Bridestones

[SE 872 910]

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Introduction

The Bridestones are a collection of tor and rock-weathering forms developed in limestones on the south edge of the North Yorks Moors. The tors show considerable morphological variety, from isolated, undercut, pedestal rocks to scarp-edge tors. Together with sites such as Newtondale and the Hole of Horcum, the Bridestones are important for studies of rock weathering, periglacial processes, landscape evolution and reconstruction of the glacial history of North Yorkshire. Controversy surrounding tor formation has centred around two main groups of tors; in the Pennines and on Dartmoor. However, the tors developed in outlying areas such as Bridestones also contain important information concerning the nature of deep weathering and tor formation in the British Isles. They also make an interesting lithological contrast, being developed not on the Millstone Grit of the Pennines, but on limestones.

Description

The Bridestones are a series of isolated tors approximately 4 km north-east of the village of Levisham on the south edge of the North Yorks Moors. The tors are developed in limestones of Corallian (Upper Jurassic) age, assigned to the Passage Beds by Fox-Strangways (1892). These gently dipping rocks form conspicuous scarp slopes and this region is commonly referred to as the 'Tabular Hills'. Two lines of tors are present, known as the 'Low Bridestones' and the 'High Bridestones' (Palmer, 1956). The northern portion of both groups consists of a bare scarp face parallel to the valley axis (Figure 7.16). Joints in this rock face have commonly weathered out, leaving isolated rock masses standing as tors. These open joints reach depths of up to 2 m in places. Palmer (1956) observed the seepage of water and moisture along joints and cavities in the bedrock. Seepage was particularly pronounced at joint–bedding plane intersections and at the junction of the bare rock with the surrounding hill-slope. No deeply weathered or decomposed rock is observed to fill the joints today.

A wide variety of tor morphologies are encountered at the Bridestones, including both edge tors and isolated pedestal rocks. The isolated pedestal rocks are commonly described as 'mushroom-shaped' (Palmer, 1956) because they have large undercut bases. In many cases, the summits of these tors consist of the Upper Passage Beds, whereas the undercut bases are composed of the more weakly cemented Lower Passage Beds (Fox-Strangways, 1892). Minor surface weathering forms are common, including linear and honeycomb weathering surfaces. Palmer (1956) also describes small rock basins and pot-holes on the upper, flat surfaces of tors.

Interpretation

Palmer's (1956) description of the Bridestones tors, their surface weathering forms (including the linear and honeycomb weathering surfaces, potholes and basins) and the surrounding slopes is by far the most detailed published study of the site. He considered the overall morphology of the pedestal rocks to be comparable to that of pedestals currently forming elsewhere in arid climates by chemical disintegration and differential weathering (Bryan, 1923, 1926). The small rock basins and pot-holes on the upper, flat surfaces of the tors were considered by Palmer (1956) to show little or no lithological or structural control on development. These features were thought to form through rock disintegration by water ponded in small hollows.

Palmer (1956) considered that collectively these forms point unequivocally to rock disintegration along structural and lithological zones of weakness, with the assistance of water emerging through the rock itself. This led him (Palmer, 1956, p. 61) to conclude that 'the intimate association between all the irregularities in the form of the tors and the scarps on one

hand, and the structure of the rock on the other, shows clearly that the main factor in the formation of these irregularities is the availability of water'. He invoked a complex of processes involving solution of the cemented bedrock, freeze–thaw and hydration by carbonic and humic acids to explain the physical and chemical processes responsible for rock disintegration. lie considered that the processes of weathering are still active under present climatic conditions and that they depend largely on the amount of water reaching the exposed rock surfaces. Palmer (1956) concluded that deep weathering, wind abrasion or solifluction have not been significant processes in the formation of the tors.

