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## Chapter 4 North-east England (Yorkshire Province)

### Introduction

In this province, lying to the south of Cleveland High, the outcrop of the Magnesian Limestone generally lies closer to the western shoreline than in the Durham Province and the position of the shoreline or of offshore islands is clearly seen at a number of places including Knaresborough and North Deighton (near Wetherby); here a number of prominent rounded hills of resistant Carboniferous sandstone rose above the general plane of the early Permian land surface and were progressively overlapped by Cycle EZ1 shallow-water carbonate rocks and even, exceptionally, by the mixed sediments of the succeeding Edlington Formation. This shows that, unlike Durham, the original basin-filling transgression failed to reach the position of the present outcrop in the Yorkshire Province, which was inundated somewhat later as a result of world sea-level changes or relative subsidence.

Virtually all the outcropping carbonate rocks of Cycle EZ1a in the Yorkshire Province are shallow-water shelf deposits indicative of at least moderate energy deposition, but borehole evidence shows that they grade eastwards over 10–30 km into much-reworked, finer-grained, slope carbonates indistinguishable from equivalent strata in the Durham Province. This implies that a shallow-water shelf prism similar to that in Yorkshire may have been built up in Durham, but has since been eroded off. In contrast, the carbonate rocks of Cycle EZ1b in the Yorkshire Province differ fundamentally and as yet inexplicably from those in the Durham Province and it is providential that rocks of this age are well exposed in both provinces.

The two provinces also differ in that the shelf and barrier carbonate rocks of Cycle EZ2 in the Yorkshire Province lie too far east to crop out, their place being taken by highly varied but poorly exposed rocks of the Edlington Formation (Figure 1.4). These varied strata extend across the Cleveland High into the southern parts of County Durham and adjoining areas and presumably at one time overlaid lagoonal ooidal grainstone of the Ford Formation in central and northern parts of the Durham Province.

The waning influence of the Cleveland High is well displayed by the Cycle EZ3 carbonate rocks, which are faunally and lithologically similar in the two provinces; the lack of a full GCR site in these rocks in the Yorkshire Province is thus not wholly critical because the rocks are readily available for research at Seaham and elsewhere in the Durham Province.

With the exception of Bilham Quarry and the Ure River Cliff, all the marine Permian GCR sites in the Yorkshire Province are in carbonate units of Cycle EZ1 (Figure 4.1); these are by far the most diverse and well-exposed parts of the Magnesian Limestone here, but the site network concentrates on the spectacular and the ordinary is poorly represented.

Bilham Quarry (near Doncaster) epitomizes the Basal Permian (or Yellow) Sands, traditionally classed as early Permian, but in the Yorkshire Province now reclassified as late Permian because the desert sands are believed to have been reworked completely during the Zechstein transgression (Versey, 1925; Pryor, 1971). Quarries in the Basal Sands are all shallow and are especially vulnerable to waste fill; the preservation of part of Bilham Quarry ensures that at least one face remains accessible for future study, together with the lowest few metres of the Wetherby Member of the Cadeby Formation. The Bilham exposure may be supplemented by the re-exposure of the red pebbly Basal Sands and breccias at Ashfield Brick-clay Pit (Conisbrough) if plans to re-excavate the lower part of this site are implemented.

Most of the GCR sites in Cycle EZ1 strata (the Cadeby Formation) in Yorkshire are in quarries and together they span the whole formation. All are in dolomitized shelf carbonates and include rocks inferred to have been formed in many of the shallow-water environments observed in modern tropical marine carbonate shelves and platforms. Five sites contain patch-reefs in the Wetherby Member and include the classic exposure at Newsome Bridge Quarry (North Deighton, near Wetherby) where an inferred bryozoan–algal patch-reef lies atop an eminence on the Carboniferous–Permian unconformity and is surrounded by shallow-water shelly grainstones. Such grainstones also surround the superbly-exposed algal-stromatolite patch-reef at South Elmsall Quarry and the several atypically tall patch-reefs in the vast working quarry at Cadeby, but are not seen (though probably are present) at the Wood Lee Common (Maltby) site,

where saccolithic bryozoan patch-reefs form striking tor-like masses on a grassy slope; elsewhere the relationships of saccolithic bryozoan patch-reefs to surrounding grainstones is especially clear at Ashfield Brick-clay Pit (Conisbrough) and in the many small exposures in the picturesque village of Hooton Pagnell (SE 4808, near Doncaster), itself not a GCR site.

