Black Keld catchment area

[SD 995 711], [SE 016 697]

Highlights

Mossdale Caverns and Langcliffe Pot are the two most extensive cave systems developed in the Yoredale limestones. The known cave passages in Langcliffe Pot breach the sandstones and shales into a lower Yoredale limestone, and both caves drain through relatively impermeable beds into the underlying Great Scar Limestone.

Introduction

The two long cave systems lie beneath the southern slopes of the Conistone and Grassington Moors, east of Wharfedale; between them they drain a large part of the slopes of Great Whernside (Figure 2.1). Each cave system is accessible through its stream sink entrance, and can be followed only as far as flooded or choked passages well before their confluence. Both caves drain to the Black Keld resurgence, in the floor of Wharfedale. Most of the accessible cave passage lies within the Brigantian Middle Limestone, which is about 30 m thick, dipping very gently south-east. Shale and sandstone separate this from the underlying Simonstone Limestone, less than 20 m thick; this is underlain by another thin shale separating it from the Brigantian Hardraw Scar and Gayle Limestones which are locally contiguous with the Asbian Great Scar Limestone. The cave drainage traverses a total stratigraphic thickness of over 280 m, to reach the Black Keld resurgence low in the Great Scar Limestone. Namurian Grassington Grit lies unconformably over the Brigantian sequence, and rests directly on the Middle Limestone at Mossdale Scar.

Many of the cave passages were originally described by Leakey (1947), Grandison (1965) and Monico (1989a). Further descriptions of the caves are given by Brook *et al.* (1988), and the hydrology and geomorphology of the area have been discussed by Brook (1971a, 1974b).

Description

Mossdale Caverns

Mossdale Caverns are entered where Mossdale Beck flows into the largest sink in the area. Over 10.5 km of cave passages have been mapped (Figure 2.48), all developed at or near the base of the Middle Limestone. The beds dip south-east at 1–5°, so that the cave reaches a depth of about 60 m. The system has an unusual branching morphology with various outlets for its water. From the descent through the collapse zone near the entrance, the main streamway continues east, only 2 m high but up to 5 m wide, floored by the sandstone underlying the Middle Limestone. Two distributary passages, one perched 2 m above the base of the limestone, branch off the south side before becoming floored with sandstone, subdividing, narrowing and ultimately becoming too tight to follow. In a second area of branching passages, the main stream turns north into low rifts too narrow to follow. The caves further to the south-east are downdip, overflow passages that normally take only small streams but can be almost filled by large flows generated by floods or sediment choking of the normal outlet rift.

The Marathon passages consist of long, angular series of small joint guided rifts. They are nearly all less than 1 m high, with a narrow triangular cross-section only widening close to the sandstone floor. Some merely form loops and some end in narrow fissures, but Kneewrecker leads into the Tunnel Caves and Far Marathon eventually meets the larger Stream End Cave. The high levels of Tunnel Caves and the Mud Caverns are largely abandoned passages about 5 m high and wide, heavily choked with sand, mud and collapse debris; they lie 5–10 m above the lower streamways. Inlets from the north join the water which flows into Stream End Cave. Both this and all the ends of the high-level passages are finally blocked by impenetrable collapses and boulder chokes. In flood conditions most of the known cave fills to the roof. The small, lower streamways are swept clean by turbulent flows, while ponded water deposits fine sediment in the larger,

higher-level passages.

South of the known ends of Mossdale Caverns, the Lost Cavern of Grassington Moor is another fragment of large, abandoned cave passage in the Middle Limestone. It was entered by miners at a depth of 55 m below the Old Turf Pits Shaft, early in the nineteenth century. They found a large dry tunnel, over 230 m long, up to 10 m high and of variable width. This and the larger side passages were mapped (Figure 2.48), but many other passages were left unrecorded, and all the caves have been inaccessible since the entrance shaft collapsed after the mining ceased (NCMRS, 1980).

Langcliffe Pot

Langcliffe Pot is very different from Mossdale Caverns, with five sinks draining to a single underground streamway, in a cave system over 9600 m long (Figure 2.48). Entrance shafts at two small stream sinks each drop about 25 m to the base of the Middle Limestone. Their outlet passages, and many tributaries, are little over 1 m high and wide; they are floored by sandstone, locally eroded through to the shale beneath. Individual segments of the passages are nearly all aligned on joints, but the overall cave pattern is of passages coalescing in the main streamway, which follows the very gentle dip to the south-east. Langstrothdale Chase carries the main stream in a square-cut canyon mostly 2 m wide and 5 m high, its floor rising stratigraphically until it is 4 m above the base of the limestone. In Boireau Falls Chamber the stream cuts down through 0.5 m of sandstone and 4 m of underlying shale to cascade down a 22 m shaft through the entire thickness of the Simonstone Limestone.

