Birkwith caves

[SD 80 75]–[SD 80 77]

Highlights

The caves of Birkwith are unusual in that the entire karst drainage remains perched high above the adjacent valley floor. They demonstrate the importance of shale beds as cave inception horizons which can guide a perched conduit within a well fractured limestone aquifer.

Introduction

The Birkwith caves lie in the upper part of the Great Scar Limestone, under the flank of Birkwith Moor where it forms the eastern slopes of Ribblesdale (Figure 2.1). All the streams flowing west from the shale slopes of Birkwith Moor sink into the limestone, but the surface topography and hydrology is complicated by a spectacular drumlin field which lies across the terraced limestone outcrop. This ice-moulded till was left on the retreat of the broad, Devensian glacier which flowed south down Ribblesdale. The Great Scar Limestone dips very gently to the north-west, and is broken by strong joint sets aligned roughly to the NNW and north. All the cave passages are developed within the top 40 m of the Great Scar Limestone, which has a full thickness of over 150 m. The resurgences are perched more than 100 m above the base of the limestone, and the streams issuing from them follow a surface course descending 75 m over limestone and glacial drift to the alluviated floor of Ribblesdale.

The cave passages are all described briefly by Brook *et al.* (1991), and Red Moss Pot was documented by its explorers (Hartley, 1972).

Description

A major cave system with over 4500 m of known passages extends between the sinks of Red Moss Pot and the resurgence at Birkwith Cave (Figure 2.27). Its main feature is the remarkably linear main streamway, draining almost due north along the main fractures from Canal Cavern to the junction inside Birkwith Cave. Over most of its length, this main streamway is a vadose rift passage 2 m wide and up to 10 m high, largely occupied by ponded, slowly moving water. The floor and roof levels vary along the rift, partly under the influence of the low bedding dip; parts are therefore deep canals, and there are four submerged sections of deep flooded fissures. Some parts of the rift above water level are well decorated with calcite speleothems. The cave only descends at two sequences of cascades, one at the upstream end, and one below the Old Ing inlet; the latter cascades are formed where the cave sidesteps between parallel joint fissures.

Access to the main rift streamway is gained via inlet passages from the east. Allogenic streams flow off the shale cover, whose buried boundary is close to the eastern margin of (Figure 2.27), and sink where they breach the thinner till between the drumlins. From the entrances of Red Moss Pot, twisting vadose canyons descend over cascades and through small collapse chambers, uniting in a passage which then descends to the main streamway. The longest inlet is well decorated with calcite straws and stalagmite, but cannot be followed to daylight. From its shakehole entrance, Old Ing Cave has a series of cleanly washed vadose canyons and rifts which carry a stream to a flooded confluence with the Red Moss water. Dismal Hill Cave is another inlet series of narrow rifts and low bedding plane passages. Beyond a last flooded section the main rift streamway drains south-west and descends through sections'of bedding-controlled gallery to reach the resurgence exit of Birkwith Cave (Figure 2.27). The abandoned passage north of the junction extends through low bedding planes partly choked with clastic sediment to a small exit below the scar north of the resurgence.

South of Red Moss Pot, Jackdaw Hole is an old choked shaft, and Penyghent Long Churn is an active rift cave which drains south to the New Houses rising. North of Birkwith Cave (and just north of (Figure 2.27)), Calf Holes is an open waterfall shaft 11 m deep into a fine stream cave, 850 m long; this can be followed through bedding plane passages and

then down joint-guided shafts and rifts to a larger streamway out to the Browgjll Cave resurgence. Like the Birkwith system, this cave is perched in the top 30 m of the limestone, and its outlet follows a surface course to the floor of Ribblesdale except for the section 15 m long beneath the 2 m thick bed of limestone known as God's Bridge.