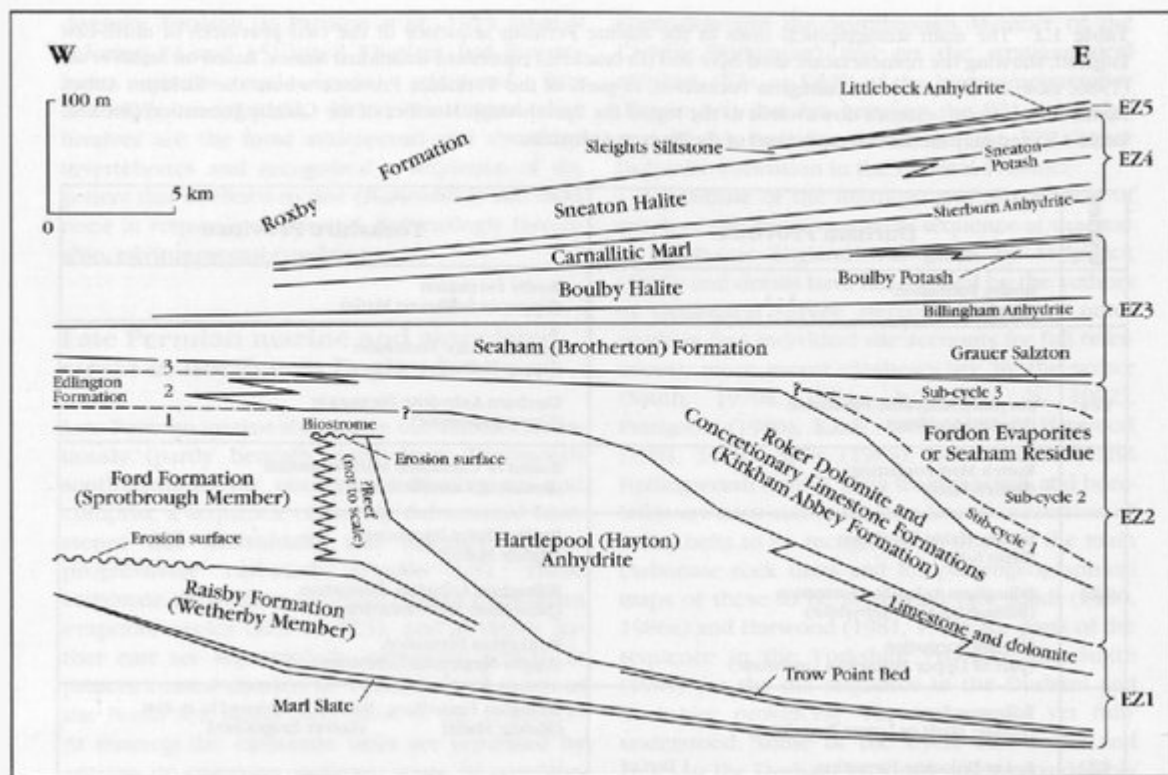
Cadeby Quarry is the type locality of the Cadeby Formation (Smith *et al.*, 1986) and, in addition to patch-reefs and grainstones of the Wetherby Member, it exposes the typical ooidal grainstone sandwave facies of the Sprotbrough Member and unusually thick Hampole Beds; the latter span the contact between the two members and overlie an intraformational erosion surface, the Hampole Discontinuity, with a relief of up to 3 m. The Hampole Beds and the underlying discontinuity are also seen in Micklefield Quarry, together with the lower part of the sandwave facies of the Sprotbrough Member, but the largest and most impressive exposures of this facies include those at Knaresborough, Jackdaw Crag Quarry ([SE 46 41], near Tadcaster) and Warmsworth Quarry [SE 53 00], which are not GCR sites. The remaining Cadeby Formation site in the Yorkshire Province is at Quarry Moor, Ripon, where ooidal dolomites and dedolomites at the top of the formation are partly algal-laminated and pass upwards by intercalation into interbedded ooidal grainstones and inferred evaporite dissolution residues (possibly of the basal Edlington Formation); a marine high-subtidal to intertidal shelf evolving to a marine sabkha is envisaged for this sequence, which is of a type unique amongst surface exposures in the Yorkshire Province, but has been seen in several cored boreholes east of the outcrop.