The stream then enters a vast zone of blockfall and collapse, estimated to have total dimensions of 100 m by 50 m and 40 m high. Beyond, the stream flows in the Hardraw Limestone but enters a perched phreas, preventing further exploration, before the Great Scar Limestone is entered. A large abandoned inlet passage enters from the south-east before the sump; this extends eastwards as a series of tall rifts along the Silver Rake mineral vein, eventually terminating in a choke.

Dye tests of the Swarth Gill sinks into the Middle Limestone almost above the Silver Rake passages were not conclusive, but suggested that the sinks do not drain into the known parts of Langcliffe Pot; the intervening sandstone and shale appear to be an effective aquiclude in the immediate area, but all the sinking water eventually flows to the Black Keld resurgence (Figure 2.48). The flooded passage at Black Keld has been followed upstream only to a choked area after 150 m. A short dry series reached from airbells has no open continuation.

Interpretation

The underground drainage system which feeds Black Keld is one of the largest and deepest in Britain, though only a small proportion of its cave passages are accessible at present. It is also unique, in that the cave drainage is constrained initially within the Yoredale limestones but then breaks through into the underlying Great Scar Limestone, and resurges about 160 m lower down from near the base of the carbonate succession. The caves therefore breach the intervening shales and sandstones which are normally hydrological barriers. Two of these aquiclude breaches are visible in Langcliffe Pot. The breakthrough from the Middle Limestone into the Simonstone Limestone occurs via a vadose canyon through undisturbed shales and sandstones which then leads to a vertical shaft in the underlying limestone. There is no known continuation of an older passage in the limestone above the breach; the initial route through the non-carbonates was probably via an open tectonic fissure or small fault. The vast area of collapse immediately below the Nemesis shaft may be located in a major zone of fractures which could have guided the initial drainage route through the shale and sandstone between the Simonstone and Hardraw Limestones. The choke now represents a type of interstratal karst, with major collapse of the beds above the limestone, though this has not yet worked through to create a surface depression. The Mossdale water must also pass through several shale and sandstone aquicludes before entering the Great Scar Limestone. This may occur along one of the faults in the area, which have throws sufficient to bring the Middle Limestone and Great Scar Limestone into juxtaposition. The extent to which the Mossdale cave stream backs up in flood conditions suggests that its drainage route into the Great Scar Limestone is via constricted or extensively choked passages.

The complex plans of both the Mossdale and Langcliffe caves are unusual for sites in the Yoredale limestones, which more typically have a single stream passage, as typified by Fairy Holes. Mossdale Caverns has the more complex

system, partly due to multiple sink points along the Mossdale valley. Its divergent, branching pattern approaches that of phreatic maze caves such as Knock Fell Caverns, and may reflect development under conditions of frequent back-flooding caused by its restricted drainage outlet. Langstrothdale Chase and Marathon Passage are the longest stream passages in the upper limestone beds in the two caves; they are almost entirely developed on joints, but they are constrained to drain downdip to the south-east within the vadose zone, though the resurgence of Black Keld lies to the north-west.

