Micklefield Quarry

[SE 445 325]

Highlights

The abandoned face at Micklefield Quarry (box 4 in (Figure 4.2)) is the best and most readily accessible exposure of the Hampole Beds, which span the contact between the Wetherby and Sprotbrough members of the Cadeby Formation (Lower Magnesian Limestone), and also affords excellent views of the Hampole Discontinuity and large-scale cross-bedding in the ooidal dolomite of the Sprotbrough Member.

Introduction

Micklefield Quarry lies behind houses near the south end of New Micklefield village and about 100 m west of the Great North Road; most of the floor of the former quarry has been filled with builders' and domestic waste. Strata now exposed comprise the lower part of the Sprotbrough Member (7.5 m+) and the uppermost part of the underlying Wetherby Member (2 m+), but the main features of interest and importance are the Hampole Beds (about 1 m) and the underlying Hampole Discontinuity. The discontinuity is regarded (Smith, 1968) as an erosion surface cut during a minor sea-level fall and the Hampole Beds are thought to be a product of an oscillating tropical shoreline on an extensive carbonate shelf at the edge of the English Zechstein Sea. The distinctive lower dolomite of the Hampole Beds was a much valued building stone and has been extensively used in the construction of the nearby walls and houses.

The quarry was first mentioned in the literature by Edwards *et al.* (1950), who recorded 60 ft (18 m) of 'limestone' (consisting mainly of the Wetherby Member), and summaries of the strata exposed now were given by Smith (1969b); a sketch of part of the quarry face was given by Kaldi (1980, fig. 3.36, 1986a, fig. 3b) who also included (fig. 6b) a photograph of a complex burrow system there.

Preservation of the face at Micklefield Quarry followed representations to the local council in 1969. Since then vital parts of the face have twice been covered and, following protests, twice re-excavated; nevertheless they remain vulnerable to illegal tipping. An information board provides a geological interpretation for visitors.

Description

The position of Micklefield Quarry is shown in (Figure 4.14); the preserved face is about 90 m long and up to about 9.5 m high. The Hampole Discontinuity is well exposed for only a short distance towards the south end of the face.

Strata present in Micklefield Quarry belong entirely to the Cadeby Formation (the Cycle EZ1 carbonate unit of the marginal English Zechstein sequence) and comprise parts of the Wetherby Member (below) and the Sprotbrough Member. The general geological sequence in the quarry is summarized in (Figure 4.15), which emphasizes the Hampole Beds that span the contact between the two members. Cavities after secondary anhydrite are present at all levels and many of the ooids have leached centres; some of the cavities are calcite-lined.

The sequence depicted is uniform throughout the quarry and dips gently eastwards. The overall apppearance of the southern part of the face is shown in (Figure 4.16).

Interpretation

Micklefield Quarry is the most accessible and best exposure of the Hampole Discontinuity and Hampole Beds in central Yorkshire, supplanting the type locality of Hampole Limeworks Quarry [SE 515 097], most of which is now covered. The discontinuity (Figure 4.17) is important in that it is evidence of a phase of erosion and probably subaerial exposure near the end of deposition of the Wetherby Member, and the Hampole Beds are important in that they furnish unambiguous

evidence of a phase of peritidal sedimentation between the end of the main phase of Wetherby Member sedimentation and the beginning of the main phase of Sprotbrough Member sedimentation (Smith, 1968). They are also important in providing a readily mappable horizon between the two members and in showing that the depositional surface of the Wetherby member had widely approached contemporary sea level and was thus particularly sensitive to minor sea-level changes.

Wetherby Member below the Hampole Discontinuity

Less than 1 m of this member is now exposed below the Hampole Discontinuity, but up to 3.65 m of strata were seen by the writer before the site was landscaped; they were of typical open-shelf shallow water to intertidal peloid shoal or marginal facies, lithologically similar to equivalent strata at the type locality at the former site of Wetherby Station [SE 397 484] and at Hampole Limeworks Quarry [SE 515 097].

