Hutton Roof

[SD 55 76]–[SD 56 78]

Highlights

Hutton Roof Crags form an extensive area of limestone pavements which are notable for their variety of structural form, including some areas of very well runnelled clints. The site is famous for its steeply sloping pavement with a diamond pattern of joint fissures and excellent long karren runnels, making a dramatic landform in an area of fine karst scenery.

Introduction

Hutton Roof Crags is a southern extension to the prominent limestone hill of Farleton Knott rising above the lowlands east of Morecambe Bay (Figure 3.1). The limestone forms an anticline plunging to the south, and faulted across its northern end; the Kendal Fault bounds it on the west, and the beds steepen into the Hutton Roof Monocline on the south-east (Figure 3.2). The Holkerian and Asbian limestones dip beneath a Brigantian cover east of the monocline, and their base is not exposed. The Hutton Roof limestones mostly dip at 10–20° away from the anticline, but dip more than 30° on the east flank, where the steeply sloping pavements of the Rakes are formed.

Although the steeply inclined limestone pavements of the Rakes are classic karst landforms which are widely known, Hutton Roof has been the focus of little detailed research. Morphometric work on the clints and grikes has compared the main pavements with others in Cumbria and elsewhere (Goldie, 1976, 1981), and the steeply dipping Rakes pavements have been referred to more widely (Williams, 1966; Sweeting 1966, 1974). Specific aspects of the karst morphology of the site have been described by Corbel (1957), Gale (1981a, b), Vincent and Lee (1981) and Pfeiffer (1991). The site is also rated as the second most valuable in Britain for the richness and variety of its flora (Ward and Evans, 1976).

Description

The greater part of the Hutton Roof karst is represented by the many tracts of good, well-dissected pavement, dipping south-west at less than 10°, on the higher parts of the hill west of the monoclinal crest. These gently inclined pavements are broken into small patches by minor structural undulations and faults, but they still display a great variety of surface solution features including kamenitzas, rundkarren and rinnenkarren. They include fine examples of stepped pavement *(Schichttreppenkarst*) — a stripped karst with exposed bedding planes on limestone beds which are truncated to create a stepped profile where the dip is not parallel to the surface slope. A partial vegetation cover only partly disguises this morphology.

The western outcrops, at Lancelot Clark Storth (Figure 3.2), are well preserved dipping pavement, some of which have unusual undulations with a wavelength close to 5 m; most of these appear to be stratimorphs over small, local folds, but some may be a direct product of large-scale glacial scour. Much of this area is bare pavement, but upslope to the east are more broken outcrops, and further south are the wooded pavements of Dalton Crags, straddling the plunging crest of the anticline.

The Rakes lie on the monoclinal flexure on the eastern edge of the site (Figure 3.2). They consist of three parallel escarpments, with their dip slopes formed on adjacent bedding plane in the massive limestone; they dip at 25–35°, and the dip slope bedding planes are scored by the famous assemblages of joint fissures and karren grooves (Figure 3.3). They are dissected by two major joint sets at about 90° to each other, orientated so that their intersection is bisected by the direction of dip. They were scoured by ice from the north, along the direction of strike. The joints have been opened by solution to form a rectilinear pattern of deep kluftkarren, and these delimit diamond-shaped clints on the steep limestone slabs. Each Clint is deeply scored by almost straight, parallel rinnenkarren — solution runnels with rounded troughs and sharp edges to the clint surface, which lie symmetrically downslope across the diamond clints. The runnels

vary in length, up to 5 or 10 m, according to their position across each Clint, starting not far short of the clint crest and draining rainwater into the grykes crossing at the lower edge. The Rakes are lightly vegetated, except in the small strike valleys at the base of each slab. A fourth limestone bed, beneath the three massive beds of the Rakes, is densely fractured and frost shattered, and its outcrop has a surface veneer of felsenmeer instead of clean pavement.

Interpretation

The gross morphology of Hutton Roof is defined by geological structure. Early suggestions that the isolated limestone hills around Morecambe Bay represent a relict tropical karst of Tertiary age (Corbel, 1957) have been positively refuted (Gale, 1981b; Vincent and Lee, 1981).