Interpretation

Strong geological control is conspicuous in the morphology of the Birkwith caves. They are developed entirely within the top 40 m of the Great Scar Limestone, perched above another 100 m of massive limestone and 75 m above the nearby valley floor, and demonstrate the role of thin shale beds in creating a perched aquifer within a fractured karstic limestone. A narrow zone of joint/shale intersections has provided a single trunk route for cave inception, which has subsequently been enlarged into a mature conduit. The joints extend below the inception horizon, as seen in the deeper canals and flooded sections; this contrasts with sites elsewhere in the Yorkshire Dales, where individual joints fail to breach the shale bands in the upper part of the Great Scar Limestone, causing caves to be perched above continuous shale beds (Waltham, 1971a). Capture of the drainage, into lower fractures and bedding planes, is minimal at present, even though the cave now stands far above a base level determined by potential resurgence sites in the floor of Ribblesdale; some leakage may be taking place to Low Birkwith Cave, a rising 600 m down the beck, whose flow is only partly accounted for by known sinks.

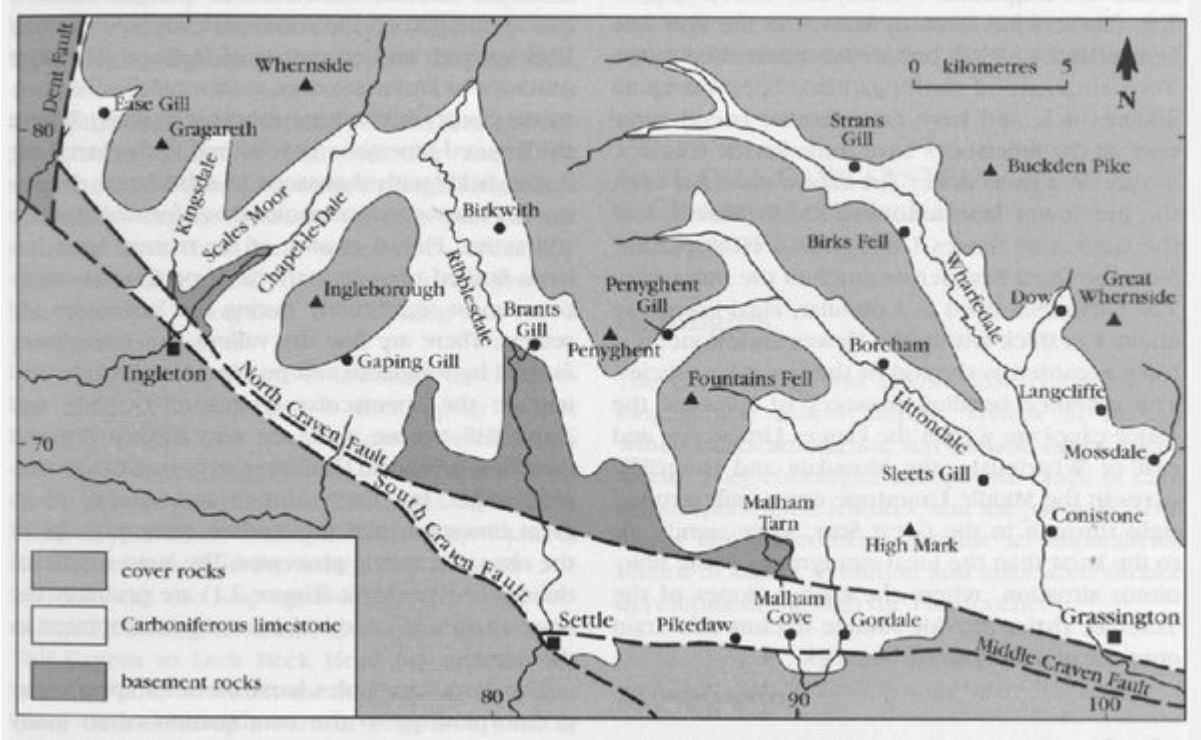
The Birkwith caves are perched and immature. The lower parts of the Great Scar Limestone have no significant cave development where they are traversed by the surface streams flowing from the resurgences. The inlet passages of the cave system all drain from between the drumlins, and there are no known passage terminations at chokes underneath the drumlins. All the evidence points to the caves being comparatively young, and many of the passages may be post-Devensian. The natural drainage of the fracture limestone is west towards the scar edge with a descent into Ribblesdale. The main cave is therefore an anomaly, developed along the joints and downdip until the scar was intersected north of the present resurgence.