Hampole Discontinuity (HD in (Figure 4.15))

The gently rolling low relief of this crusted surface at Micklefield Quarry is typical of its configuration throughout the province; as elsewhere, it bears only a few minor eminences and hollows (?channels) and only slightly truncates bedding in underlying strata (Figure 4.17). This widespread low relief is known to be exceeded only in Cadeby Quarry and its immediate surroundings, but greater relief may also be inferred in places where the lower dolomite is abnormally thick (e.g. Bramham and Wetherby) and in places such as Kirk Smeaton [SE 51 16] where the lower dolomite is underlain by interbedded, multicoloured dolomite and siliciclastic mudstones like those at Cadeby Quarry.

Hampole Beds

Early workers from Sedgwick (1829) onwards recognized that the Cadeby Formation (formerly the Lower Magnesian Limestone or equivalents) could be readily divided into two main units on the basis of lithology and sedimentary characteristics, but the two units were nowhere fully defined and their mutual contact was commonly regarded as diachronous. Mitchell (in Mitchell *et al.,* 1947, p. 122), however, described a distinctive bed about 0.6 m thick at the junction between the two units in the Don Valley near Sprotbrough and this bed was informally defined in his memory as the lower dolomite of the Hampole Beds by Smith (1968); the full normal sequence of the Hampole Beds at Micklefield Quarry (Figure 4.15) differs only slightly from that at the type locality. Within the Hampole Beds, the contact between the two members is taken at the base of the middle mudstone, though Moss (1986) advocated taking the contact at the top of an inferred palaeosol in the middle of the middle mudstone in parts of the Don Valley area where this bed is thicker than its usual 10–30 mm.

Micklefield Quarry

The most striking feature of the Hampole Beds is the unusual and environmentally significant lithology of the lower dolomite. The pronounced fenestral fabric of this algal-laminated ooidal bindstone is exceptionally clearly seen, and, in the Magnesian Limestone, is confined to this youngest bed of the Wetherby Member and a few thin lenses in grainstones a short distance below the Hampole Discontinuity. The combination of algal lamination, inferred crusts, imbricated rip-up clasts, minor channels and a convincing fenestral fabric suggests with reasonable confidence that this bed can be interpreted as the deposit of a high intertidal to predominantly low supratidal tropical marine-marginal sabkha or coastal flat (Smith, 1968); the presence at Mansfield of amphibian footprints on the surface of the underlying discontinuity (Hickling, 1906) is consistent with this interpretation.

The Hampole Beds have been traced along the depositional strike for more than 150 km from near Ripon to near Nottingham and, for a peritidal shoreline sequence, are extraordinarily uniform. All the component beds are lithologically consistent, the greatest variations being in relative and absolute thicknesses. In these respects the lower dolomite is the most variable, in keeping with its inferred beach or sabkha origin, ranging to more than 2.5 m thick at Wetherby (SE 49945)[sic] (but see Harwood, 1981, p. 82 for an alternative view) and Bramham [SE 429 422], but generally being 0.20.8 m thick; at Wetherby and Bramham, this bed features abundant small contemporaneous volcano-like structures (?gas- or fluid-escape vents) in addition to its other distinguishing features. The lower dolomite is, of course, absent or

unrecognizable above and below the tidal range (i.e. west and east of the intertidal belt). A local variant, in which a sequence of bedded dolomite and subordinate siliciclastic mudstones lies between the Hampole Discontinuity and the lower dolomite of the Hampole Beds, is discussed in the account of Cadeby Quarry.

