Newsome Bridge Quarry

Highlights

Newsome Bridge Quarry (box 3 in (Figure 4.2)) is a superb exposure of a late Permian marine bryozoan–algal inferred patch-reef; it rests in a textbook position on a low eminence on the Carboniferous–Permian unconformity, and is flanked and partly overlain by dolomitic oolites and pisolites.

Introduction

The quarry lies on the south side of West Lane about 100 m SSE of Newsome Bridge and 1.2 km west of North Deighton village, near Wetherby. The floor has been patchily filled with farm waste, but this does not impinge on the main rock faces in the east and south sides of the quarry. Working ceased long ago and the main faces look much the same today as when they were sketched by J. C. Ward for the Harrogate Memoir (Fox-Strangways, 1874, fig. 1; 1908, fig. 1).

The section comprises a lower unit of slightly reddened, coarse-grained Namurian sandstone, the Upper Plompton Grit (4.5 m+), unconformably overlain by dolomite (7.5 m+) of the Wetherby Member of the Cadeby Formation (formerly the Lower Magnesian Limestone). The dolomite mainly comprises a massive, inferred bryozoan–algal reef, but this passes sharply into bedded variably shelly ooidal and pisoidal grainstone at the northern end of the east face; basal parts of the Magnesian Limestone contain scattered fragments of Upper Plompton Grit (Fox-Strangways, 1874, fig. 1), some of which are exceptionally large.

In addition to the sketch by Ward in Fox-Strangways (1874, 1908), the main features of Newsome Bridge Quarry — the uneven nature of the unconformity, the presence of large sandstone clasts in the overlying Magnesian Limestone, the large inferred patch-reef and adjoining bedded dolomite — were mentioned by Smith (1969b, 1974a), who noted that lowest parts of the Magnesian Limestone were absent through onlap against hills on the buried Permian land surface. A more recent account is by Cooper (1987b, p. 30) in which reef-rocks are not recognized and the Magnesian Limestone is regarded as being mainly ooidal.

Description

The position and shape of Newsome Bridge Quarry are shown in (Figure 4.11), together with the main features of geological interest. The preserved faces of the quarry have a total length of about 120 m and a maximum height of about 10 m.

The general geological sequence is shown below.

	Thickness (m)
Cadeby Formation, Wetherby Member; patch-reef (inferred) and peloid grainstones	up to 7.5
————unconformity, relief at least 2.5 m————	
Upper Plompton Grit	up to 4.5

The disposition of the lithological units exposed in the east and south faces of the quarry is shown in (Figure 4.12). All the Permian rocks are of buff and cream dolomite and contain scattered to abundant cavities up to 0.10 m across after secondary anhydrite.

Upper Plompton Grit

The lowest unit exposed in Newsome Bridge Quarry is a coarse-grained sparingly pebbly feldspathic sandstone assigned by Cooper (1987b) to the Upper Plompton Grit (Namurian). It is a resistant, thick-bedded (partly cross-bedded), pale grey

to pale yellow-brown rock, with a faint purple discoloration consistent with its position immediately underlying the unconformity. Cooper records a patchy dolomite cement in the uppermost 1–2 m, where the rock is generally paler than below.

The Carboniferous–Permian unconformity

This is a smooth, sharp erosion surface with a total relief in the quarry of more than 2.5 m; it is highest in the south-eastern corner of the quarry and forms a low hill beneath the middle of the inferred patch-reef. Slopes on the surface are generally low, but in places they increase to 30° and some small near-vertical steps are present. The unconformity is generally clean-swept except where coarse debris lies in the basal 0.5 m of the overlying reef, and represents a hiatus of at least 75 million years.

Cadeby Fonnation, Wetherby Member, patch-reef (inferred) and peloid grainstones

The patch-reef at Newsome Bridge Quarry (Figure 4 .13) extends across the full width of the preserved faces, but thins northwards towards an inferred margin just north of the quarry; it is largely obscured by vegetation on the south-west side of the quarry, where it includes a thick wedge of crudely bedded dolomite and may grade laterally into non-reefoid dolomite. In the south-east corner of the face the inferred reef forms all of the Magncsian Limestone exposed sequence, but there are hints that originally the reef was probably no more than 8 or 9 m thick.

