
Grace Dieu, Leicestershire

[SK 433 182]

Introduction

Lying within woodland less than 1 km north-east of Thringstone in north-west Leicestershire, the disused quarry workings at Grace Dieu [SK 433 182] expose a unique sequence of shallow-marine, dolomitic limestones; part of the Ticknall Limestone (Brigantian). The lower boundary of this sequence is unexposed, but is probably an unconformable contact with Precambrian basement. At its upper boundary the sequence is truncated by a Triassic unconformity. The rocks of this site have a long but intermittent history of research, being mentioned or featured in work by Hull (1860), Fox-Strangways (1905), Parsons (1918a), Mitchell and Stubblefield (1941), Spink (1965), Kent (1968), Monteleone (1973) and more recently by Carney (1995). The significance of the site derives from its unique palaeogeographical position, being the southernmost Lower Carboniferous section on the Hathern Shelf, in close proximity to the eroding basement that formed the contemporary northern shoreline of the Wales-Brabant Massif.

Description

The strata exposed are close to horizontal. A thick section described in detail by Kent (1968) records almost 17 m of Carboniferous strata below the Triassic unconformity. At the base of the section, Kent (1968) recorded a 1.2 m-thick massive brown sugary oolite capped by a 'deeply pocketed erosion surface' or palaeokarst (Figure 7.34). This erosion surface probably corresponds to the marl-filled pockets and cavities noted here by Fox-Strangways (1905) and Parsons (1918a). Above this, the same author recorded 2.7 m of bedded dolomitic limestone with *Gigantoproductus* and crinoids, 2.4 m of dolomitic and brecciated limestone, 1.2 m of limestone conglomerate containing angular to rounded clasts set in a purplish marly matrix, and more than 9 m of well-bedded and locally dolomitized limestone. The most recent account of the site (Carney, 1995), however, recorded less than 5 m of exposure. Carney (1995) noted undulating bounding surfaces to beds, discontinuous internal partings, lenticular bodies of laminated skeletal wackestones and packstones, and lateral transitions between bedded strata and cemented limestone breccias. Most of the fossils in the Grace Dieu section are fragmentary or dolomitized, but brachiopods (including *Spirifer* and *Gigantoproductus*), crinoid debris, and corals have all been recognized (Parsons, 1918a; Kent, 1968; Monteleone, 1973).

Interpretation

The proximity of the flat-lying and apparently undisturbed dolomitic limestones of the Grace Dieu section to the Neoproterozoic rocks exposed less than 100 m away in Grace Dieu Brook suggests that the Lower Carboniferous sequence in this area most probably rests directly on Charnian basement (e.g. Kent, 1968; Carnes 1995). Unfortunately, the contact is not exposed, and although faulting along the southern margin of the inlier cannot be ruled out entirely (Carney, 1995), there is no evidence for this. Carney (1995) invoked uplift along the Thringstone Fault during the Caledonian orogeny to explain the stratigraphical overstep of the Carboniferous limestone onto the Neoproterozoic basement in this area.

Although many primary lithological characteristics have been obscured by dolomitization, the fauna clearly indicates deposition in a marine setting. The bioclastic nature of at least some of the Limestones (Carney, 1995) together with the presence of oolites (Kent, 1968) suggests high-energy, probably shallow-water depositional conditions that are consistent with the palaeogeographical setting of the site, close to the shoreline along the northern edge of the Charnwood Massif (Kent, 1968), part of the Wales-Brabant Massif to the south. These interpretations are also supported by the occurrence of pebbles of Charnian basement in some beds. The limestone breccias have been variously interpreted as the result of contemporaneous brecciation in a shallow-water environment (Mitchell and Stubblefield, 1941), pseudo-breccias resulting from pre-Triassic diapiric uplift (Spink, 1965), or as products of karstic dissolution processes operating along fault and joint systems before or during deposition of the overlying Triassic strata (Carney,

1995). The more recent of these interpretations is probably the most reliable, and cavities and erosion surfaces in the lower part of the section (Fox-Strangways, 1905; Parsons, 1918a; Kent, 1968) may also be the result of subaerial (karstic) weathering processes (Carney, 1995; cf. Monteleone, 1973).

Stratigraphically, Monteleone (1973) assigned the strata exposed at Grace Dieu to the Ticknall Limestone (see (Figure 7.3)). This was based on the gross lithological and faunal similarities between the strata at Grace Dieu and the Ticknall Limestone at its type locality (see Ticknall Quarries GCR site report, this chapter). The evidence for the age of the beds at Grace Dieu is scant, but the presence of *Gigantoproductus* (Kent, 1968) is consistent with a Brigantian age.

The site provides significant evidence for the development of nearshore shallow marine facies on the southernmost shore of the Hathern Shelf during late Dinantian times. Although the rather complex interplay of lithofacies, diagenesis, dolomitization, post-depositional brecciation and subsurface karstification is still rather poorly understood, the application of modern analytical approaches would probably reveal much more of the geological history of this intriguing and regionally significant site. Micropalaeontological investigation has the potential to provide significant new data to constrain regional correlations and determine the age of the sequence.

