Hell Gill

[SD 787 969]

Highlights

The section of Hell Gill cut into the limestone is one of the finest examples in Britain of a gorge formed entirely by subaerial fluvial action. It admirably demonstrates the role of subaerial erosion in the formation of gorges in karst areas.

Introduction

Hell Gill Beck is the largest of the streams draining off the Namurian shales and sandstone of Mallerstang Common, and is the highest head-stream of the River Eden (Figure 3.1). It cuts through the horizontal Main Limestone in a deep and narrow ravine. This is clearly of subaerial origin, and yet lies adjacent to caves formed by parallel streams. Except for its lack of roof, the gorge is very similar in morphology to vadose canyons in cave systems, and clearly shows the similarity between subaerial limestone gorges and underground cave passages. Although very impressive and locally well known (Waltham, 1984), Hell Gill has not been studied and documented in any serious investigation. The adjacent caves are recorded by Brook *et al.* (1994).

Description

The Hell Gill gorge is cut into the Namurian Main Limestone by a stream draining off a hillside of horizontal, interbedded shales, sandstones and thinner limestones within the Carboniferous Alston Group (Figure 3.14). The Main Limestone is the thickest limestone exposed on the fell, but is only 20 m thick. Hell Gill descends between altitudes of 425 and 395 m, following the limestone dip; it is a narrow, twisting, rock gorge 500 m long, mostly less than 5 m wide, and up to 15 m deep. The stream descends steadily through moulins and connecting trenches, and cascades over three small falls into deep, round plunge pools. The sides of the gorge are mainly vertical, smooth and polished, with the stream occupying the entire floor width, locally undercutting the walls in deep swirls. Immature cave development is represented by various short rifts, and some of the flow passes through short parallel loops which are intersected phreatic fissures; a rock bridge stands across the gorge where the stream has enlarged an underground short cut. At the lower end of the gorge, the stream flows onto the underlying sandstone, and then breaks out from the low limestone scar into the valley.

Many of the neighbouring, parallel streams on the fellside sink underground where they reach the top of the Main Limestone, and resurge several hundred metres to the south-west at the base of the same limestone outcrop (Figure 3.14). Jingling Sike goes underground through 300 m of cave just to the south, and streams feeding Eden Sike flow through 770 m of cave just to the north, both in the Main Limestone. The streams have cut subaerial ravines through most of the thinner limestone bands on the fell, and Hell Gill Beck flows through a shallow rock canyon cut in the Underset Limestone (Figure 3.14). Percolation water feeds small risings at the base of all the limestones.

Interpretation

There is no evidence in the Hell Gill gorge of any cave roof or wall collapse, currently or in the past. Cave development in the gorge is limited to flow through short fissures in the immediate walls and floor, which is part of the normal mechanism of entrenchment in a limestone river bed. The location, and the dimensions consistent with the modern flow of Hell Gill Beck, suggest that the ravine is entirely a surface feature cut by the stream which it still contains. Its youthfulness, the absence of fill, and the lack of deep weathering in its walls suggest that it was excavated during the Pleistocene, though it may have been initiated by meltwater flow as the Devensian glaciers retreated from the area.

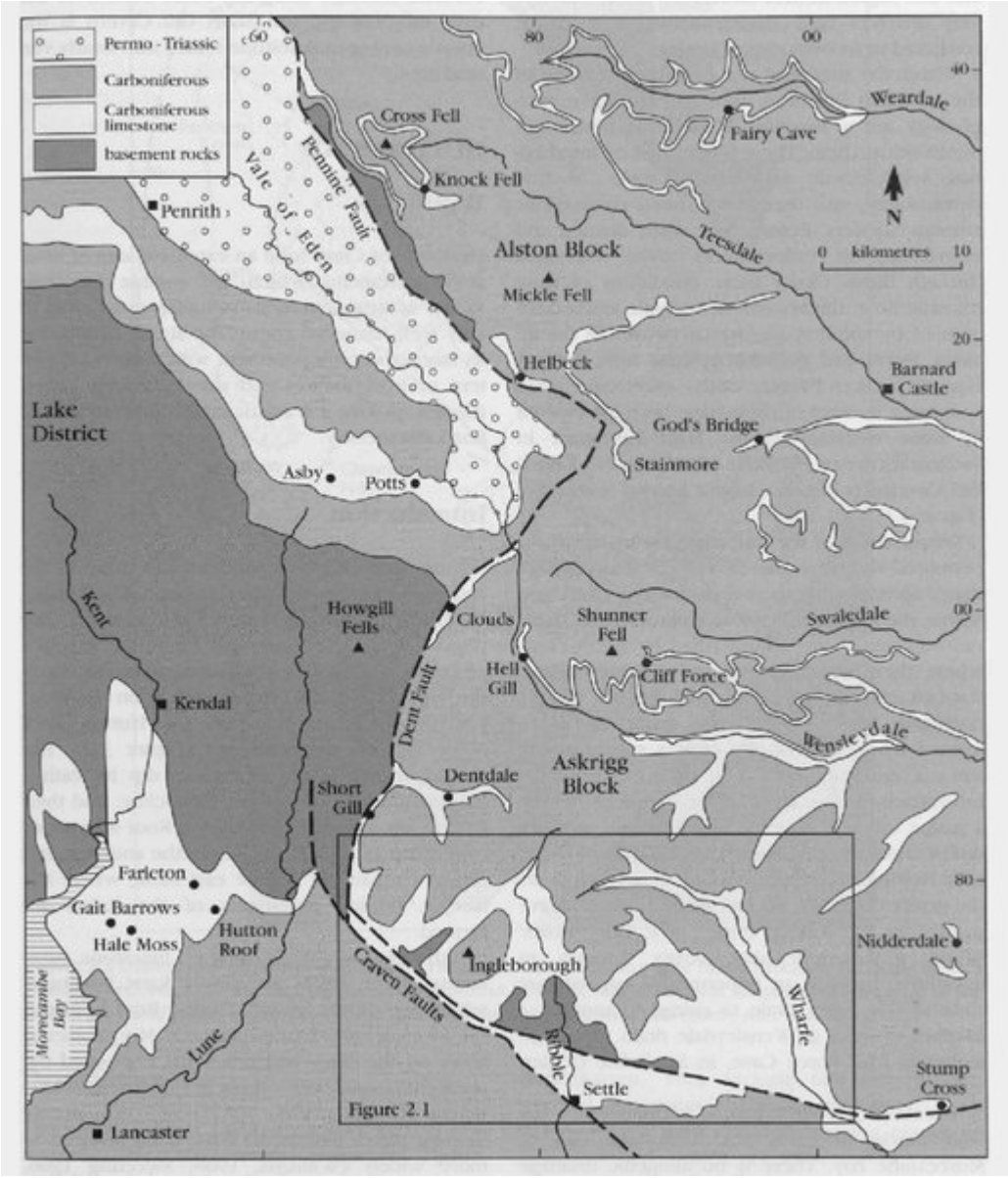
Apart from details of plant colonization and minor weathering on its upper walls, the gorge is very similar to many large vadose canyons in the Pennine cave systems. The ability of Hell Gill Beck to maintain its surface course across the

