Cheddar caves

[ST 467 539], [ST 474 544]

Highlights

The Cheddar caves show the development of successively lower passages to a sequence of resurgences; these formed at positions dictated by the lowering of a periglacial surface drainage route which constituted the local base level. The main upstream river cave is aligned with the dip, and provides a fine example of phreatic loops developed on joints and bedding planes in dipping limestone. Downstream of this, distributary passages, aligned on the strike, demonstrate the role of local geological structures.

Introduction

The Cheddar caves are located in the walls and beneath the floor of the lower end of Cheddar Gorge (Figure 5.1). A number of caves represent fragments of a single extensive system. Cheddar Rising, the outlet for the active cave system associated with the Cheddar Gorge, is the largest resurgence in the Mendip Hills. Allogenic water drains off the Old Red Sandstone slopes on the south side of Blackdown Hill, entering sinks in the Charterhouse area, 3 km to the north. A second group of sinks feeding to the Cheddar resurgence lies up to 11 km to the east, draining the northern limb of the North Hill pericline (Figure 5.1). Atkinson (1977) identifies the drainage system as an important example of conduit flow with diffuse input and storage. The explored caves at the resurgence end of the system are developed largely along the southern flank of the gorge, with the most extensive section, Gough's Cave, located at the lower end of the gorge immediately adjacent to the active risings.

The Cheddar caves have been the subject of many popular and scientific publications. Descriptions of the caves are given in Barrington and Stanton (1977) and Irwin and Jarratt (1992), with a more detailed account of discoveries in the river cave given by Palmer (1988) and Stevenson and Palmer (1986). Aspects of the hydrology are discussed by Atkinson (1977), Drew (1975a), Drew *et al.* (1968), Smart (1981), Smart and Hodge (1980) and Smith and Newson (1974). The history of development of the cave systems has been discussed at length by Ford (1965b, 1968), Drew (1975b), Stanton (1985) and Farrant (1991). Aspects of the sediments contained within Gough's Cave have been the subject of papers by Collcutt (1985) and Leroi-Gourhan (1985). There have been many publications concerned with the Pleistocene fauna recovered from excavations in the Cheddar caves; these have been reviewed by Jacobi (1985).

Description

The most extensive caves in Cheddar Gorge lie close to the present resurgence. Numerous other caves have been explored, most of which probably are connected with Gough's Cave in some way. The most important of these are Great Oone's Hole, Long Hole and Reservoir Hole (Figure 5.10).

Gough's Cave, together with Great Oone's Hole and Long Hole (Figure 5.10) and (Figure 5.11), contains more than 2200 m of explored passage developed over a total vertical range of more than 180 m. Part of the system is currently operated as a show cave. The lowest part of Gough's Cave is the active river cave, a phreatic tube typically 5 m wide and 3 m high. Upstream, the River Cave forms a series of deep phreatic loops on a north-south alignment (Figure 5.10) and (Figure 5.11). In each loop, the river flows under pressure almost straight down the dip of bedding planes and then rises through vertical rifts aligned on joints. The loops reach depths of up to 58 m, more than 30 m below present sea level. Vadose incision by the river has cut a loop crest to leave the Bishop's Palace chamber, which rises to almost 30 m above the present river level, partly due to upward stop-ing of the roof. The flooded passages are up to 7 m wide and 2 m high, and contain laminated mud sediments which are being re-excavated by the river. Downstream, the river passes through Lloyd Hall, a rift chamber 20 m long and 12 m high with a roof connection to the cave level above; it then continues to a choke close to the resurgence.

The lowest of the abandoned levels lies at about 45 m OD, about 18 m above the river cave, and includes much of the show cave (Figure 5.10) and (Figure 5.11). Part of the tourist route follows a magnificent phreatic tube of similar dimensions to the active river passage almost directly below. Phreatic solution along the NNW–SSE joints, has created cross rifts and avens up to 30 m high. The large gour pools of the Fonts occupy a side passage, and speleothems are abundant at several points within this level. Speleothem dates from this level (Farrant, 1995) indicate an age in excess of 120 ka. The passage terminates at a large chamber above Lloyd Hall, but further caves at this level are known to extend west from the lower part of Boulder Chamber.

