Helbeck Scars

[NY 79 16]–[NY 76 20]

This is a proposed GCR site, not yet designated as an SSSI

Highlights

Helbeck Scars form an extensive area of open limestone pavement high on the Pennine escarpment. The limestones are well folded, and consequently the pavements contain a wide range of solution forms. The larger clints have kamenitza and rundkarren, and more jointed areas are reduced to outcrops of knife-edged clints.

Introduction

Helbeck Scars is the collective name given to a series of limestone outcrops just below and west of the crest of the Pennine escarpment overlooking the Vale of Eden, north of Brough (Figure 3.1). They range across altitudes of 350–600 m. The pavements form an almost continuous band 300 m wide and 4 km long, from Helbeck Intake, north-west across Key Scar, Musgrave Scar and Middle Fell, to Long Fell. They are all formed on the Dinantian Great Scar Limestone, exposed between the Swindale Beck and Barnarm Faults near the top of the Pennine scarp face. Mixed sequences of shale, sandstone and limestone of the Alston group overlie the Great Scar, and similar rocks of the Orton Group lie below. The regional dip is to the east, but local folding and block faulting produce considerable dip variation across the limestone outcrops. The limestone outcrops therefore include both wide pavements and narrow scars.

Most of the site lies within the Warcop military ranges, which probably accounts for the small degree of human damage to the pavements. There has been almost no geomorphological research on these little known but very spectacular pavements. The botanical values were assessed by Ward and Evans (1975) and in recent unpublished reports for English Nature.

Description

Pavement morphologies vary considerably across the site, in response to geological structure, outcrop pattern and aspect. They are best reviewed sequentially from south-east to north-west (Figure 3.21).

Helbeck Intake has outcrops across its southern slope with narrow bands of scar top pavement dipping north at 30°. Deep and narrow grikes separate elongated clints which are reduced to linear, knife-edge blades as narrow as 20–30 mm in areas of close jointing. At the western end of the scars, the beds dip over an eroded anticline, where parallel runnels develop on the larger and steeper clints. A large expanse of undulating pavement in the north of the Intake stands on limestone bedding planes dipping 10–25°, with curved grikes between clints with well developed rundkarren, kamenitzas and solution pits.

Key Scar has stepped pavements and small scars up the hill side. Local joint patterns dictate the shapes of rhomboid clints on the higher beds and more elongate beds lower down. The large outcrop at the western end of the scar lies across a monocline, so that a belt of the pavement slopes at 15–20° to the west, between almost level pavements above and below (Figure 3.21). The level areas have scattered kamenitzas 20–200 mm across, but virtually no runnel development. The steeper pavements have rhomboid clints with solution basins which have lost their front rim to form trittkarren. They also have sequences of kamenitzas, in which each overflow into its lower neighbour, and the stepped systems drain into rundkarren lower down the clint.

Musgrave Scar has narrow bands of dipping pavement separated by strips of acidic, grass-covered soil forming on the bottom of each dip slope below scars less than 1 m high onto the next bed. Along the crests of the scars, the grikes are deeper and narrower than they are lower down the same bedding planes. Natural breakdown is degrading the scar

edges, most rapidly in areas of closer jointing and thinner bedding. Runnels are broad, shallow and convergent, but steepen and deepen into the grikes. Some grikes, inclined at 30° from the vertical, have well developed flutes on their lower surfaces. Kamenitzas are shallow and locally stepped.

Middle Fell has wide pavements formed across a synclinal flexure, where dips of 30° east at the scar edge ease to 10° further into the slope (Figure 3.21). Clints are up to 1 m across but are smaller and increasingly knife-edged towards the scar edges. Deep rundkarren score the clints, and some start as stepped series of kamenitzas. Proto-grikes form along lines of weakness, commonly parallel with mature grikes. Further north, a group of larger depressions, 2–10 m across, have formed in a band within the stepped and dipping pavements, and a line of active sinks along the rear of the pavements swallows drainage from the overlying sandstone.

Long Fell has the most northerly and highest of the pavements. Narrow outcrops and small scars have deep, narrow grikes between small rhomboid and triangular clints with poor runnels. Further west the highest limestones of the Great Scar form dip slope pavements with larger clints on the massive beds between zones of broken rock on the outcrops of more rubbly beds.

Interpretation

The Helbeck limestones were subjected to intensive glacial scour by Pleistocene ice moving the length of the outcrops south-east towards the ice-way through the Stainmore gap. Solution features on the pavements are mostly on a small scale commensurate with formation since the Devensian ice retreat. Reaching altitudes of 600 m, the Helbeck pavements are higher than any others in England, except for the small features on the Yoredale limestones high on Simon Fell, Ingleborough. No direct influence of this altitude, and its climatic impact, can be recognized in the pavement morphology, though the modern flora is certainly restricted (Ward and Evans, 1975).