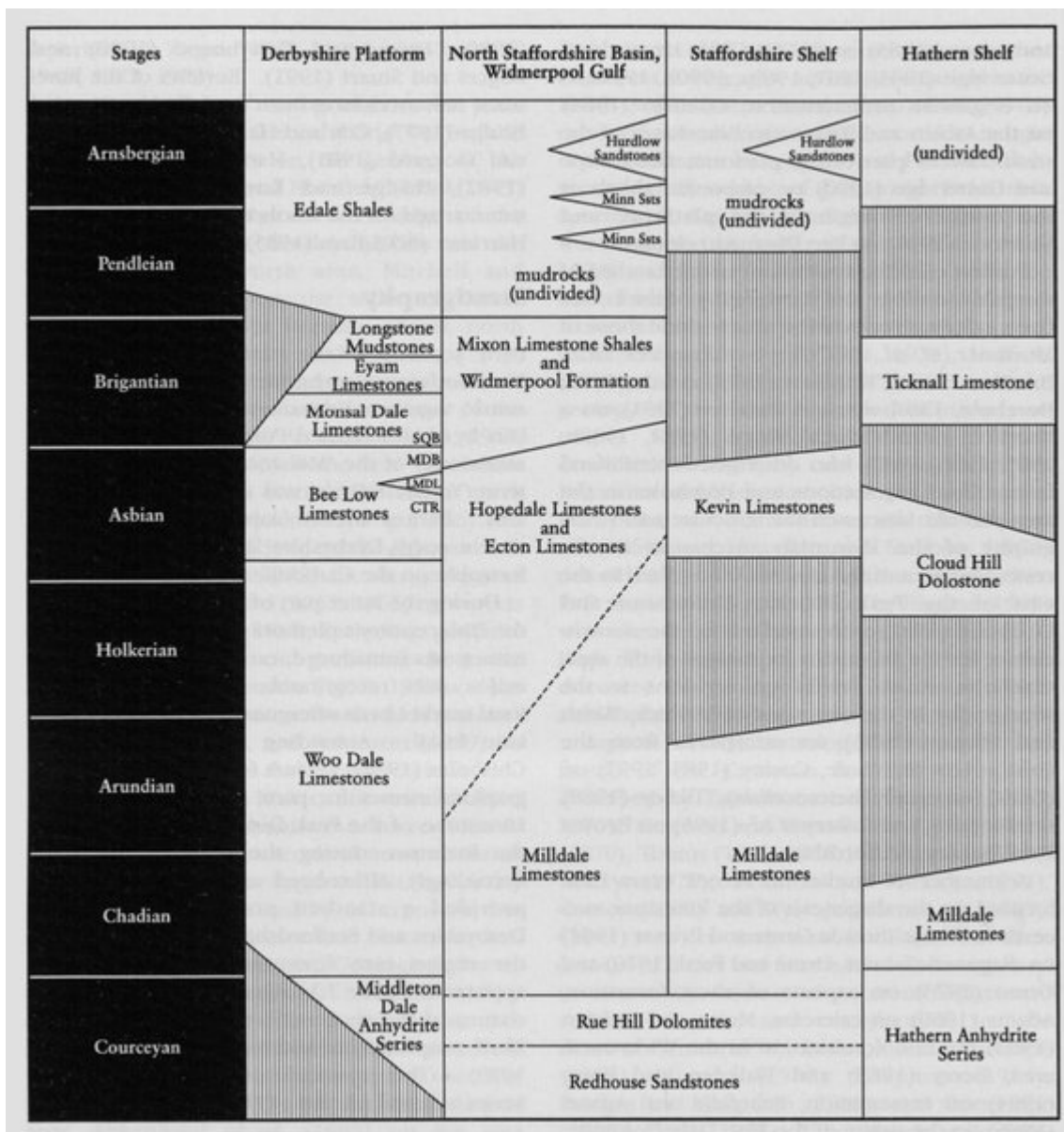
Conclusions

The sequence exposed at Grace Dieu provides rare evidence for the development of late Dinantian shallow marine environments along the northern shoreline of the upstanding and eroding Precambrian basement of the Charnian Massif. The locality also has significant potential as a source of new sedimentological and palaeontological data that may shed new light on the geological history of this rather poorly known area within the British Lower Carboniferous sequence.

References



(Figure 7.34) Dissolution surface in the Ticknall Limestone (Brigantian) at the Grace Dieu GCR site. Note that part of this section is currently obscured. (Photo: P.J. Cossey.)



(Figure 7.3) Simplified stratigraphical chart for the Lower Carboniferous succession of Derbyshire, north Staffordshire and north-west Leicestershire. CTR — Chee Tor Rock; LMDL — Lower Millers Dale Lava; MDB — Millers Dale Beds; SQB Station Quarry Beds. Areas of vertical ruling indicate non-sequences. Not to scale. Note that, unless otherwise stated, all major lithostratigraphical units shown on this chart are recognized as formations. Compilation based on information from Aitkenhead and Chisholm (1982) with additional details from Smith et al. (1967), Aitkenhead et al. (1985), Chisholm et al. (1988), Ambrose and Carney (1997, 1999) and Ambrose (1999).