The smaller karst landforms have all been imposed by Holocene solution onto limestones exposed and scoured by Devensian ice. Scar edges on single limestone beds were ice-scoured, leaving smooth, rounded scar fronts which still have only limited runnel development. The ice also moved and then dumped the many erratic limestone blocks perched on the pavements at Hutton Roof Crags. Glacial scour may also be responsible for the long, parallel, rounded undulations on the gently dipping pavements of Lancelot Clark Storth.

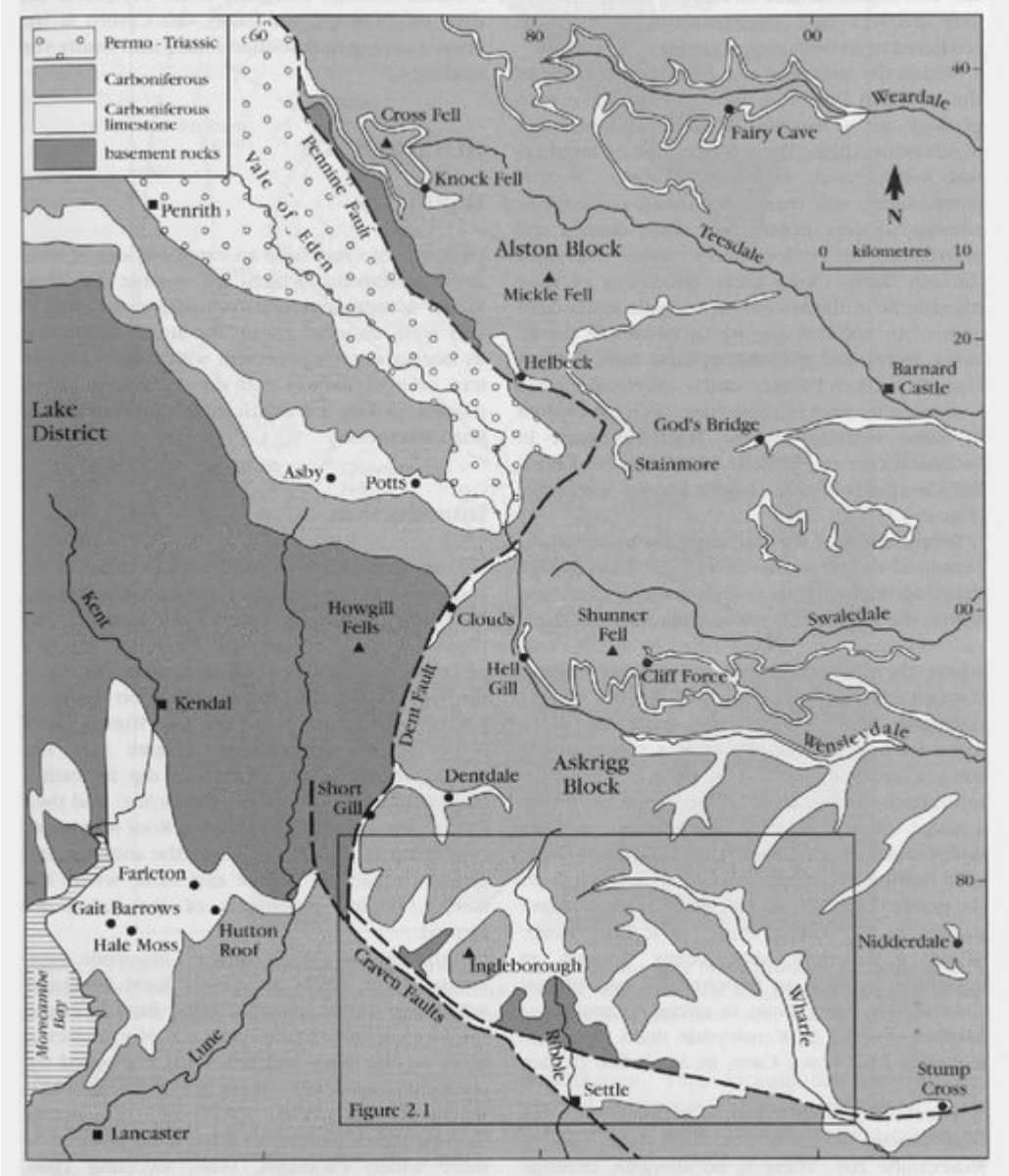
The limestone outcrop has a patchy cover of soil and vegetation, which has retreated locally to reveal the rounded rundkarren features typical of subsoil solution. The time-scale of development and removal of the soil and vegetation cover is not known. The rinnenkarren on the inclined Rakes are excellent examples of these large solution runnels formed by high subaerial flows of rainwater on sloping pavements. They are far larger than the little, sharp-edged rillenkarren found on many outcrops of bare limestone; they have large rainfall catchments on the large sloping clints, and develop into Hortonian channels which are only slightly convergent on the steep slabs of limestone. They retain their sharp upper rims, because the steep slabs have not retained a soil cover which could blanket them and round their features into the normal subsoil rundkarren.