The structural variety in the limestone has produced a full range of bed scars, bare pavements on the dip slopes, and soil-covered pavements in sheltered sites. The Middle Fell pavements stretch undisturbed from scar top open pavement down to a soil cover and the scree of the next scar. On Musgrave Scar, narrow dipping pavement grades downslope into bands of acidic grassland dominated by *Nardus stricta,* probably growing on accumulations of windblown loessic silt at the lowest point of each dip slope. Breakdown of the narrow bands of pavement is accelerated by unloading fractures close to the scar edges. Closely spaced tectonic joints create the linear knife-edged clints of Helbeck Intake and Musgrave Scar.

Limestone lithology also influences pavement morphology. On Long Fell, adjacent beds at outcrop include an upper pseudobrecciated, rubbly limestone with no recognizable karren forms, over a lower massive limestone developing a smooth pavement surface with gently rounded solution features. The upper bed degrades and retreats to reveal the fresh surface beneath, but there is no clear pattern related to the retreating cover in the morphology of the lower pavement. Some pedestal clints have developed on Middle Fell where a massive bed overlies an easily degraded rubbly limestone.

Solutional features on the massive beds of limestone are well developed and show morphological response to the local dips and clint slopes, which vary so much across the folded limestone. Rundkarren develop below smooth areas of clint which are not runnelled. The relationship between dip and morphology is clear, with parallel, straight runnels on the steeper dips and branching, meandering forms on the more gentle slopes. Catchments on the steeper slopes include broad, tapering, shallow depressions, and runnels steepen into flutes down the sloping walls of grikes.

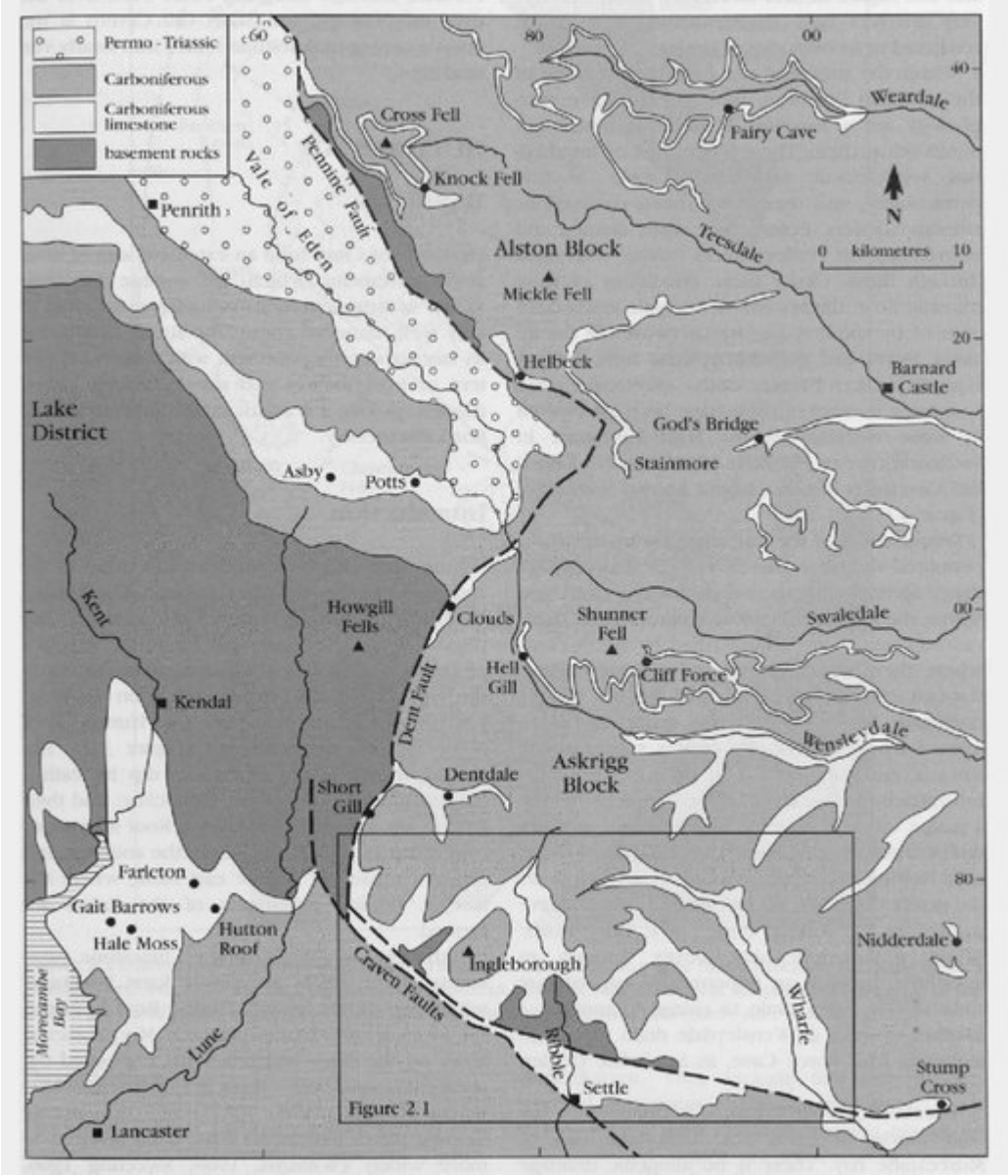
Kamenitzas are abundant, and many link to form cuspate elongated forms. Some kamenitzas eventually drain through rock fissures, but others overflow, to create stepped basins, and some appear to evolve into trittkarren. On Key Scar, many of the runnels on the sloping clints appear to originate as sequences of linked, overflowing kamenitzas. This may conflict with the wider evidence that rundkarren develop beneath a soil cover, whereas kamenitzas form on bare pavements where they catch water and organic debris. The relationship adds support to the concept of rounding the rundkarren crests merely beneath a lichen cover.