Marked diagenetic changes have obscured most details of the primary fabric of the reef-rock and its interpretation as reefoid is based mainly on gross structure and overall relationships. Jn particular, the identification rests on the massive character of much of the rock, the apparent lack of ooids or pisoids, the sharp upper contact in the east face, the suggestion of saccoliths (pillow-shaped masses, mith, 1981b) at the north end of the east face and, especially, the strong impression of presumed algal-stromatolitic doming in the upper part of the east face. Together these characteristics are so similar to those of the undoubted bryozoan stromatolite patch-reef at South Elmsall Quarry that interpretation as a reef is reasonably firm. Small bivalves (mainly *Bakevellia binneyi*) are present locally in the inferred reef but the distinctive and unmistakable framework of straggling *Acanthocladia* colonies that characterizes most reefs in this member has yet to be identified. J. Pattison (by letter, January 1990), however, records bryozoa at the south end of the quarry where the rock is believed by the writer to be reefoid; the presence of bryozoans strongly favours a reef interpretation, since in most of the shelf facies at outcrop, bryozoa are common only in and near the patch-reefs.

Angular fragments of gritty sandstone are present in the basal part of the ?reef where it overlies low parts of the underlying unconformity (J.C. Ward in Fox-Strangways, 1874), and in places are crudely imbricated or vertical (Smith, 1974a; Cooper, 1987b); they are mainly flaggy and some fragments near the south-western end of the face are almost 1 m long.

The peloid dolomite that abuts against and laps onto the reef in the east face comprises a varied mixture of mainly thin-bedded, soft, skeletal ooidal and pisoidal grainstones and subordinate packstones. As in the ?reef, many fabric details have been obscured by advanced diagenesis, but ooids generally predominate. Most beds, however, contain a poorly sorted mixture of ooids and pisoids, and some beds near the top of the face are composed almost entirely of pisoids and shell remains; the pisoids include lumps, grapestones and coated compound grains, some of which bear evidence of contemporaneous fracturing, erosion and re-cementation. Some of the pisoids may be oncoids but undoubted algal filaments or structures have not been recognized. Shells in the grainstones range from thinly scattered to very abundant and most are only slightly abraded; most are small bivalves (chiefly *Bakevellia binneyi* and *Schizodus obscurus*) and gastropods, but J. Pattison (by letter, January 1990) also noted many reworked bryozoans in peloidal brash in the field above the east face.

Interpretation

Newsome Bridge Quarry is unique in combining superb exposures of both the Carboniferous–Permian unconformity and an inferred bryozoan–algal patch-reef with its enclosing grainstones; it is unmatched in the Permian of England and is rivalled in significance only by the famous quarry exposure at Bartolfelde, Germany (Richter-Bernburg, 1952, fig.1),

where the sequence is generally similar but which, in addition, is richly fossiliferous.

Although the Carboniferous–Permian land surface has a low relief where it is cut onto Westphalian rocks in much of Yorkshire, there is more morphological diversity where the erosion surface is composed of resistant Namurian and earlier strata (Smith, 1974a, b). This diversity is particularly clearly seen in the Knaresborough area where local relief of up to 10 m and slopes of 30° are clearly visible; here also Aveline *et al.* (1874) demonstrated marked onlap indicative of a regional palaeorelief of at least 50 m (confirmed during the recent re-survey; see, for example, Summary of Progress of the Geological Survey for 1977, 1978, p. 37 and Cooper, 1987b). The unconformity at Newsome Bridge Quarry is probably more typical of these North Yorkshire areas, and is comparable with that exposed in St Helen's Quarry [SE 376 517] nearby and in old quarries [SE 394 456] near Collingham. The quarry is atypical, however, in that reddening of the underlying Namurian Sandstone is unusually faint compared with its more normal intensity as displayed, for example, at St Helen's Quarry and in some of the Knaresborough Gorge exposures.

The onlap of the late Permian marine Magnesian Limestone in the Knaresborough area locally resulted in the overlap of both the Cadeby Formation and the Edlington Formation, and Tute (1884) noted that earliest marine Permian strata are missing in Knaresborough Gorge. At Newsome Bridge Quarry, however, perhaps slightly farther from the basin margin, only the lowest few metres (?5–8) of the Wetherby Member sequence appear to be missing, though onlap is convincingly demonstrated both here and at St Helen's Quarry.