Boulder Chamber has high-level, tall chambers and rifts, well decorated with speleothems in places, linked by largely sediment-filled passages at about 60 m above sea level; speleothem dates indicate an age of more than 230 ka (Farrant, 1995). Excavations in the floor of Boulder Chamber revealed a narrow shaft, filled with boulders and clastic sediment, which once formed an inlet to the system (Stanton, 1965).

The highest level in the Gough's Cave system is represented by Great Oone's Hole and Long Hole, both of which lie almost directly above parts of the lower levels. Flowstone with a uranium-series date of 380 ka (unpublished) lies in Great Oone's Hole, which has 150 m of abandoned phreatic passage opening in the side of the gorge more than 60 m above the show cave entrance. Beyond a level section the passage gently descends to a choke close above one of the chambers in the back of Gough's. Long Hole, with 260 m of passages, probably represents a downstream continuation of Great Oone's Hole. Descending rifts connect to chambers in Gough's Cave, while the main cave ascends to passages on the same level as Great Oone's Hole choked close to the present surface.

Reservoir Hole lies on the southern side of the gorge upstream and north-west of Gough's Cave (Figure 5.10); it covers a vertical range of 123 m and descends to within 8 m of resurgence level. A descending series of small tubes and tall vertical rifts intercepts an abandoned stream passage 6 m wide containing mud formations and thick sediments. This continues downstream beneath tall avens to a choke. A side passage has a decorated collapse chamber and avens including the Great Aven, a wide rift 60 m high on a fault; it may be a truncated downstream phreatic loop. A high-level passage contains speleothems dated in excess of 350 ka (Farrant, 1995).

Interpretation

With the recent discovery of the river cave the Gough's Cave system now shows, more clearly than any other cave in Mendip, the characteristic geological controls exercised by the dipping limestone. The downstream section of the river cave, and all the old passages developed at the three levels above, are developed along the strike and hence maintain fairly constant levels throughout their lengths. The flattened elliptical shapes of the main passages reflect a strong bedding plane control, though narrow rifts have developed at prominent joints. In contrast, the upstream section of the river cave displays classic dip-orientated development in inclined limestone, with deep phreatic loops caused by the passage following the bedding downdip before rising vertically up joint-guided rifts. The close superimposition of the three levels of old strike passage above the present active river passage suggests that their position has been controlled by a major east-west zone of fracturing and minor folding which has coincided with the available outlet position in the gorge floor.

Ford (1965b, 1968) and Farrant (1991) have identified at least four distinct levels within the strike-orientated part of the Gough's Cave system. These have been interpreted as zones of mature, shallow phreatic cave development formed sequentially below four base levels, possibly recognizable also as surface terraces (Ford and Stanton 1968; Stanton 1985). No evidence has been found for any higher levels of development in the dip-orientated upstream section of the river cave, suggesting that these upper three levels were all fed by phreatic lifts towards the eastern end of the strike passages. There are at least two abandoned phreatic lifts from the River Cave into the upper levels of Gough's Cave, but the size of these appears inconsistent with the flow which they would have had to transmit, and the ancient strike passages may have been fed by other, unknown, dip passages (Farrant, 1991, 1995).

