jarratt (1992) and Irwin (1991).

## Description

Swildon's Hole is the most extensive of the caves at Priddy, and the streamway passes directly beneath the village (Figure 5.1). It has 9100 m of mapped passages, forming a complex dendritic system with many crossing links provided by high-level galleries (Figure 5.12). The main streamway takes a course westwards from the entrance to beyond Sump 1, and then turns south along the western margin of the system. Both legs of the streamway are oblique to the south-west dip. The first portion of the cave, as far as Sump 1, descends fairly steeply in a large vadose canyon (Figure 5.13). One section near the entrance was formerly filled almost entirely with clastic sediment, creating the 40 Foot Pot, but this was scoured out by the catastrophic floods of July 1968 (Harwell and Newson, 1970). Deep rounded potholes, excavated by both solutional and mechanical action, are a notable feature of the steeper sections (Ford 1965a). Beyond Sump 1 the gradient of the cave is much lower (Figure 5.15), and the stream meanders over a floor, of clastic sediment fill in a vadose canyon entrenched in the floor of a phreatic passage.

Along the course of the Swildon's streamway there are 12 flooded sections of passage where phreatic loops have been created by the obliquely downdip and up-joint route of the stream. Isolated sections of vadose canyon along the streamway, and elsewhere in the system, have formed by entrenchment through the crests of these phreatic loops, while the troughs have been infilled by clastic sediment, their ceilings migrating upwards by paragenesis. Sump 12, the present limit of exploration, has been dived to a depth of 20 m, 167 m below the entrance. North of the upper limb of the main streamway lie the old rejuvenated inlets of Vicarage Passage and Black Hole Series, while in the area enclosed by the

two limbs of the main streamway lies a complex series of abandoned passages at several levels. Some sections are blocked by collapse, but elsewhere they contain extensive clastic sediment deposits and are locally well decorated with speleothems. The Priddy Fault cuts across the cave, and Cowsh Avens (from Priddy Green Sink), Shatter Series and Southeast Inlets developed in its fracture zone.

St Cuthbert's Swallet lies east of Priddy (Figure 5.1), and is the most complex system on Mendip. It contains 7100 m of mapped passages, largely developed over a minor anticline plunging SSE (Figure 5.14). From the entrance, the streamway descends steeply for more than 100 m, beneath a multi-level series of inclined bedding-plane mazes of abandoned phreatic passages and chambers (Irwin, 1991). A roughly linear series of chambers and passages defines the south-western margin of the main part of the system and is developed along a minor fault, the Gour-Lake Fault (Figure 5.14). Caves cross this fault in at least two places. At the eastern crossing, the streamway continues as a gently sloping passage to Sump 1, which is perched. Beyond lies a further 300 m of tall, joint-guided, vadose canyon, partly entrenched beneath a gently ascending phreatic tube, leading to Sump 2. The abandoned phreatic passages and chambers have been extensively modified by collapse. They also contain abundant clastic sediment deposits and exceptionally fine speleothems of many types; these include some notable calcite curtains formed on the overhanging walls and some clusters of cave pearls in shallow pools beneath high shafts. Within one sediment sequence at least nine successive cycles of clastic sedimentation, vadose erosion and stalagmite deposition have been recognized.

Eastwater Cavern lies 400 m west of St Cuthbert's, and contains nearly 2500 m of explored passages reaching to a depth of 180 m. The upper part of the cave is mainly a steeply inclined phreatic maze formed on a bedding plane; there is only minor vadose trenching, as the cave has a very small catchment in its modem phase of development. Series of vertical vadose shafts, developed on fractures associated with the nearby fault, drop to lower levels with short sections of streamways; most passages end in small choked rifts. The cave system is largely abandoned but lacks significant speleothem development.

Hunter's Hole lies 600 m south-east of St Cuthbert's, and contains less than 300 m of passage. It drains a closed depression and has no allogenic stream input from North Hill. A vadose shaft 20 m deep drops directly into a remnant of large phreatic passage descending steeply to the south-east but largely choked with sediment and collapse debris.