It follows therefore, that the inferred patch-reef at Newsome Bridge Quarry, although lying on the unconformity, is stratigraphically some distance above the base of the formation; this position is consistent with the overall inferred composition of the reef, with its massive core and its stromatolitic mantle (see also the account of South Elmsall Quarry). It is speculated that the reef exposed in Newsome Bridge Quarry was nucleated there because of the elevated firm substrate furnished by the Upper Plompton Grit.

As noted in the account of South Elmsall Quarry, patch-reefs in the Wetherby Member of the Cadeby Formation lie in a roughly north-south belt that is a few kilometres wide and extends from north of Harrogate to south-east of Sheffield (Smith, 1981b). The inferred reef at Newsome Bridge Quarry is thus towards the northern end of the known range, only those exposed at Brearton (Smith, 1974a, p. 375) and South Stainley (Cooper, 1987b, pp. 4 and 39) being farther to the north; it is slightly above the average size of about 20 m diameter and may not have projected much more than half a metre above the surrounding sea floor.

For further discussion of the character and biota of late Permian patch-reefs in the Wetherby Member see Smith (1981b) and the accounts (this volume) of the South Elmsall and Wood Lee Common sites.

The dolomitized peloid grainstones surrounding and onlapping the inferred patch-reef at Newsome Bridge Quarry are, like those at South Elmsall, typical of the belt of patch-reefs, though rip-up clasts have not been noted at Newsome Bridge. The rarity of carbonate muds and the large size of some of the sandstone clasts at the base of the sequence point to phases of moderate to high energy, and the general impression is of a broad unevenly shelving shallow tropical sea floored by shelly peloid sands and fine gravels and unevenly dotted with both subaqueous marine patch-reefs and irregular rounded islands, formed by incompletely submerged sandstone hills; the shoreline lay perhaps 1–5 km to the west.