The morphology of some of the pavements, notably on and around Lancelot Clark Storth has been modified by the recent removal of limestone for garden rockery stone, and on a lesser scale to feed limekilns in earlier times. The results vary from the occasional lack of the top bed of solutionally runnelled clints, to areas systematically stripped of these features leaving a surface of rough bedding planes (Goldie, 1976; Ward and Evans, 1976). There has been virtually no damage on the eastern part of Hutton Roof Crags, and the Rakes remain pristine.

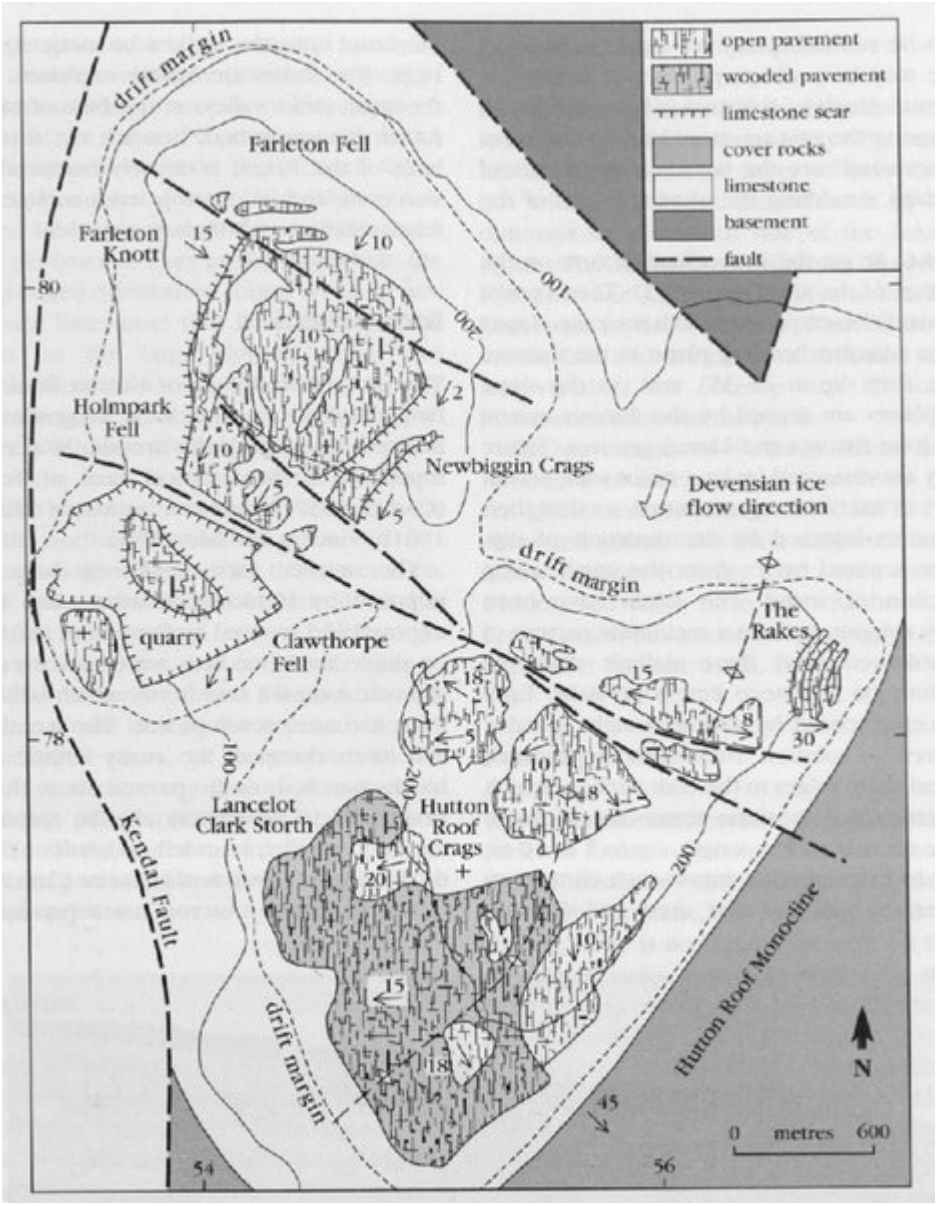
Conclusions

Hutton Roof Crags contains diverse and unusual limestone pavement features of national and international importance. The steeply dipping pavements at the Rakes contain the finest rinnenkarren in Britain, and their diamond patterns of deep kluftkarren are uniquely spectacular with their diagonal fluting by the rinnenkarren.