Great Oone's Hole and Long Hole represent parts of a single conduit which was the first phase outlet (Figure 5.10); this may be correlated with the middle level of Longwood Swallet and Manor Farm Swallet at Charterhouse (Farrant, 1995). The connection between Long Hole and Gough's Cave is much more recent and due to chance interception by later

passages. The second phase is represented by the high-level chambers in Gough's Cave, perhaps fed by a phreatic lift along Damocles' Rift. It may correlate with the lower levels in Longwood Swallet and Manor Farm Swallet (Farrant, 1995), and the main resurgence at the time may have been Cooper's Hole, now largely truncated by incision of the gorge. Gough's Old Cave may represent a late diversion of this phase or else a southerly derived inlet. The modern tourist route in Gough's Cave, and the isolated fragment of Cox's Cave further to the west, were formed in the third phase of phreatic cave development, possibly fed by a phreatic lift at Boulder Chamber, since bypassed by a lower connection. The abandoned passages are all phreatic with little vadose modification, and the fourth phase is the modern river passage still largely within the phreas. The four levels represent phases of adjustment to successive resurgences (Figure 5.10), whose positions were determined by surface lowering of the lowlands to the south of the Mendip Hills. Incision of the gorge may also have exerted a significant influence through breaching of phreatic drainage routes. The vadose entrenchment at the crests of the phreatic loops in the active river passage, particularly at Bishop's Palace, also reflects the lowering of the modern resurgence level.

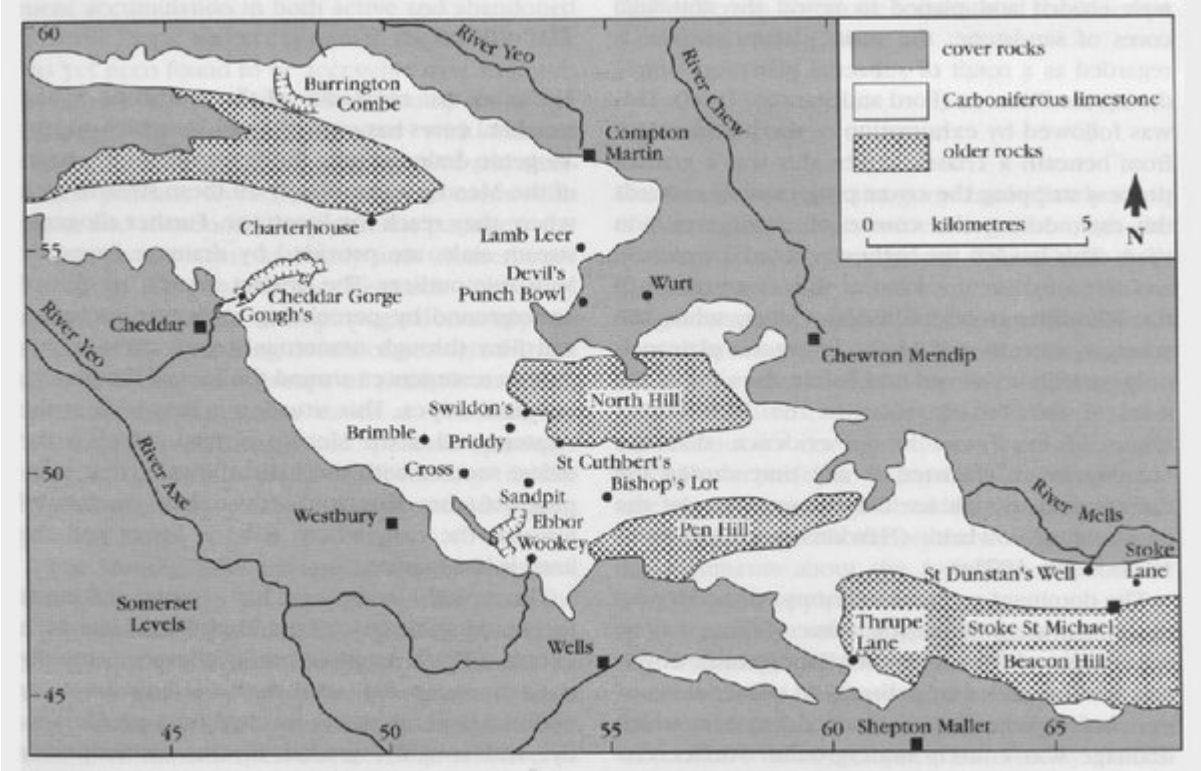
Reservoir Hole is a complex system showing very strong control by faulting and associated fractures. The main passage has an inclined profile and appears to represent the downdip sector of an old phreatic loop on a tributary to the main Cheddar cave system.