## Interpretation

The caves of Priddy are classic examples of predominantly phreatic cave development in steeply dipping limestone (Ford 1965b, 1968). Hence they complement the largely vadose cave systems in the Charterhouse area. Swildon's Hole is a fine example of underground dendritic drainage and has been cited as the type example of a shallow phreatic, influent cave system. This contrasts with St Cuthbert's Swallet which is a deep phreatic influent system (Ford 1965b, 1968; Irwin, 1991). In both caves, phreatic loops have developed by the stream flowing downdip and then rising up joints or faults. This is most clearly seen in the alternation of open vadose passage with short flooded sections in the Swildon's Hole main streamway. Rejuvenation of the streamway has led to vadose entrenchment into the crests of the phreatic loops, while the trough's have acted as sediment traps and have become infilled. Hence, not all of the loops are as clearly defined as those in the active phreatic sections of Wookey Hole and Gough's Cave, Cheddar.

In St Cuthbert's Swallet only a single ancient phreatic loop has been identified, but this extends to a depth of more than 80 m along the dipping shale-limestone boundary before rising obliquely up a fault. The presence of a minor plunging anticline has had a strong influence on the initial development of the St Cuthbert's cave system. In the first phase of development, passages were formed along the western flank of this anticline but, as swallets opened further upstream, the water sank and flowed along and down the eastern flank of the anticline. Later these networks coalesced to become a single system. In both this cave and Eastwater Cavern, complex inclined phreatic mazes have developed on bedding planes. Joints are limited in extent and appear to have played a relatively minor role in cave inception in the Priddy area, other than in the rising component of phreatic loops. Faults have exerted a significant influence in the development of rifts and vadose shafts, particularly in Eastwater Cavern.

The complex sequence of passages in the three main systems clearly reflects a long and complex history which probably extends well back into the Pleistocene and must relate closely to the history of the resurgence at Wookey Hole. Drew

(1975b) and Ford (1965c) have identified a sequence of events for cave development in this area on the basis of morphological criteria but no speleothem dates are yet available to test their tentative hypotheses. Hunter's Hole was a major depression drain early in the Pleistocene (Drew, 1975b; Smith, 1977), though how it relates to the three swallet caves is unclear.

In Swildon's Hole, Ford (1963, 1965c) identified three main stages of development which he interpreted as responses to successively lower water tables, which then remained static for some time before dropping rapidly to the next level. Although Drew (1975b) questions the concept of a single water table in a limestone aquifer, he does accept that Swildon's experienced at least two or three rest levels during its development. The oldest section of passage appears to be the Shatter Series (Figure 5.12), draining south-west along the fault from a sink 150 m south of the present entrance. With the lowering of base level, the stream sink moved close to its present position to enlarge the second phase of passages, with flow along St Paul's Series to be joined by water from the Black Hole Series, flowing along Trouble Series and Paradise Regained. Further lowering of base level produced the system as seen today by development of new streamway passages (the third phase), vadose modification, capture of strike drainage by dip tubes and rifts, and rejuvenation of existing passages. The cave therefore developed while the local water table fell in at least two stages from an altitude of about 183 to 100 m; details of the cave morphology may allow these stages to be divided into a total of four periods of rapid water table decline (Ford, 1963, 1965c).