Eight circular depressions, in a group on the north of Middle Fell, are each 2–20 m across and up to 2 m deep, with level, grassed floors. These are distinctly larger than any other features on the Helbeck Scars, and appear to be relics of pre-Devensian landforms. An annular zone of pavement about 50 m wide around these basins has more mature karren morphologies, with runnels up to 400 mm deep in large, smooth, rounded rundkarren.

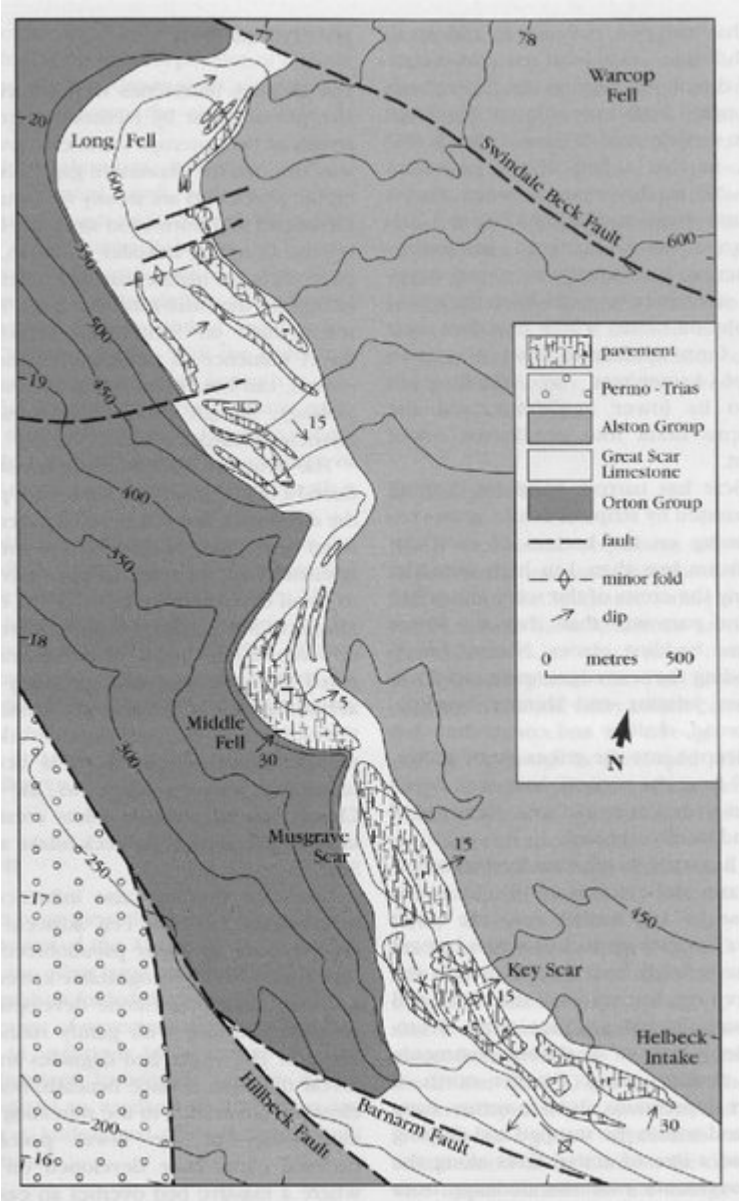
Conclusion

Helbeck Scars have the only extensive pavements on the limestones of the Alston Block, at higher altitude than any other large pavements in Britain. They are formed on folded limestones which support a wide range of pavement types and features in response to variations in structural dip and lithology. Abundant kamenitzas appear to be genetically related to rundkarren, and there are very fine linear, knife-edged clints in the densely jointed limestones.

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 3.21) Geological map of the pavements on the Helbeck Scars. The Alston Group includes thin limestones with low scars and narrow pavements which are not marked.