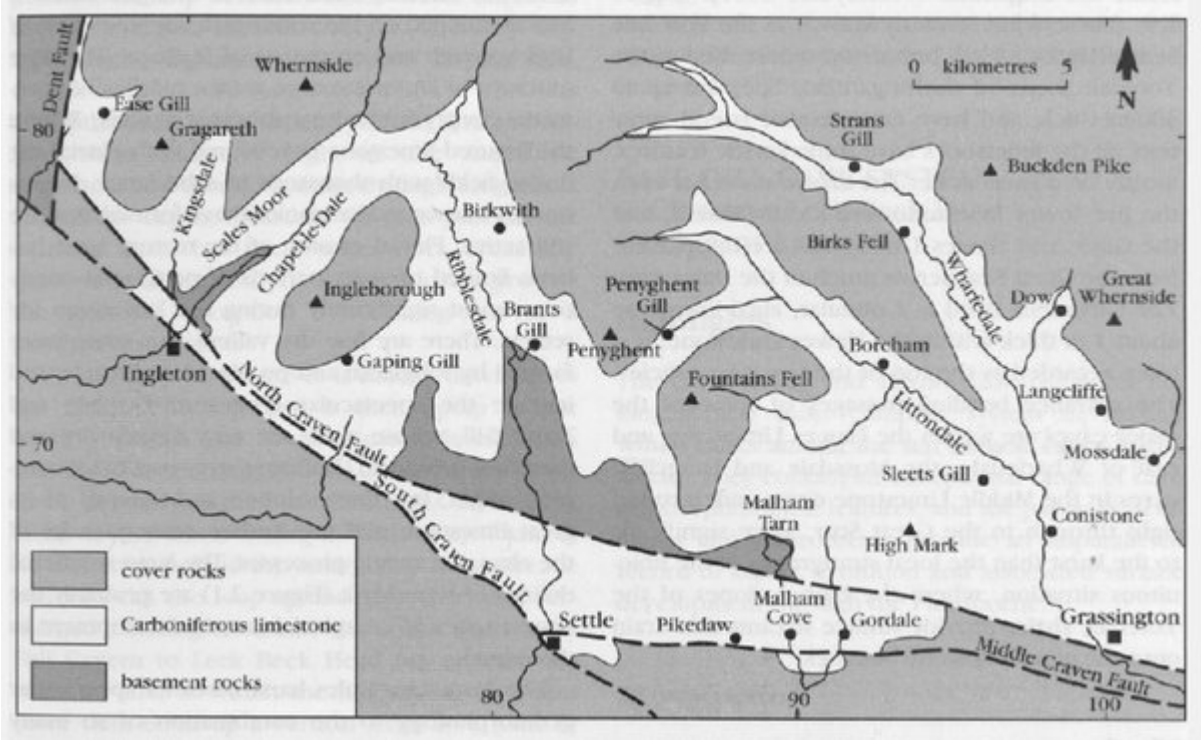
Mossdale Caverns has an older series of large relict passages along its north-eastern sector through Tunnel Passage, Stream End Cave and the High Level Mud Caverns. This may have developed from sinks higher in Mossdale Beck which have been subsequently choked, probably by an input of glacial debris. The large passages below the modern sink in Mossdale Scar may constitute an old phase which has been reinvaded, and these now drain into the small, relatively immature passages on the base of the limestone. There are other abandoned and choked passages within the entrance complex and Western Passages. Abandoned sinks occur further down the valley, but floor deposits of alluvium and peat now prevent Mossdale Beck from continuing down to Bycliffe Sink. The cave passages show very little vadose development other than small grooves in their sandstone floors. The known parts of Mossdale Caverns probably developed initially within a shallow perched phreas above the sandstone, which was unaffected by regional rejuvenation. A long history of intermittent flooding and epiphreatic development has etched the cave passages out of the joint network to produce a rather open version of a phreatic maze cave (Palmer, 1975).

Langcliffe Pot is morphologically simpler than Mossdale Caverns. The initial phreatic development of the passages occurred up to several metres above the base of the limestone. It is only the active inlets which have cut down to the sandstone, and then rise above it further downstream where the dip is steeper than the cave gradient. The lower series of largely abandoned passages entering from the east in the Hardraw Scar Limestone may represent an earlier phase of development associated with old sinks in the Mossdale valley, but their point of origin is unknown and there is now no flow though from the sinks in the Middle Limestone.

Conclusion

The two influent caves perched high above their Black Keld resurgence are the longest known systems in the Yoredale limestones. They are unique in that they drain through shale and sandstone sequences into the Great Scar Limestone beneath; two of the hydrological breaches which have permitted this are already visible in Langcliffe Pot, as a cave canyon entrenched into the non-carbonates and a major collapse zone.

References



(Figure 2.1) Outline map of the Yorkshire Dales karst, with locations referred to in the text. The Carboniferous limestone shown includes all the Great Scar Limestone (Kilnsey, Cove and Gordale Formations) and also the lower Yoredale limestones (of the Wensleydale Group) where they are hydrologically linked to the Great Scar and are therefore part of the same karst unit. Higher limestones within the Yoredale Series are not marked. Basement rocks are Palaeozoic slates and greywackes. Cover rocks are the Yoredale facies of the middle and late Brigantian Wensleydale Formation and various Upper Carboniferous and Permian clastic formations.

(Figure 2.48) Outline map of Mossdale Caverns and Langcliffe Pot, which both drain to Black Keld. The limestone includes the Great Scar Limestone and the Yoredale facies limestones of the overlying Brigantian Wensleydale Group; the latter are separated by thin shales and sandstones that are not marked (from surveys by University of Leeds Speleological Association and others).