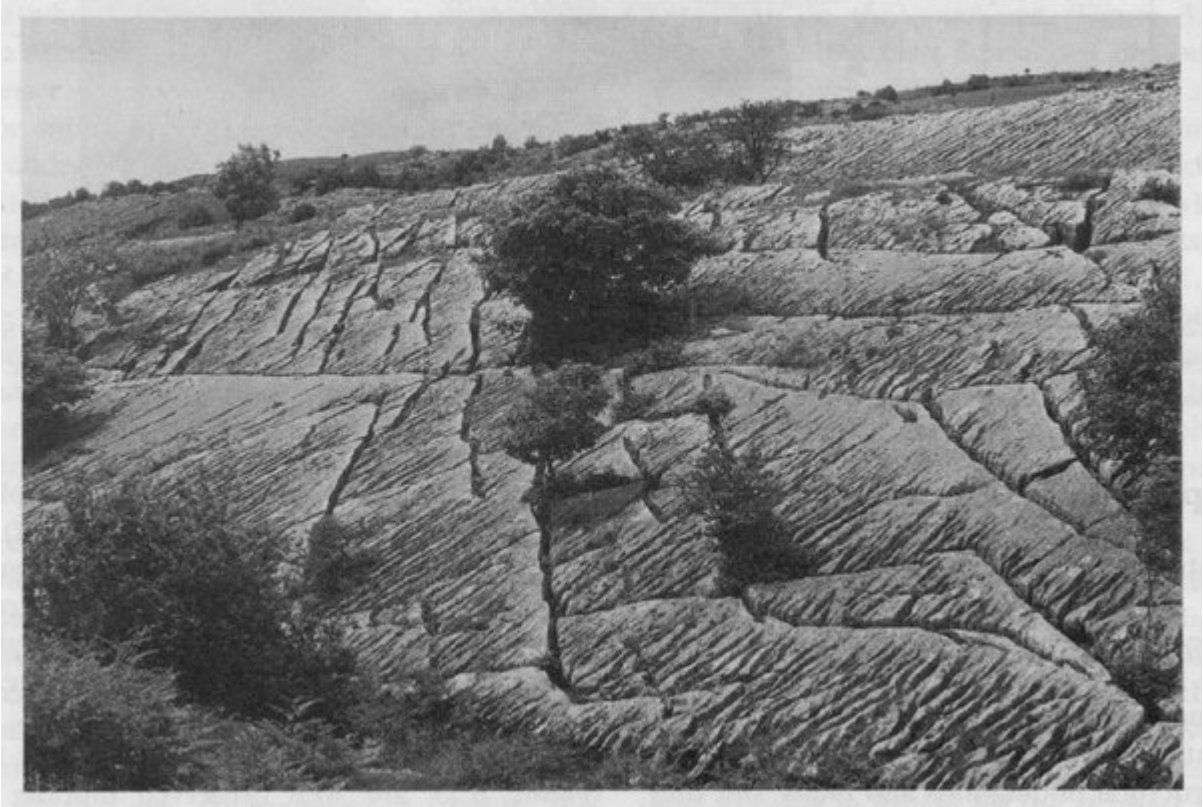
References



(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 3.2) Outline map of the limestone hills of Farleton Knott and Hutton Roof Crags. Basement rocks are Silurian mudstones. Cover rocks are the Brigantian and Namurian Bowland Series. The drift margin marks the edge of the thicker glacial till which covers most of the lowland around the limestone hills (partly after Moseley, 1972).,



(Figure 3.3) The distinctive inclined limestone pavements of the Rakes above Hutton Roof, with the deep rinnenkarren raking down the diamond-shaped slabs between the joint-guided kluftkarren. (Photo: A.C. Waltham.)