Speleothems and thick clastic sediment deposits in the various cave levels of Cheddar Gorge may enable a chronology to be constructed for the sequence of events in the development of the cave system. Since this sequence reflects the history of the surface landscape through the Pleistocene, such an investigation will have a fundamental bearing on any future study of the geomorphological evolution of this area of Somerset.

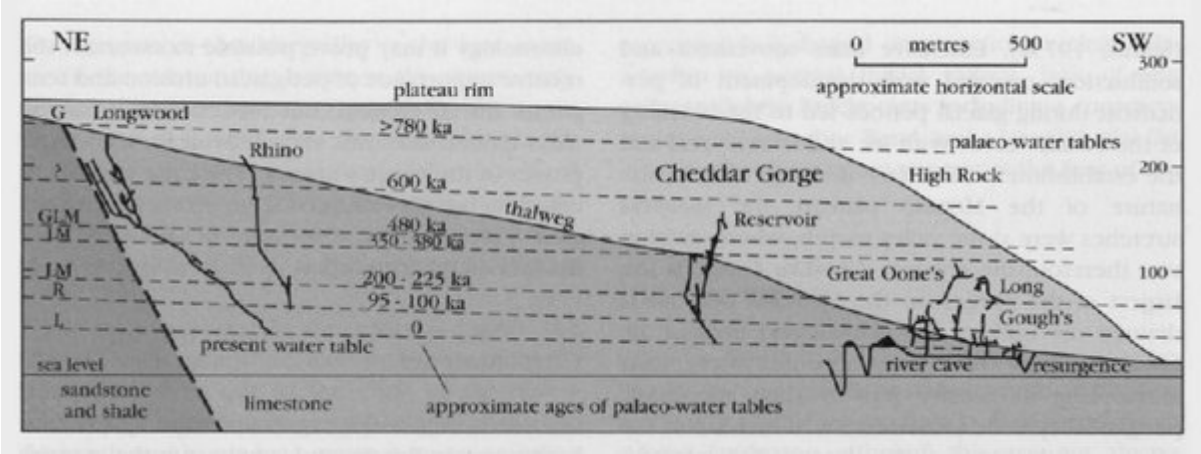
Conclusion

The Cheddar caves clearly show phreatic cave development at the resurgence end of a major cave system extending through the dipping limestones of the Mendip Hills. Both active and abandoned passages exist, formed both along the strike, and with a dip-orientated, joint-guided, looping profile. The several levels of old cave record the Pleistocene entrenchment of Cheddar Gorge and the adjacent lowlands; they contain stalagmite which provides an absolute chronology, based largely on uranium-series dates. The relative simplicity of the dip-orientated section of the river passage, apparently lacking any tributaries or distributaries, contrasts with the converging passages in an analogous position behind Wookey Hole.