The Sprotbrough Member

Micklefield Quarry furnishes a representative (though relatively small) cross-section through the lower part of the grainstone shoal facies of this member, but displays most of the main distinguishing features; these are a parallel-laminated to thin-bedded basal unit, a coarsely cross-stratified main body, a scarcity of shelly fossils but local abundance of burrows, and an overall makeup of well-graded small (0.10–0.15 m) dolomite ooids (Kaldi, 1980). The member is also exposed high in the face at Cadeby Quarry and in many quarry and natural sections scattered along the outcrop between Ripon (where it is in a different facies) and Nottingham. The best and most spectacular exposures of the grainstone shoal (or sandwave) facies include those at Knaresborough [SE 348 571] [SE 359 559], Jackdaw Crag Quarry, Tadcaster [SE 46 41], Warmsworth Quarry [SE 53 00], Cresswell Crags [SK 53 74] and Pleasley Vale [SK 517 649]–[SK 525 651].

The grainstone shoal facies of the Sprotbrough Member is up to 60 m thick and forms most of the outcrop from Knaresborough southwards (Smith, 1989, fig. 7). It is interpreted as marking the site of an offshore field of high-energy subaqueous dunes (Smith, 1968, 1970b), sandwaves (Kaldi, 1980, 1986a) or grainstone barriers (Harwood, 1981, 1989), and separates a shallow protected shelf or lagoon to the west from a deeper-water open marine outer shelf to the east. The sedimentology and diagenesis of these rocks was investigated in detail by Kaldi (1980, 1986a, b) and their mineralization by Harwood (1981, 1986). By analysis of the trends of the prevalent large-scale cross-stratification, Kaldi showed that the sandwaves were constructed mainly by currents from the north-east (i.e. oblique to roughly normal to the inferred contemporary shoreline) with occasional storm currents from the south-east. The change of style from parallel-bedded at the base to coarsely cross-stratified above, points to a rapid deepening of the sea following the inferred peritidal phase of the Hampole Beds (Smith, 1974a, b, 1979; Kaldi, 1980, 1986a; Harwood, 1981, 1989).

