Kinver Edge, Staffordshire

[SO 828 820]–[SO 837 836]

Introduction

The Lower Permian Bridgnorth Sandstone Formation is seen in superb three-dimensional exposure on Kinver Edge. The formation displays large-scale, high-angle cross-bedding, which records palaeowinds blowing from the east. A number of other characteristic aeolian features are well displayed, including hierarchical bounding surfaces between individual dunes, various lamination types, and very well■rounded sand grains. These sedimentary features make this an important site for the elucidation of Permian environments in the English Midlands.

The Permian sediments exposed on Kinver Edge have been described briefly by Shotton (1937), Whitehead and Pocock (1947), Smith *et al.* (1974), and Mader and Yardley (1985).

Description

Kinver Edge is a ridge of high ground with three separate outcrops, Vale's Rock, Nanny's Rock, and Holy Austin Rock, arranged in a SSW–ENE line. The crags expose the Lower Permian Bridgnorth Sandstone Formation, formerly the 'Lower Bunter', 'Lower Mottled Sandstone', or the 'Dune Sands' (Wills, 1948; Smith *et al.,* 1974), which is capped by the Kidderminster Formation, formerly the 'Bunter Pebble Beds' (Warrington *et al.,* 1980).

The Bridgnorth Sandstone Formation on and around Kinver Edge rests unconformably on the Upper Carboniferous Enville Breccia. It is characterized by a brick-red or reddish-brown colour and irregular pale green mottles. The sandstone is medium- or fine-grained, and the grains are generally well rounded. In places, the rock has a 'millet seed' texture, although the smaller grains may tend towards angular or subangular; pebbles are rare. Sedimentary structures include large-scale, high-angle cross-bedding arranged mainly in trough-cross-bedded sets, with minor planar-cross-bedded sets (Figure 2.29)a. The cross-beds are divided by a complex system of bounding surfaces (Figure 2.29)b, divisible into a hierarchy of as many as four levels.

The base of the overlying Kidderminster Formation channels deeply into the top of the Bridgnorth Sandstone Formation. The Kidderminster Formation comprises sandstones and pebbly sandstones, which are generally brownish-red in colour. The basal bed, exposed on the top of Kinver Edge, reaches a maximum thickness of 0.6 m; it contains subrounded and subangular clasts in a soft sandy or marly matrix that is locally calcareous. The clasts consist predominantly of quartzite, although Carboniferous limestone, chert, and volcanic rocks are present. The marly or sandy breccio-conglomerate is, in places, overlain by a unit of pebbly grit (Whitehead and Pocock, 1947).

Interpretation

The Bridgnorth Sandstone Formation, characterized by large-scale cross-bedding and well-sorted, polished 'millet seed' sands grains, is a classic aeolian deposit, as recognized by Shotton (1937). The orientations of the foresets of the dunes indicate palaeowind directions from the east. Shotton (1956) interpreted the unit as the deposits of large-scale, crescentic barchan dunes.

Mader and Yardley (1985) suggested that the complex hierarchy of bounding surfaces (Figure 2.29)b demonstrates that the Bridgnorth Sandstone Formation is a compound system consisting of major draa bedforms bearing superimposed smaller-scale transverse dunes. The sinuous-crested transverse dunes migrated partly obliquely down the lee side of essentially inactive draa bodies. The four elements of the hierarchy of bounding surfaces reflect, respectively, draa migration, draa modification, dune migration, and dune modification. Here and there, individual cross-bed sets pinch out laterally, which indicates cut-off by succeeding migrating dunes. The apparent absence of inter-dune deposits points to a sand-saturated system with closely spaced aeolian bedforms (both draas and dunes) separated by only narrow interdune

corridors that are represented by minor disconformities. This is in contrast with, for example, the Corrie Sandstone of Arran, where interdune beds are a major part of the record (see above).

In a study of the Bridgnorth Sandstone Formation around Bridgnorth, Karpeta (1990) presented evidence for three major facies associations: transverse draas, barchanoid draas, and dome dunes, with long-term winds blowing from the east (controlling the shape of the transverse draas and dome dunes), and seasonal winds blowing from the north-east (controlling the shape of oblique crescentic dunes on the lee face of the transverse draas and the barchanoid draas). This study depended on detailed mapping and recording of all sedimentary structure orientations; such work has yet to be done on the Bridgnorth Sandstone Formation of the Worcester Basin.