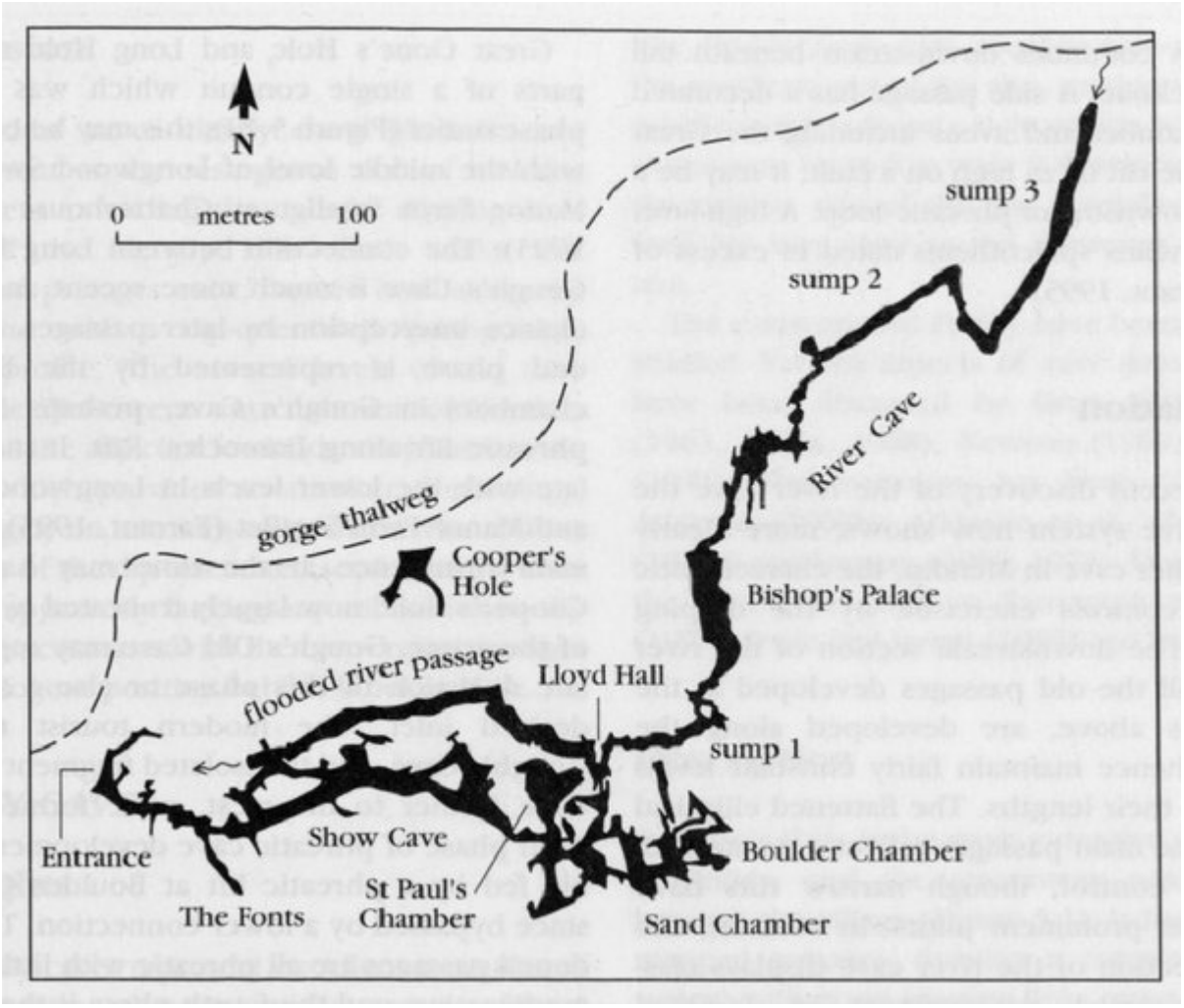
References



(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 5.10) Long profile of Cheddar Gorge up into the Longwood Valley, with the caves beneath. Each palaeo-water table is recognized from cave and surface morphology, and is dated from the sediments in associated cave passages at both the swallet and resurgence ends of the system. The water tables steepen greatly in the sandstone and shale, but are marked beyond the limestone only to label the caves in which each is recorded (G = GB Cave; L = Longwood Swallet; M = Manor Farm Swallet; R = Rhino Rift). The horizontal scale is distorted by the projection, and the vertical scale is exaggerated three times (largely after Stanton, 1985; Farrant, 1995).



(Figure 5.11) Outline map of Gough's Cave, Cheddar. Long Hole and Great Oone's Hole lie partly over the show cave section and are omitted for clarity (from surveys by Wessex Cave Club and Cave Diving Group).