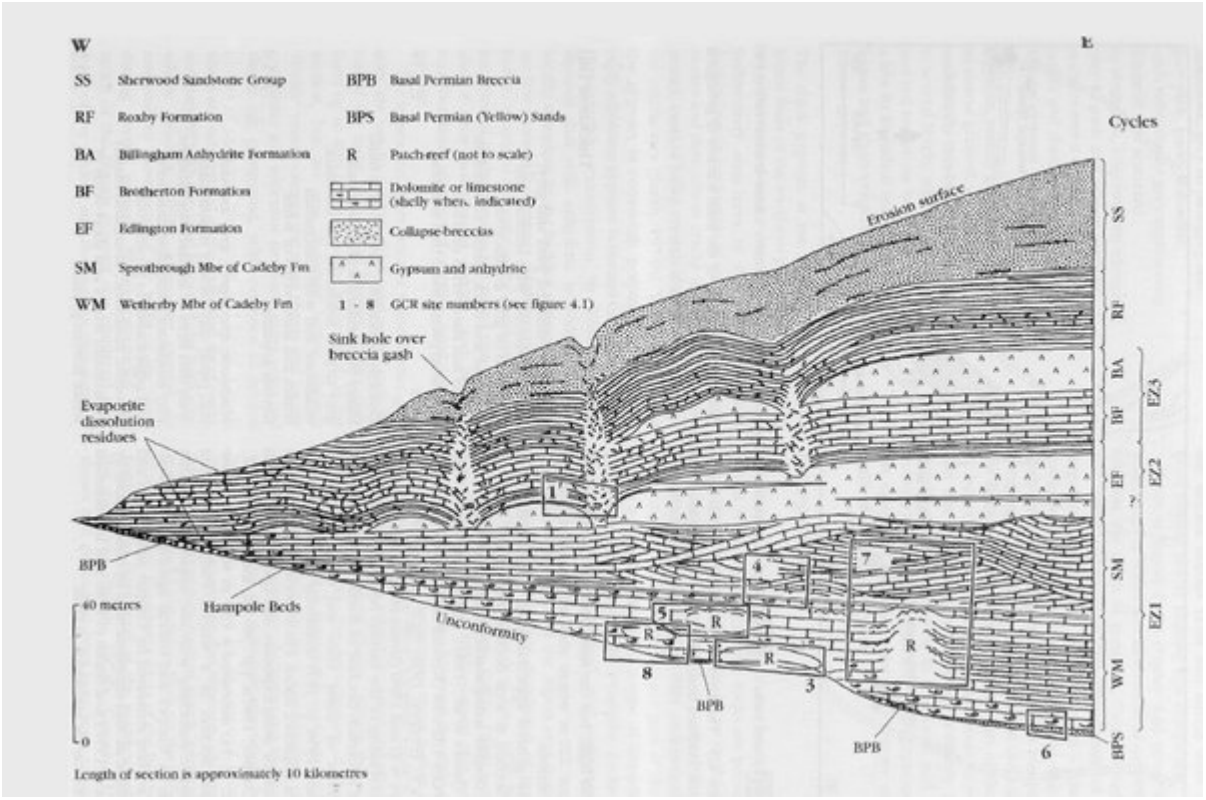
Future research

There is scope here for further detailed research on the petrography and sedimentology of the lower dolomite of the Hampole Beds and on the mineralogy and origin of the various argillaceous beds present both here and at other exposures of these strata.