limestone outcrop is the result of its high discharge. This ensures that the floor of the gorge is lowered by solution and mechanical abrasion fast enough to unroof, expose and incorporate fissure openings developed in its floor by slow solution alone. The smaller parallel streams of Eden and Jingling Sikes have not been able to entrench their beds fast enough, and have subsequently been captured by underground drainage forming small cave systems of joint rifts and bedding passages with little or no collapse.

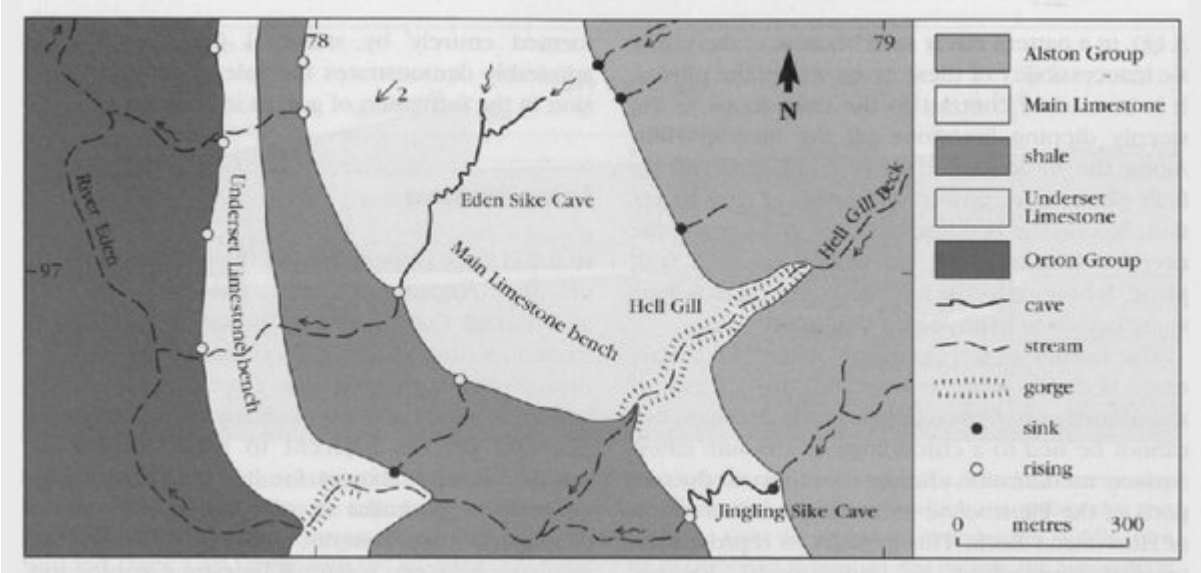
Conclusions

The gorge on Hell Gill Beck provides an excellent example of subaerial fluvial action in a karst terrain. It is especially significant as it can clearly be demonstrated to be of subaerial origin, and yet lies adjacent to caves cut by smaller, parallel streams through the same limestone. It also demonstrates the similarity between surface fluvial gorges and underground vadose canyons, and has important implications for the understanding of process in limestone gorges.

References



(Figure 3.1) Outline map of the karst regions in the northern Pennines, with locations referred to in the text. The other Carboniferous rocks are the non-carbonates of the Orton Group and Yoredale facies of the Dinantian, and the Namurian, but they include thin bands of limestone with lesser karst features not shown on this map. The Carboniferous limestone includes the Dinantian Great Scar Limestone, the Yoredale limestones with significant karst, and the Main or Great Limestone of Namurian age. The basement rocks are Lower Palaeozoic non-carbonates. Details and locations in the southern Dales are shown in (Figure 2.1).



(Figure 3.14) Outline map of the limestone bench containing the Hell Gill gorge and various sinkholes, risings and cave on the adjacent streams.