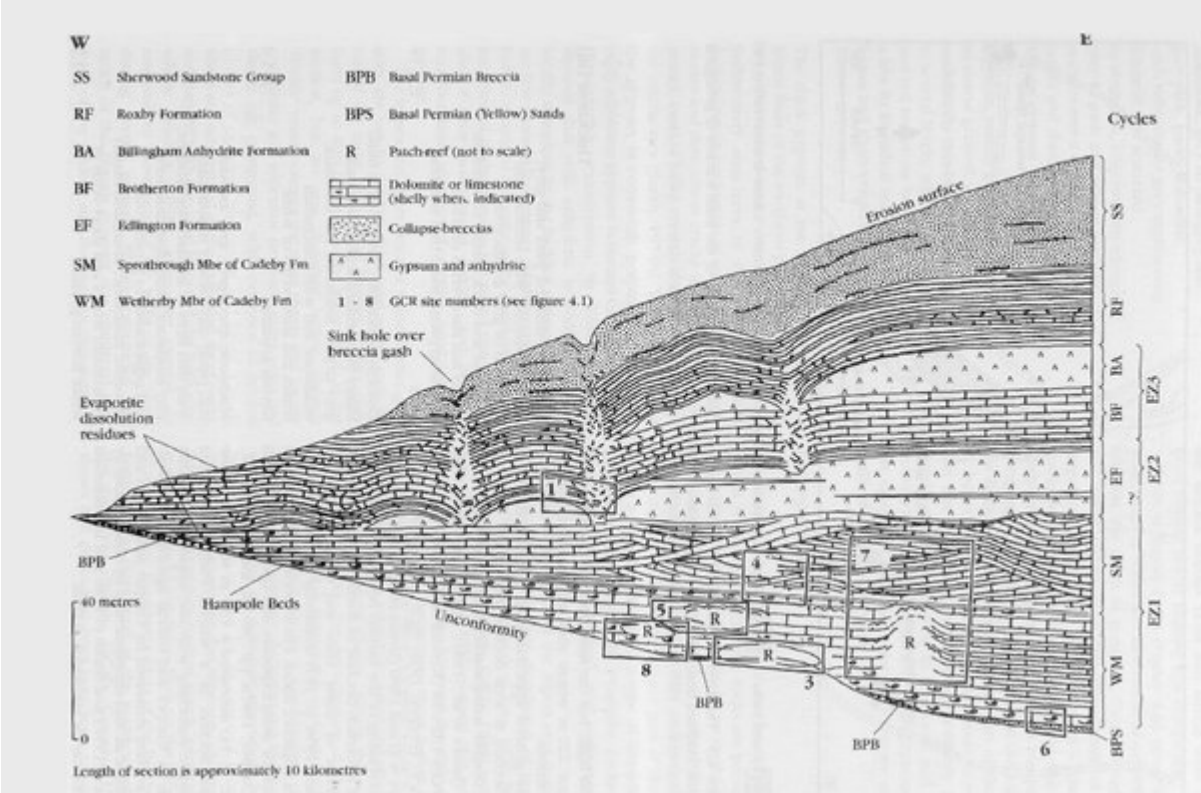
Future research

As with South Elmsall Quarry, the section at Newsome Bridge Quarry derives most of its impact from spatial relationships; for this reason, it is best viewed from a distance and the main (east) face ought not to be scarred by intensive sampling. Nevertheless, it is important to try to establish whether the inferred reef has an *Acanthocladia*-rich framework and is therefore a true patch-reef or if, as thought probable by Cooper (1987b and in conversation, 1990), the reef-like body is an expression of differential diagenesis of the peloid grainstones.