Prior to the excavation of Ribblesdale, and also when the glacial trough was occupied by ice, the groundwater drainage would have been towards the lowland to the south. Phreatic initiation of the main rift passage may date back to these conditions, but no morphological evidence of such an early phase has yet been recognized. Abandoned high-level passages in the Old Ing and Birkwith sections are features of local rejuvenation through phreatic uploops, and the outlet passage may have developed in response to a retreat phase of the scar in which the resurgence now lies. Dates of calcite speleothems from the caves may provide evidence for the evolution of both the caves and the local surface morphology, but they are not yet available.

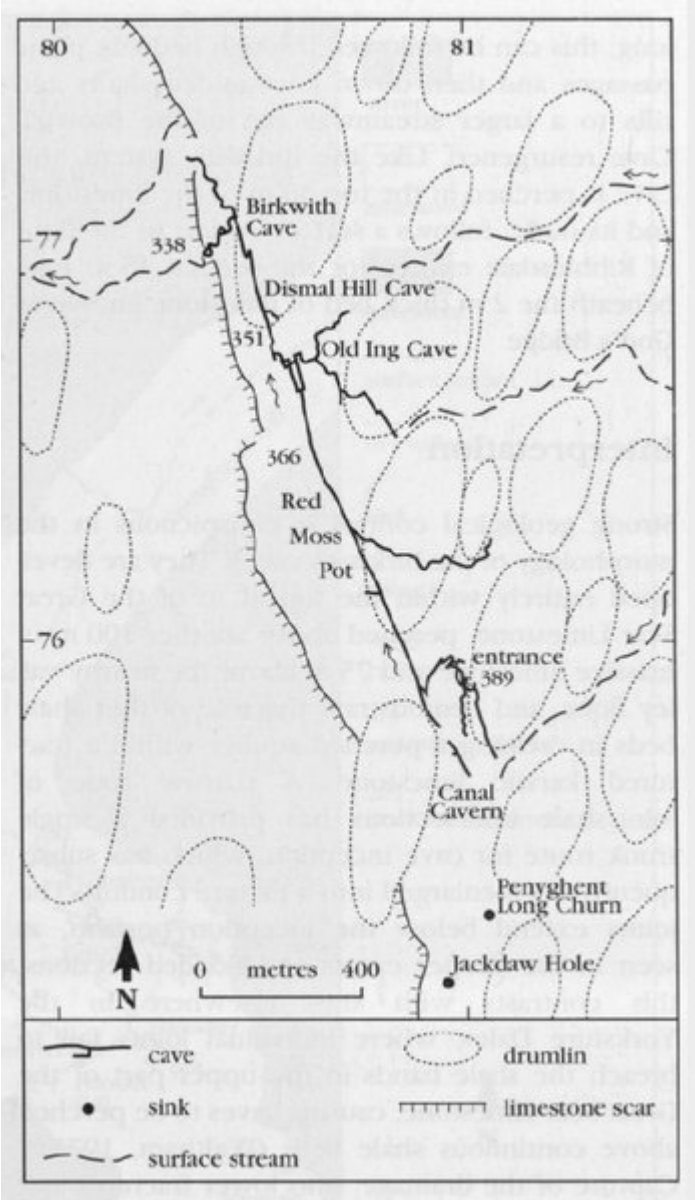
Conclusion

The cave system at Birkwith consists of relatively immature stream caves which clearly demonstrate the significance of shale beds in cave development. Despite their linear, joint-controlled plans, the cave's trunk conduit remains perched at shale horizons far above base level, and drains downdip against the pattern of surface drainage.

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 2.27) Outline map of the caves of Red Moss and Birkwith, draining the limestone bench beneath part of the Ribblesdale drumlin field. Figures given represent elevation in metres (from surveys by Burnley Caving Club and others).