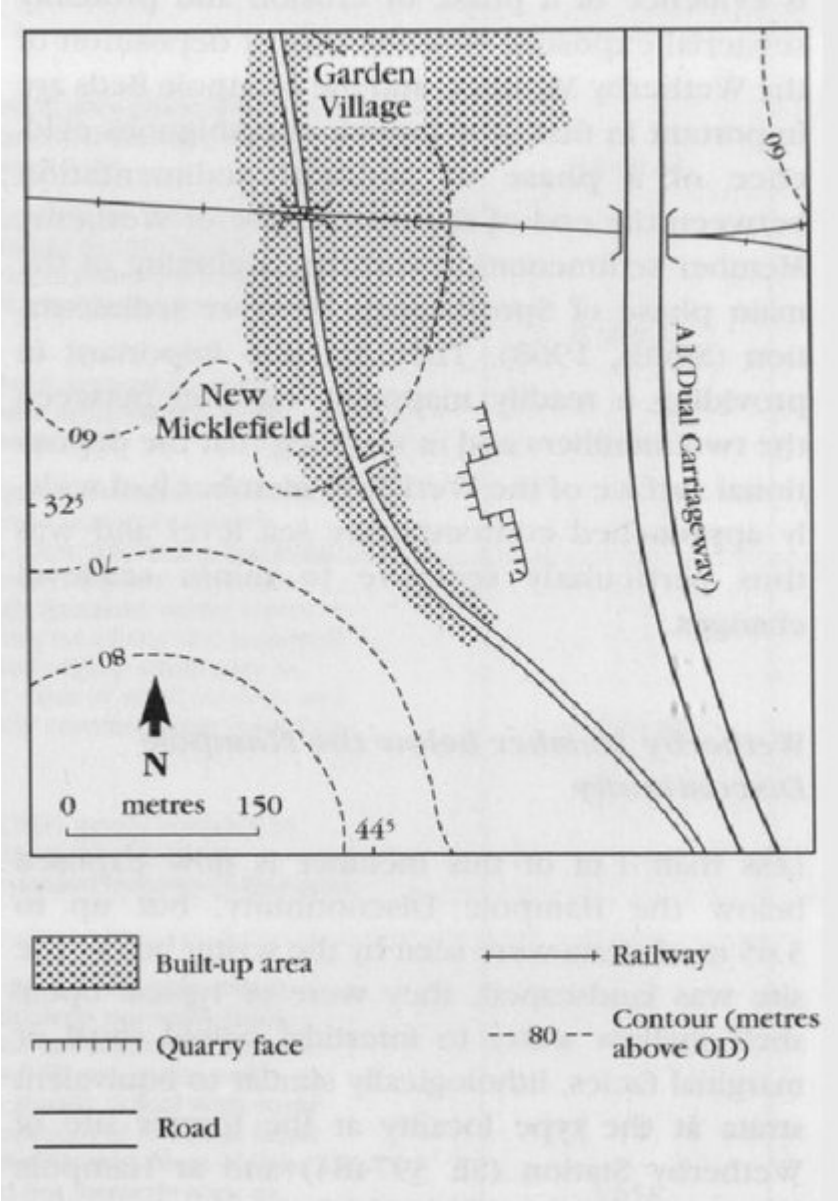
Conclusions

This site provides an excellent exposure of the Hampole Beds, a remarkably persistent and uniform sequence of passage beds spanning the contact between the Wetherby and overlying Sprotbrough Members of the Cadeby Formation, and of the Hampole Discontinuity. This marine carbonate sequence evolved from shallow water to intertidal and coastal plain sediments, before the Zechstein Sea again transgressed westwards and shallow marine deposition was resumed. The site is important in recording these changing phases of deposition, and in providing evidence in the form of the Hampole Discontinuity of a phase of emergence and erosion near the top of the Wetherby Member.

