God's Bridge

[NY 957 126]

Highlights

The natural limestone span crossing the River Greta at God's Bridge is the best example of a natural limestone bridge in Britain. Cave development in a thin limestone in the valley floor has now captured much of the river flow.

Introduction

The River Greta drains a large area of the fells of Stainmore Forest in the northern Pennines (Figure 3.1). Its headwaters lie on impermeable rocks, but 4 km west of Bowes, the river crosses a thin bed of Carboniferous limestone, where several generations of caves have developed. The progressive development and subsequent collapse of a sub-valley floor cave system has produced a natural limestone bridge spanning the river. A lower system of caves is still active and captures much of the river flow. There is no published study of the site geomorphology, but the caves are described in Brook *et al.* (1988).

Description

Nearly horizontal sequences of Carboniferous shales, sandstones and limestones form the high fells around the Stainmore saddle over the northern Pennines. Karst landforms are limited in the thin limestones, of which many outcrops are hidden beneath glacial till. The River Greta is an underfit in a broad valley which carried substantial flows of Pleistocene ice through the Stainmore gap. God's Bridge is developed where the River Greta crosses the outcrop of the Great Limestone, which is about 20 m thick and lies at the base of the Namurian succession.

The river flows onto limestone a few hundred metres above the Bridge, and has developed a series of caves below the valley floor. God's Bridge is a bedrock span over a cave 12 m long, 2 m high and about 4 m wide through which the river flows, and is large enough to accommodate almost all the modern flood flows. The Bridge is made from two beds of limestone and is only about 2 m thick (Figure 3.22). There is limited block collapse at the upstream end, while a shallow rocky gorge represents the unroofed continuation of the cave on the downstream side. The upper surface of the bridge is bare rock, exposed to weathering and ultimately destined to collapse by a combination of thinning, fissuring and undercutting. Part of the river flow now passes through a lower cave system, extending 500 m from sinks upstream of the Bridge to resurgences downstream. Most of this cave is a series of low, wide, bedding passages with oxbow loops, and parts of the route are permanently flooded (Brook *et al,* 1988).

Interpretation

God's Bridge is the last surviving relic of a valley floor cave system. Early solution by the River Greta of the limestone at outcrop produced a cave system below the valley floor, which was subsequently unroofed and dissected as valley lowering proceeded. The natural bridge is part of this earlier generation of sub-valley floor caves, and the rocky gorge downstream is an unroofed section of the same cave. Continued solution has created a younger and lower cave system extending parallel to the Bridge site from new sinks upstream. This new cave has developed along bedding planes downdip of the surface river bed, so that it forms a drainage loop beneath the north bank. Ultimately, this new cave will suffer the same fate as its predecessor and will be unroofed, leaving temporary fragments spanning the river.

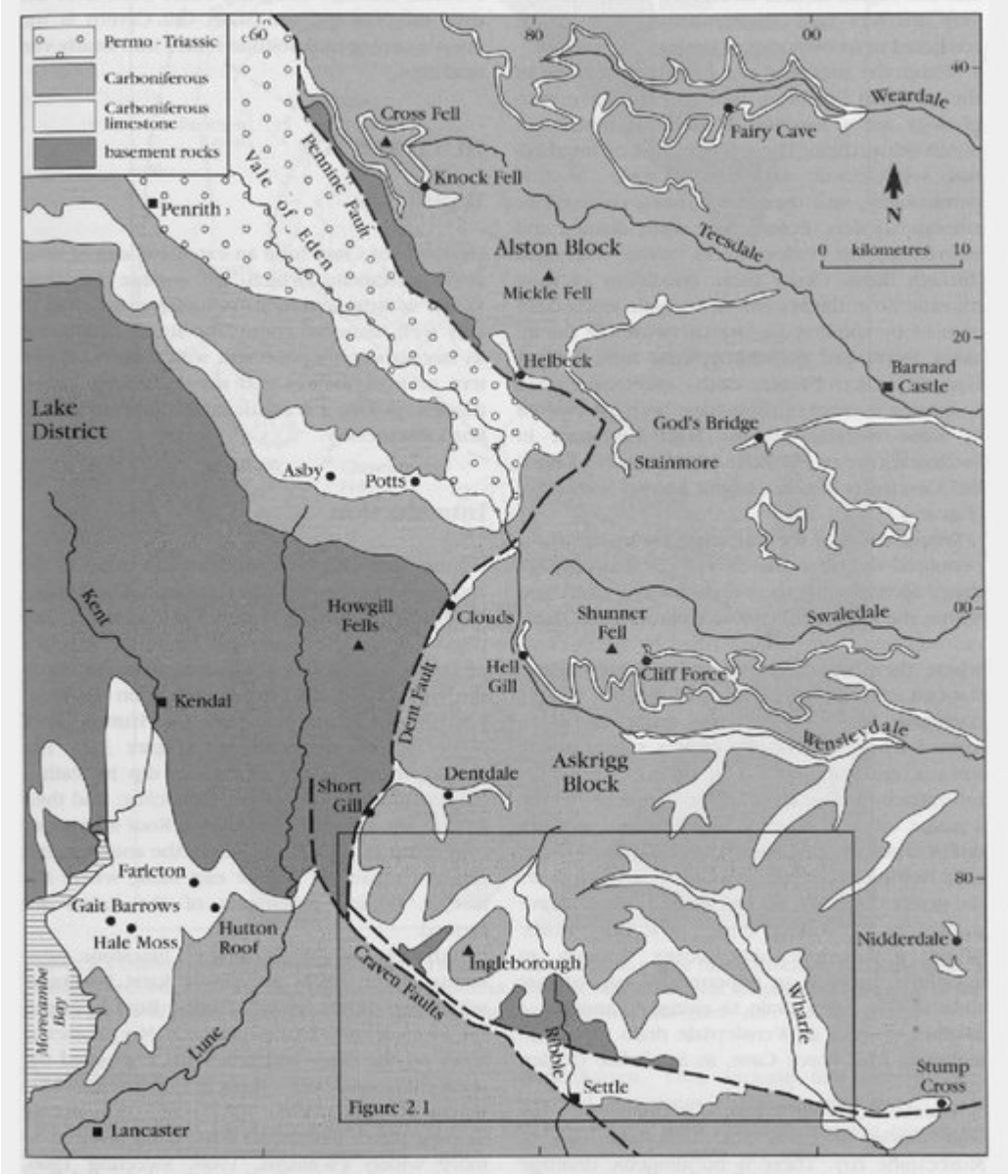
There is no positive evidence of the age of the caves. The river bed location is compatible with youthful caves, but abandoned loop passages in the lower cave system north of the surface river suggest that even this may not be entirely Holocene. The caves can only have developed where the limestone was exposed in the valley floor with a downstream outlet for their drainage, and so cannot be older than the time taken for surface lowering to pass through the 20 m

thickness of the limestone. However, this is greater than the 15 m of valley floor lowering attributed to a single glacial episode in some of the Pennine limestone valleys (Waltham, 1986). It is therefore possible that the caves were overridden by Devensian ice. The section of river channel downstream of God's Bridge is a cave which may have been unroofed by glacial plucking; this would have been greater downflow of the old cave exit than where the ice overrode the upstream entrance.

Conclusions

There are at least three sites in the limestone Pennines known as God's Bridge. All are cave remnants which provide convenient natural routes over rivers or streams. The God's Bridge of Stainmore is the finest of them. It is a truncated fragment of a formerly more extensive valley floor cave passage, and has a similar, but newer, cave system now developing parallel to it.

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 3.22) The upstream side of the limestone span of God's Bridge across the River Greta. (Photo: A.C. Waltham.)