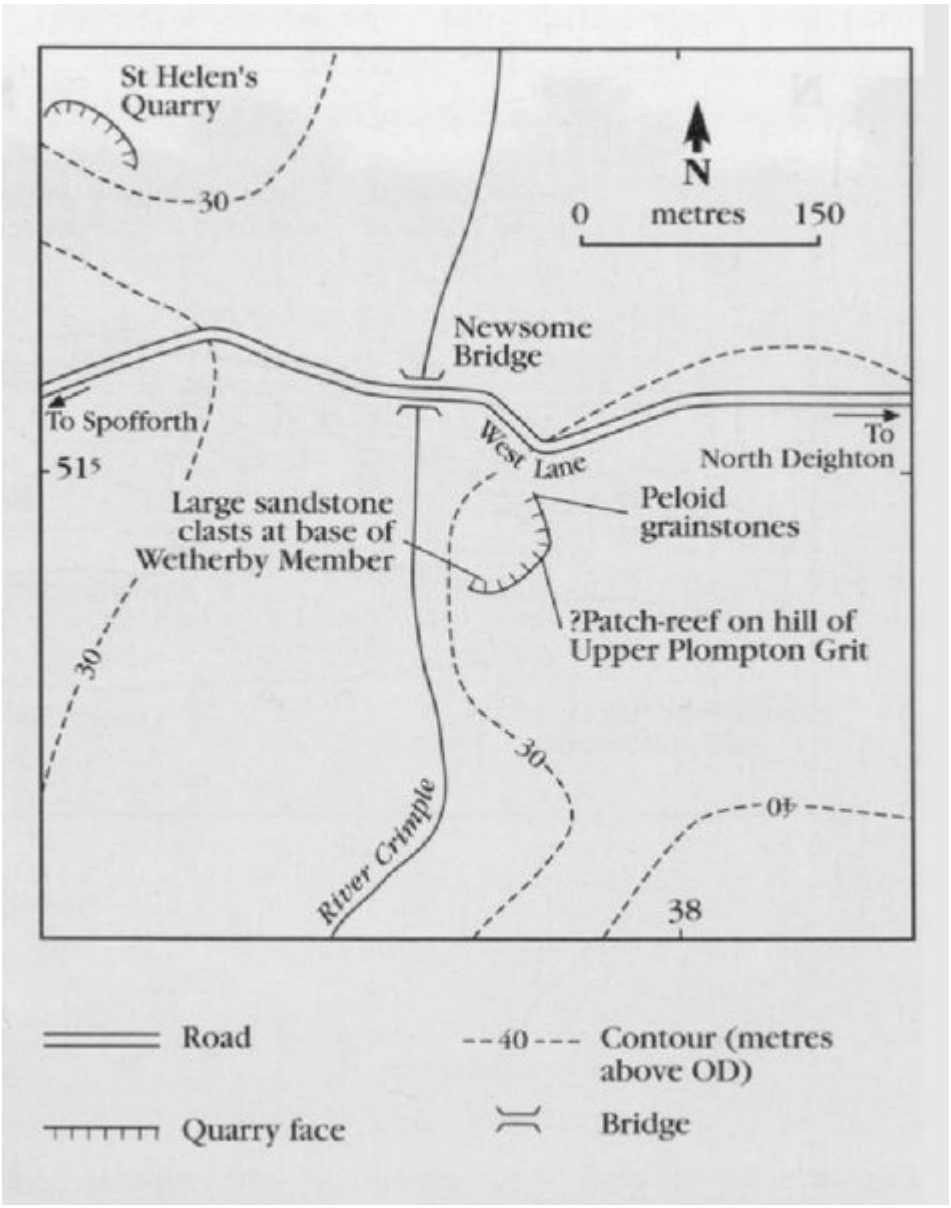
Conclusions

The site is highlighted by the exposure of a probable patch-reef resting on older sandstones marking the Carboniferous–Permian unconformity. The character of the ?patch-reef is considered to be similar to the bryozoan∇stromatolite patch-reef at South Elmsall Quarry, but has undergone greater diagenetic change which has obscured much of the original internal detail. Bedded oolitic and pisolitic dolomite lap against the ?reef, and still display their original texture. The Carboniferous–Permian unconformity is an undulating erosion surface, formed on resistant felspathic sandstones of the Upper Plompton Grit of Namurian age. The exposure eloquently illustrates the variability of the nearshore carbonate sedimentation and reef building on the newly-inundated erosion surface near the western margin of the Zechstein Sea.

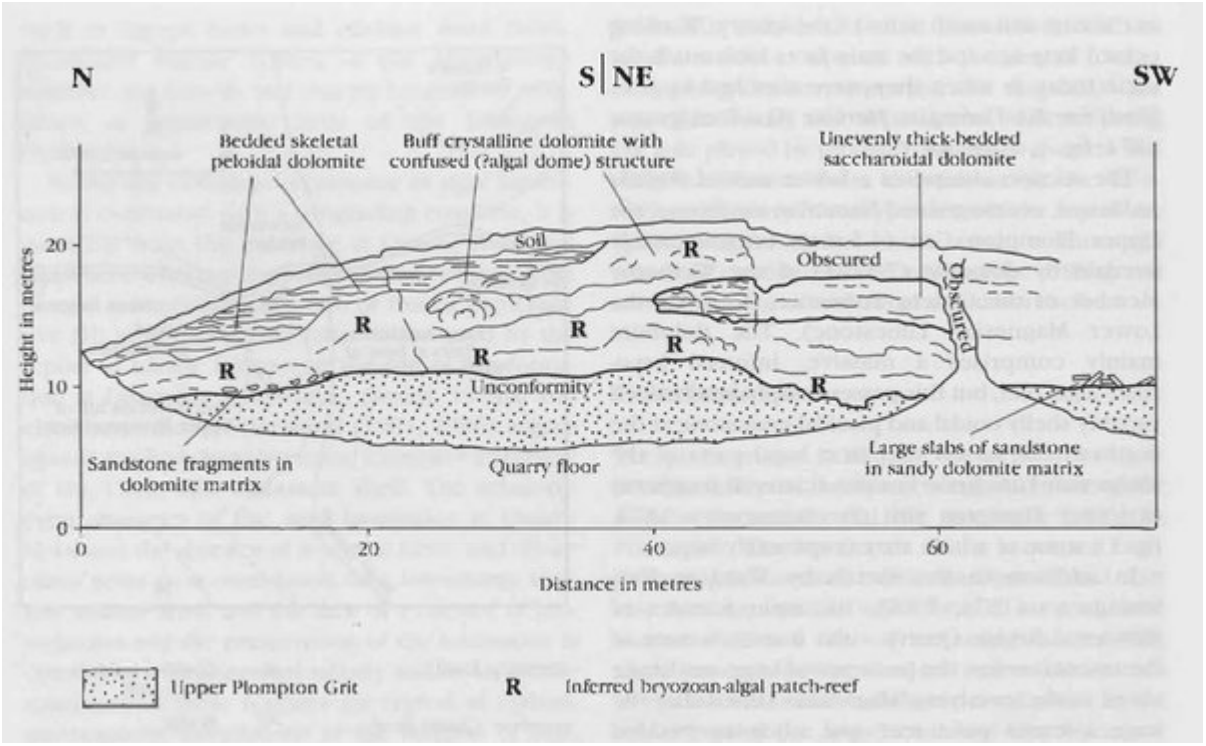
References



(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 4.11) Newsome Bridge Quarry and its environs, showing the position of the main features of geological interest.



(Figure 4.12) Sketch of the main faces of Newsome Bridge Quarry showing the inferred bryozoan-algal patch-reef centred on an eminence in the Carboniferous–Permian unconformity here cut onto Upper Plompton Grit.