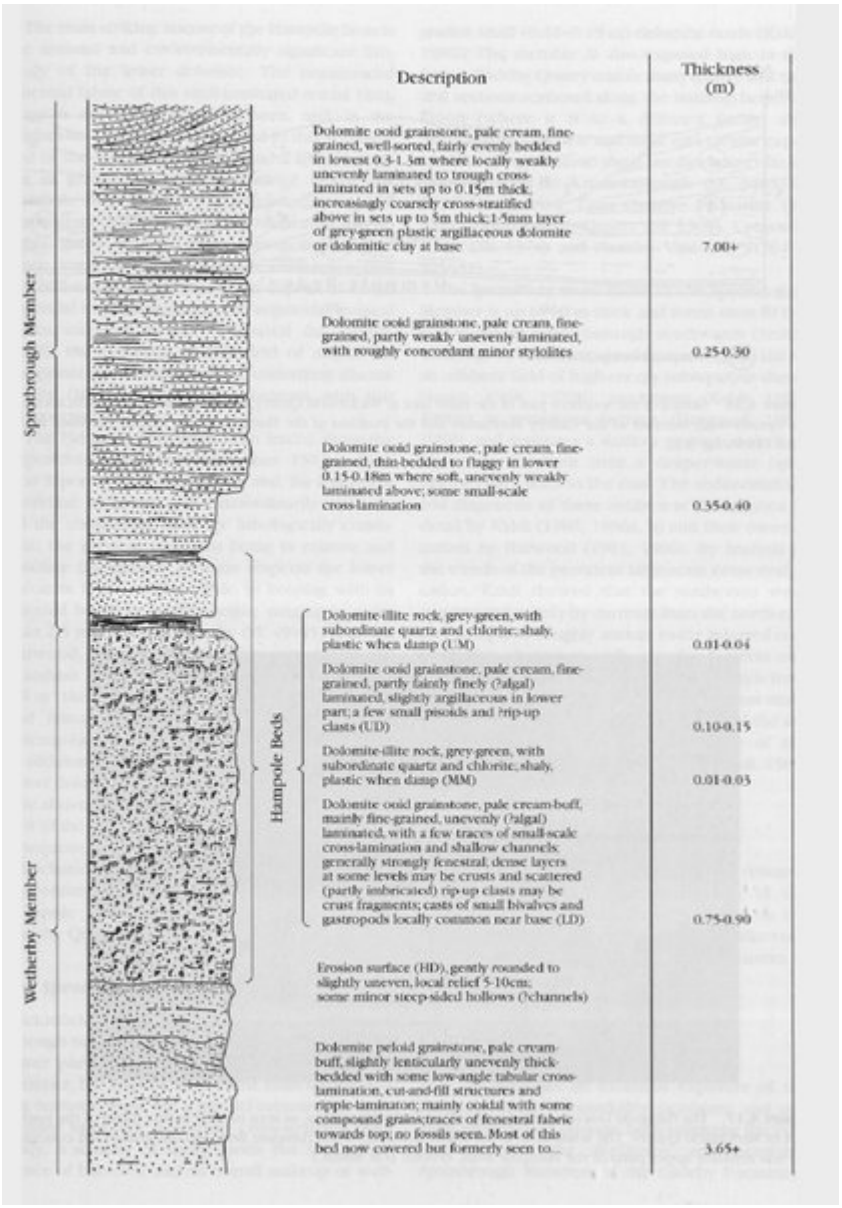
References



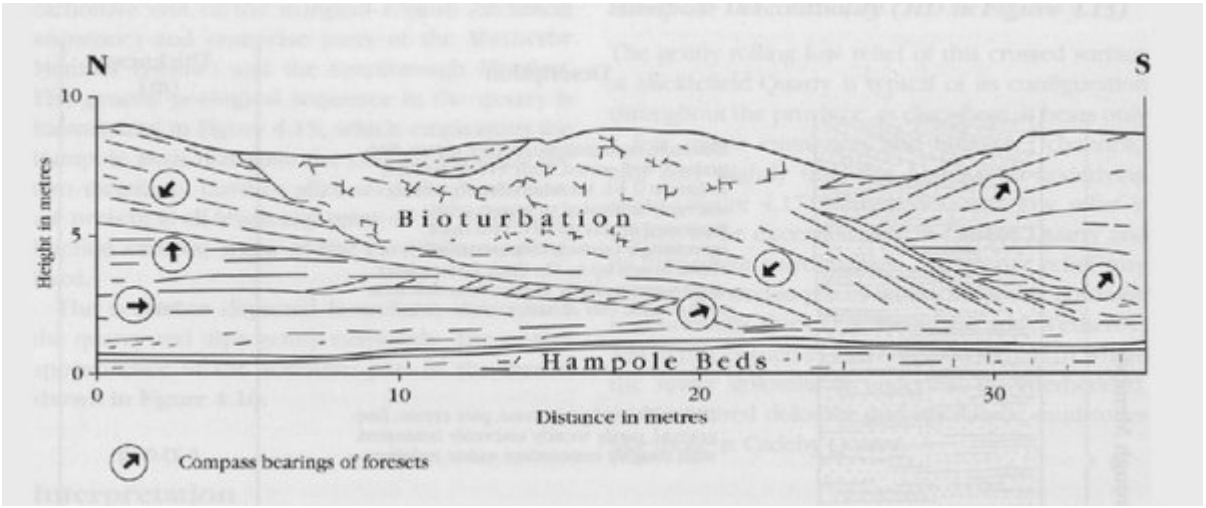
(Figure 4.2) Approximate stratigraphical position of marine Permian GCR sites in the Yorkshire Province of north-east England (diagrammatic). Some sites cannot be shown on this line of section and have been omitted.



(Figure 4.14) Position of Micklefield Quarry GCR site.



(Figure 4.15) Section of the Hampole Beds and other strata at Micklefield Quarry. Abbreviations signify parts of the typical Hampole Beds sequence: HD, Hampole Discontinuity; LD, lower dolomite; MM, middle mudstone; UD, upper dolomite; UM, upper mudstone. The lower mudstone is absent. The Wetherby Member–Sprotbrough Member contact is taken at the top of the lower dolomite.



(Figure 4.16) Sketch of the southern part of the main face at Micklefield Quarry, showing the cross-stratification in the Sprotbrough Member of the Cadeby Formation and the position of the Hampole Beds. Slightly modified from Kaldi (1980, fig. 3.3).

(Figure 4.17) The Hampole Discontinuity (arrowed) and adjoining strata, as seen in 1967 before filling of the lower part of Micklefield Quarry. The white layer is the lower dolomite of the Hampole Beds and the grassy cleft conceals the less resistant upper parts of the Hampole Beds. (Photo: D.B. Smith.)