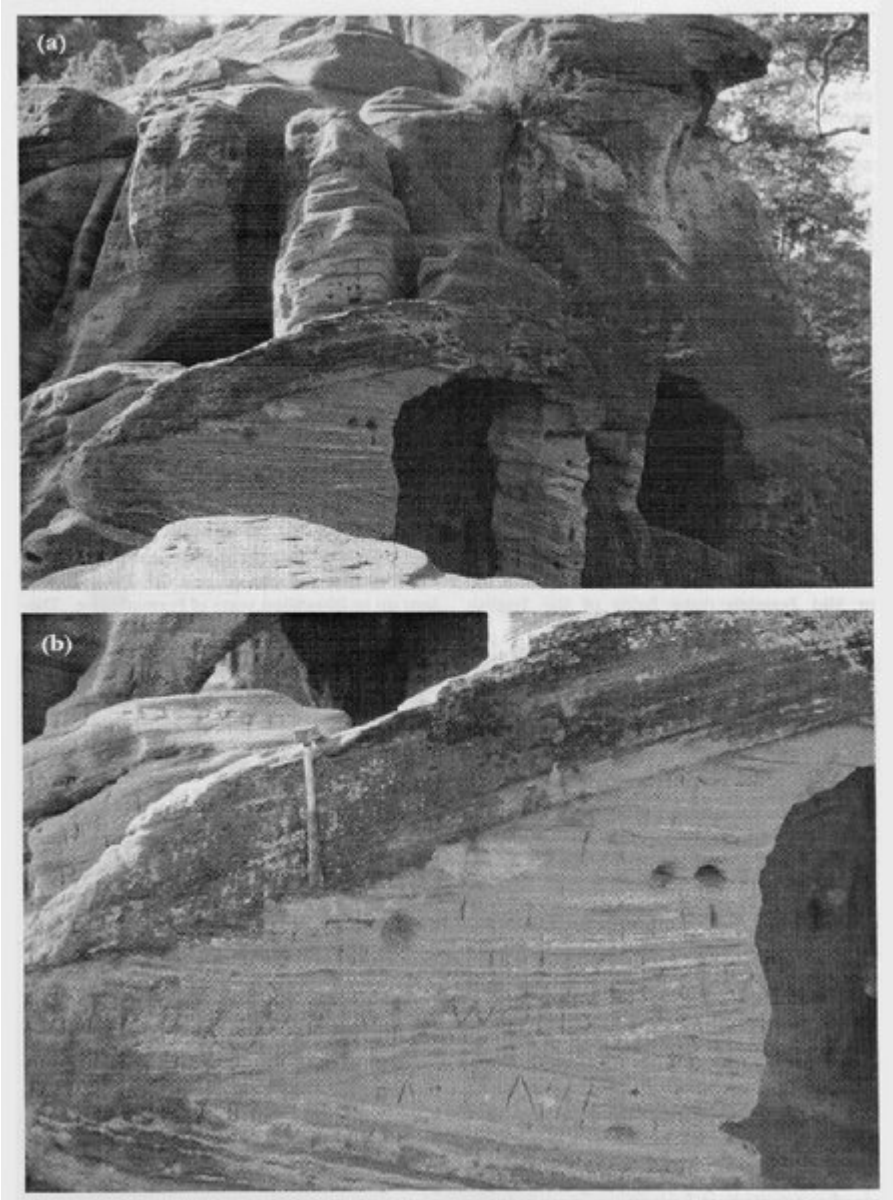
The overlying Kidderminster Formation comprises breccio-conglomerates deposited on large alluvial fans at the margins of the sedimentary basin (Whitehead and Pocock, 1947), probably where deeply incised wadis opened onto the more even relief of the sedimentary basin.

The Bridgnorth Sandstone Formation contains no fossils, nor has it yielded any independent evidence of age. However, it appears to be part of a widespread series of thick aeolian sandstones deposited over much of central and northern England, and has been broadly correlated with the Collyhurst Sandstone of the Irish Sea Basin, the Penrith Sandstone of the Vale of Eden, and the Quartzite Breccia, Barr Beacon Beds, and Hopwas Breccia of the North Staffordshire Basin (Smith *et al.,* 1974, p. 26).

Conclusions

The natural crags on Kinver Edge provide a series of small, but informative sections through Permo-Triassic sequences. The Bridgnorth Sandstone Formation consists of large-scale dune cross-beds, and the exposures show excellent three-dimensional detail that allow the ancient compound dune forms to be reconstructed. This is a key site for understanding Early Permian palaeogeography and the palaeoenvironments at the margins of the Early to Mid Permian dune fields of the English Midlands.

References



(Figure 2.29) The Bridgnorth Sandstone at Kinver Edge, showing (a) large-scale barchanoid aeolian dune bedding, and (b) a close up of the aeolian bounding surfaces. The hammer is about 300 mm long. (Photos: P Turner.)