In contrast, St Cuthbert's Swallet lacks any clear expression of these episodes of base-level lowering and instead shows evidence for prolonged solutional enlargement in the phreatic zone. Ford (1968) attributed the persistence of this deep phreatic loop to ponding behind an aquiclude at the Wookey resurgence; this suggests that St Cuthbert's Swallet is considerably older than Swildon's Hole, where evidence of uninterrupted phreatic development is not apparent. Eventual breaching of this aquiclude led to rapid draining of the St Cuthbert's phreas, when the local water table fell from an elevation around 200 m to one at about 117 m. The hypothesized aquiclude may be the Ebbor Thrust, in which a thin wedge of Upper Carboniferous sandstones and shales has been preserved, up to an altitude of 190 m, beneath an overthrust block of the Lower Carboniferous limestone, exposed west of Ebbor Gorge (Figure 5.1). An alternative is that the St Cuthbert's passages were merely ponded behind a large phreatic lift, which was formed on one of the widely spaced major fractures in the dipping limestone; the cave was drained when a new route was opened beneath the phreatic uploop. This concept is more applicable to a karst aquifer whose high transmissivity is so dependent on conduit flow. The eventual rejuvenation of the cave resulted in vadose entrenchment of the present streamway canyon through the phreatic network as well as forming some high-level inlet passages. At least nine episodes of vadose erosion, clastic sedimentation and stalagmite deposition have been identified (D.C. Ford, 1964).