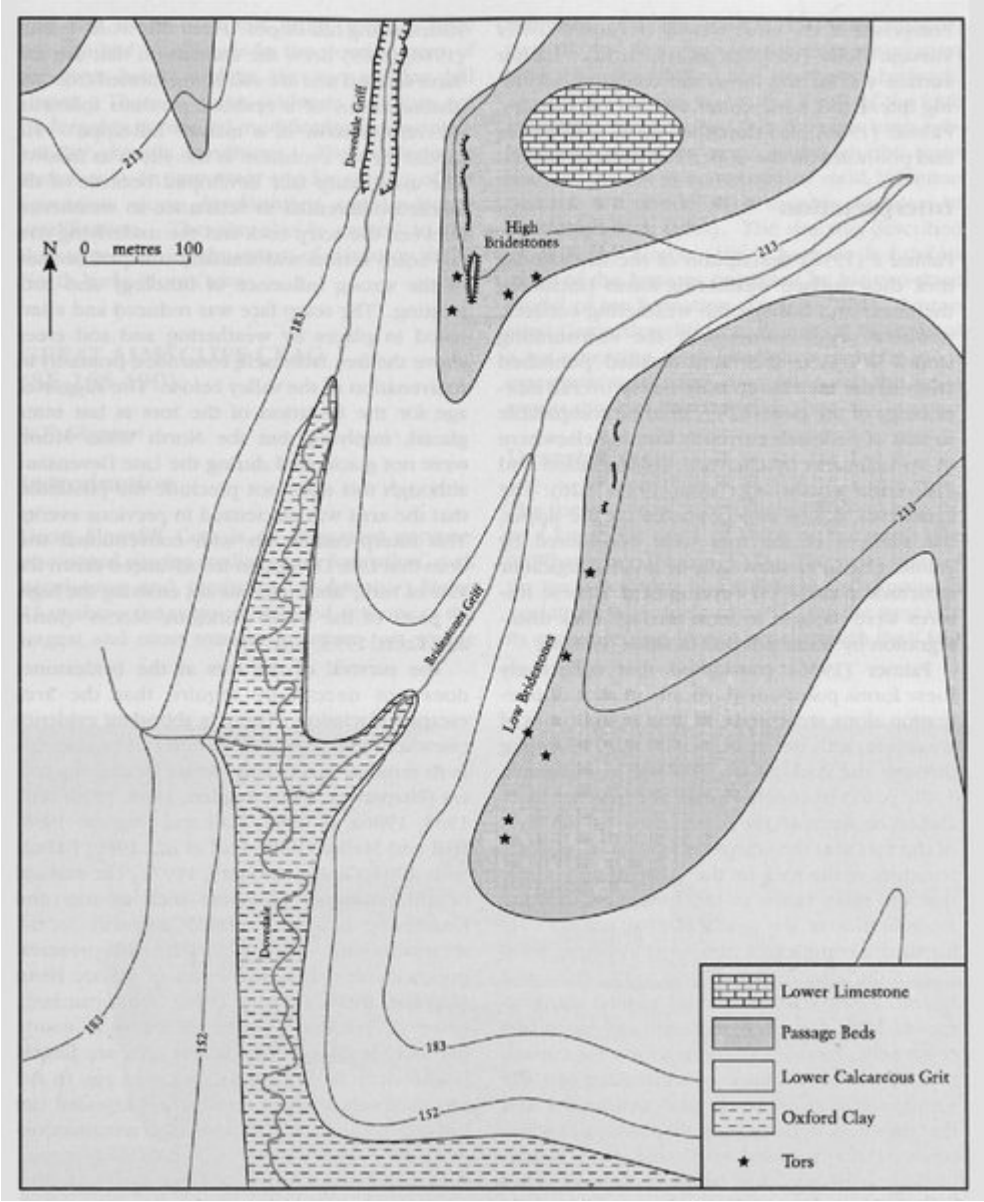
Overall, Palmer considered that the tors of the Bridestones evolved in response to successive stages of valley-side incision and scarp-edge retreat. These stages were related primarily to fluvial dissection of the valley below and to the consequent changes in water availability on the surrounding hill-slopes. From this work, Palmer (1956, p. 69) drew the conclusion that the tors 'have formed and are still being formed from the disintegration of a resistant stratum following the rejuvenation of a mature hill-slope'. His model for tor evolution at the site is as follows. The main scarp face developed because of the marked differential in resistance to weathering between the scarp rock and the underlying strata. Scarp retreat was similarly unequal because of the strong influence of lithology and rock jointing. The scarp face was reduced and eliminated in places by weathering and soil creep above the free face itself, controlled primarily by rejuvenation of the valley below. The suggested age for the initiation of the tors is last interglacial, implying that the North Yorks Moors were not glacierized during the Late Devensian, although this does not preclude the possibility that the area was glacierized in previous events. This interpretation fits with conventional wisdom that Late Devensian ice advanced down the Vale of York, 'abutting, but not crossing the higher parts of the North Yorkshire Moors' (Jones and Keen, 1993, p. 178).

The survival of the tors at the Bridestones does not necessarily require that the area escaped glaciation. There is abundant evidence elsewhere that ice-sheet erosion can be selective in its removal of tors and former weathering covers (Fitzpatrick, 1963; Sugden, 1968, 1989; Hall, 1985, 1986a, b, 1991; Hall and Sugden, 1987; Hall and Mellor, 1988; Hall *et al.,* 1989; Ballantyne, 1994; Glasser and Hall, 1997). The survival of old landscape elements such as tors and weathering covers is related primarily to the thermal regime of the ice sheet, with preservation beneath cold-based zones of the ice sheet (Kleman, 1994; Glasser, 1995). Unfortunately, however, because former glaciological conditions in the North York Moors area are largely unknown, it is difficult to assign an age to the tors themselves. As a result, the suggested last interglacial age for their initiation remains conjectural.

Conclusions

The limestone tors at the Bridestones provide a strong contrast with the main group of gritstone Pennine tors. Their detailed morphology and surface weathering forms suggest that water seepage along joints may have played a prominent role in tor development. Changes in the rate and location of this water seepage have been linked to changes in the development of the river below and to the surrounding hill slopes. There is some evidence that tors are undergoing continued modification under present-day climatic conditions. The Bridestones therefore is an important site for studies of tor formation, slope development and landscape modification. The site also is central to the debate concerning the extent of glaciation in the North Yorks Moors area.

References



(Figure 7.16) Map of the Bridestones showing relief and location of tors (atter Palmer, 1956).