In Eastwater Cavern there appears to have been only minor vadose trenching, following draining of the phreas. It appears that, unlike the other systems, lowering of base level caused the main routes to be abandoned in favour of swallets further up the valley. The drainage from these now flows largely beneath the explored passages of Eastwater Cavern.

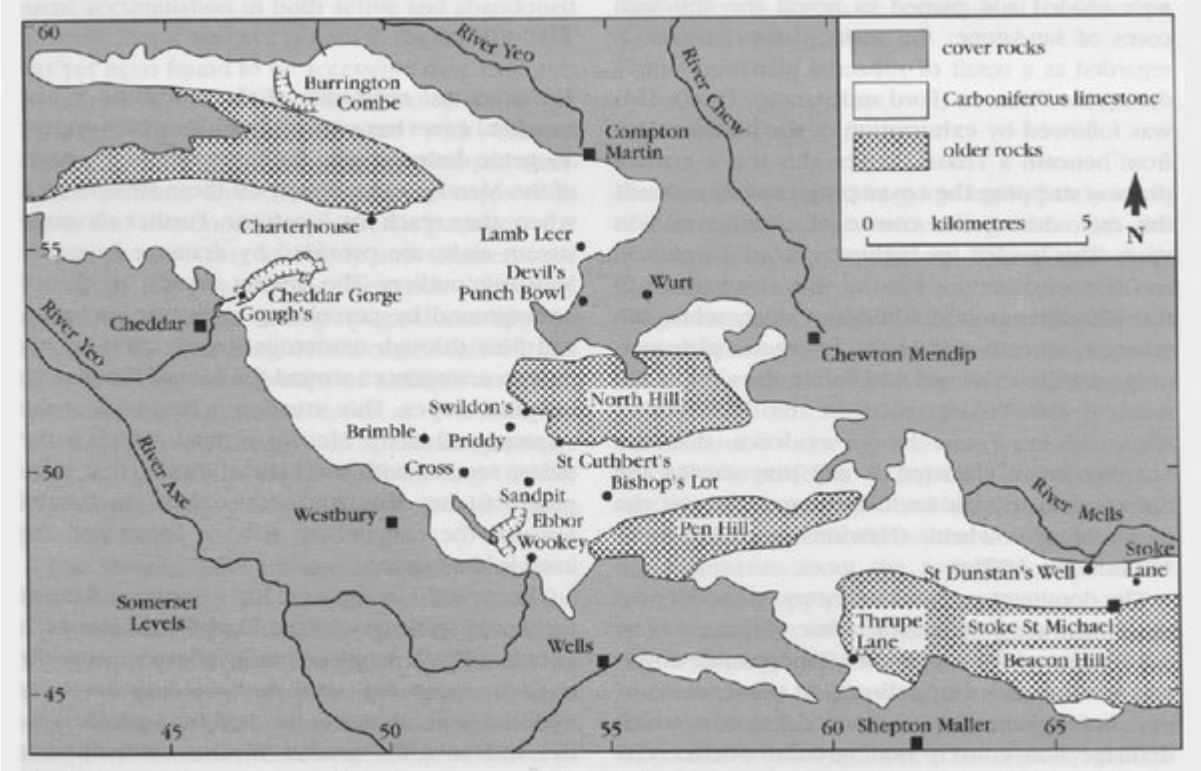
The individual histories of each of these three systems appear to differ considerably. Hydrological investigations by Atkinson *et al.,* (1967) suggested that the paths of the streams from the three main systems are discrete for the greater part of their lengths, uniting only a short distance behind the resurgence. This view has since been challenged by Irwin (1991) but appears to account for some of the differences between the adjacent cave systems. Nonetheless, since all now drain to a common resurgence it might be anticipated that they should share at least some features related to the evolution of the resurgence system. This notion is destroyed by recognizing that the main drainage route from each swallet was a discrete conduit looping through the phreas by following inclined bedding planes and fractures. The evolution of the separate cave systems at the swallet end of each conduit was therefore dependent on the bypassing or incision of the phreatic uploops, and subsequent drainage of the passages upstream of the loop crests. The pattern of loops is dependent on the local geology, and each conduit therefore has its own particular initial profile. This allows for the deep phreatic development of St Cuthbert's, at the same time as Swildon's cave was progressively drained when a sequence of shallow phreatic loops were successively breached. Eastwater appears to have only one drainage phase, comparable to St Cuthbert's, which is its nearest neighbour.

In the absence of dates for any of these events, it is impossible to correlate phases of development identified in one cave with those in another. However, all the Priddy caves contain abundant clastic sediments which are commonly interbedded with stalagmite layers. These present an ideal opportunity not only to correlate events between caves, and so investigate the relationship between the development of different sinkhole systems and their common resurgence, but also to document the climatic history of the area through the Pleistocene.

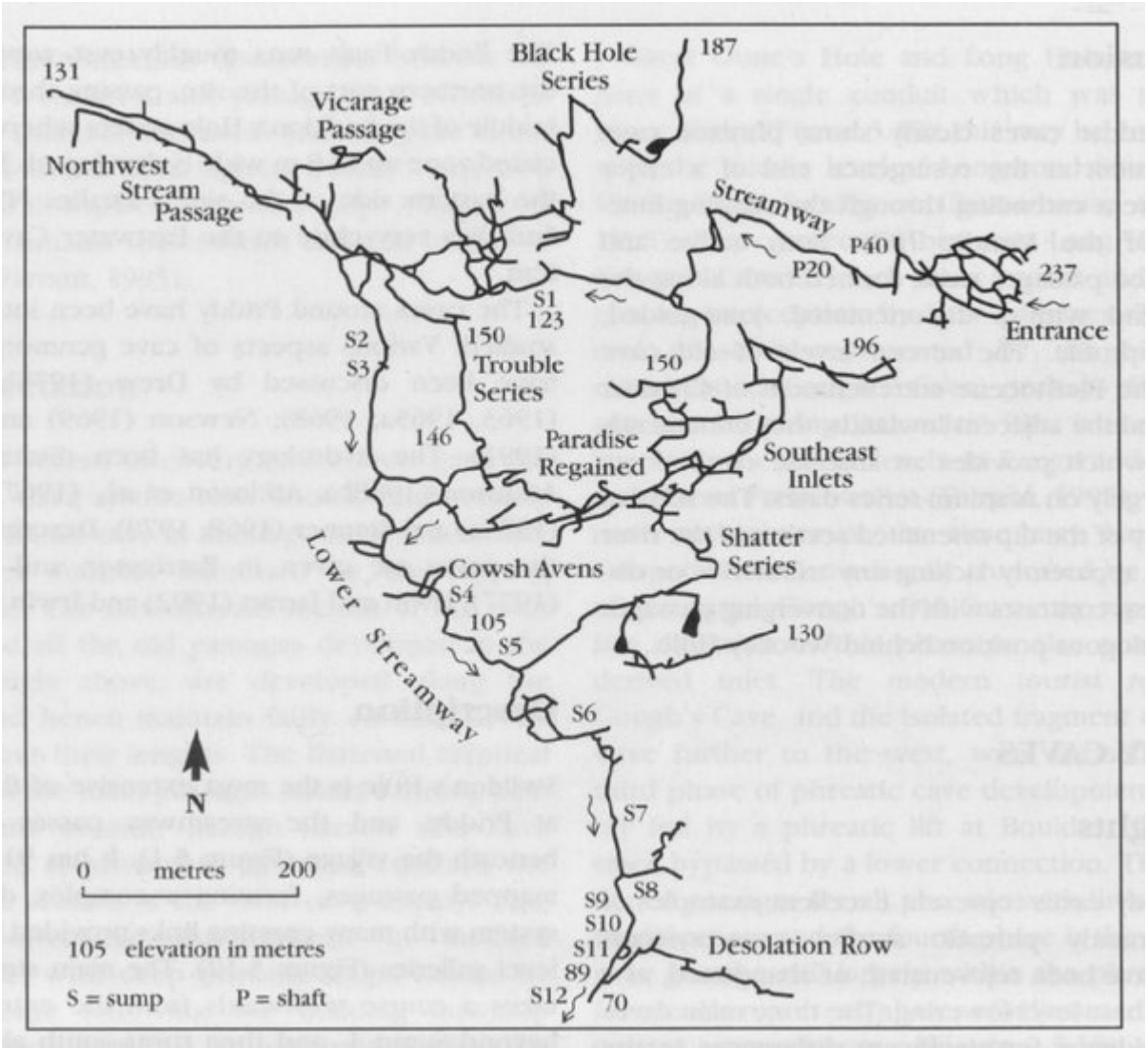
## Conclusion

The Priddy site contains a series of sinkhole caves which show varying degrees of development in ponded phreatic conditions within the steeply dipping limestones. They were subsequently rejuvenated in response to surface lowering on the Somerset Levels, and show contrasting styles of evolution into the vadose environment. Sediment deposits and speleothems within the cave provide an exceptionally valuable record of Pleistocene environmental changes, whose full elucidation awaits analysis of both the radioactive and stable isotopes within the calcite speleothems.

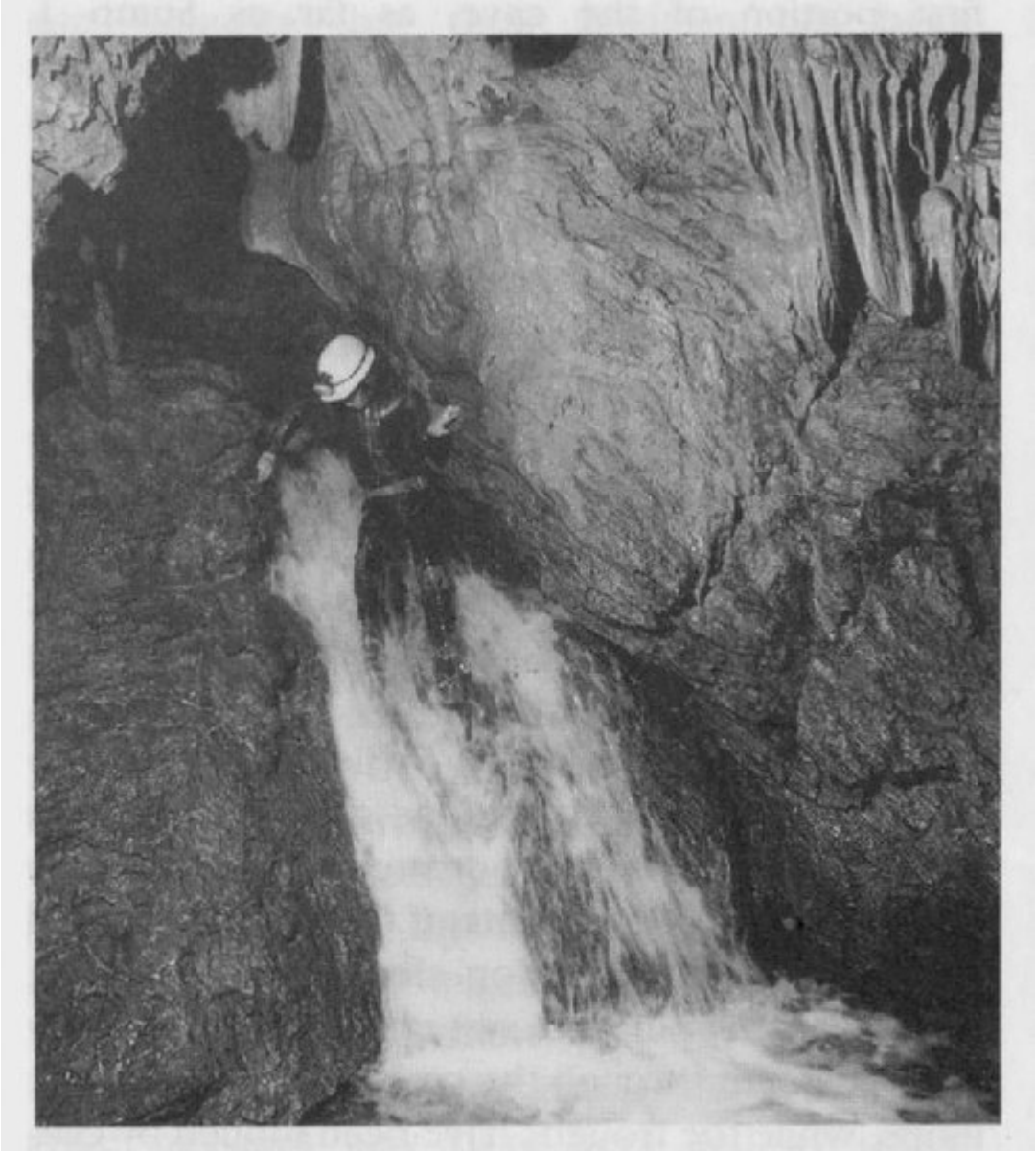
**References**



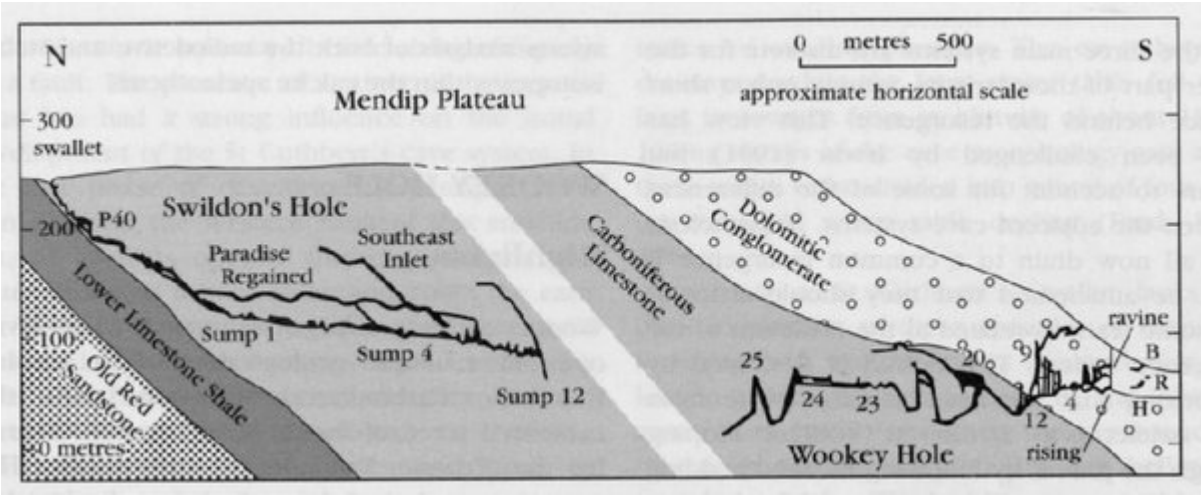

*(Figure 5.1) Outline map of the Mendip Hills karst, with locations referred to in the text. Cover rocks are mostly the Triassic and Jurassic mudstones and limestones; Upper Carboniferous rocks form the thrusted outlier on the east side of Ebbor Gorge. The Triassic Dolomitic Conglomerate is included with the Carboniferous limestone where it is composed of blocks of the limestone and is an integral part of the karst. Older rocks are the Devonian Old Red Sandstone and the Dinantian Lower Limestone Shale.*



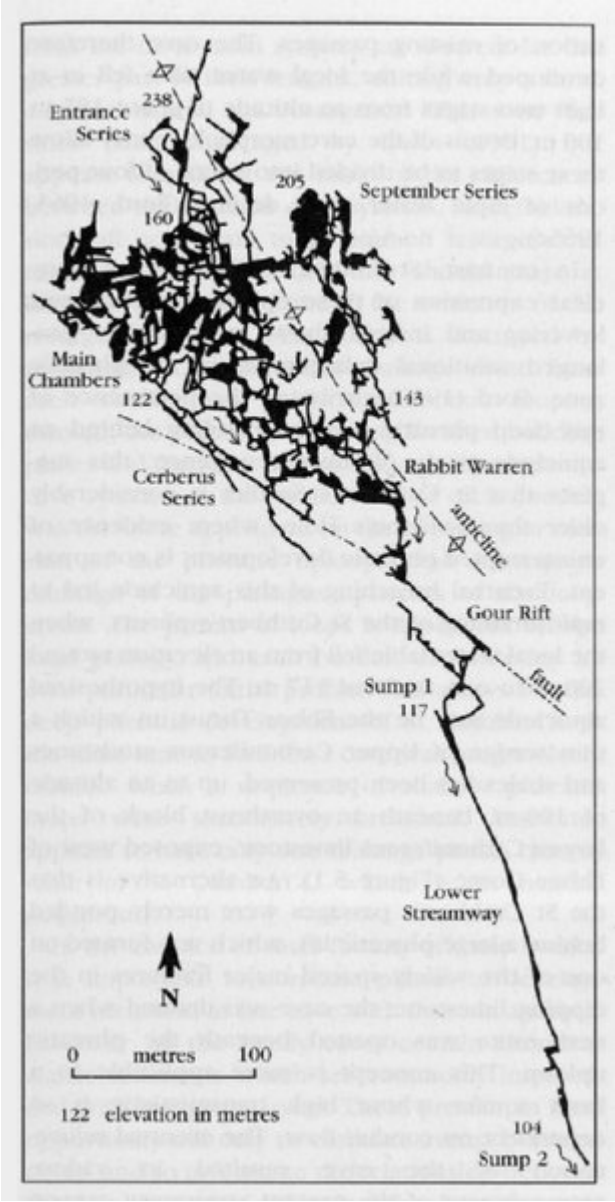

*(Figure 5.12) Outline map of Swildon's Hole (from survey by Wessex Cave Club).*



*(Figure 5.13) The cascading streamway in thinly bedded Black Rock Limestone in Swildon's Hole. (Photo: J.R. Wooldridge.)*




*(Figure 5.15) Semi-extended profile through the cave system from Swildon's Hole to Wookey Hole. The gap in the middle has not yet been reached by underground explorations; the distance between the explored limits of the two caves is about 2.3 km, and the vertical scale is exaggerated by five. The small caves in the ravine are keyed as: B = Badger Hole; R = Rhinoceros Hole; H = Hyaena Den (after drawings by W.I. Stanton).*




*(Figure 5.14) Outline map of St Cuthbert's Swallet (from survey by Bristol Exploration Club).*