There are no thick Cycle EZ2 carbonate rocks at outcrop in the Yorkshire Province, where their approximate equivalent is partly represented by the interbedded siliciclastic and evaporite rocks of the Edlington Formation. These mixed strata, together with thin carbonate units, are exposed in the well-known River Ure Cliff section, near Ripon, where lower parts are only broadly folded, but upper parts are spectacularly tightly folded; the cause of the folding has been a matter of much controversy and remains uncertain, and recrystallization of the evaporites has obscured most primary fabrics. The River Ure Cliff is the only exposure of the Edlington Formation in the GCR site network, the type locality GCR site at New Edlington Clay Pits having recently been filled, and is one of only a very small number of exposures of this formation in the Yorkshire Province.

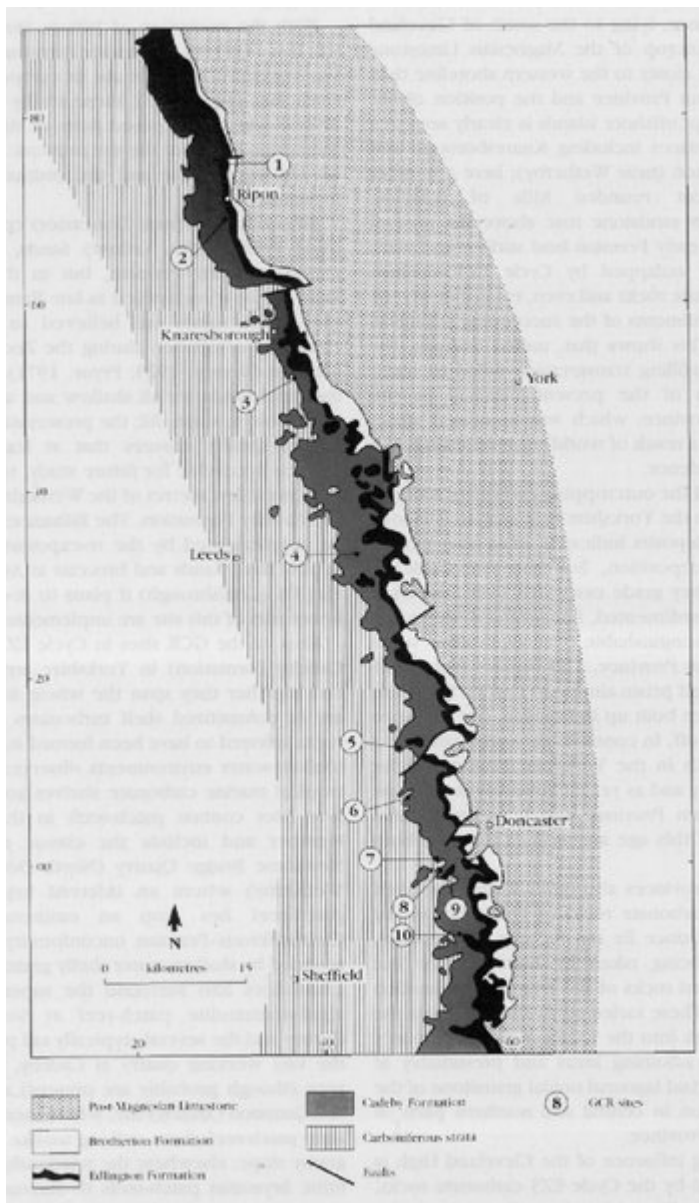
Cycle EZ3 carbonate rocks, the Brotherton Formation, are not the main interest at any Yorkshire Permian marine GCR site, but a few metres of rocks typical of this formation lie at the southern extremity of the Ure River Cliff site where they have foundered and been partly brecciated through dissolution of the gypsum of the Edlington Formation (Smith, 1974a; Cooper, 1987a). There are, however, many large exposures of these strata in and around Brotherton [SE 48 25], Knottingley [SE 49 23] and Womersley [SE 53 19], although basal beds are generally poorly represented.

The main features of the GCR Marine Permian sites in the Yorkshire Province are summarized in Table 4.1 and their approximate stratigraphical positions are shown in (Figure 4.2).

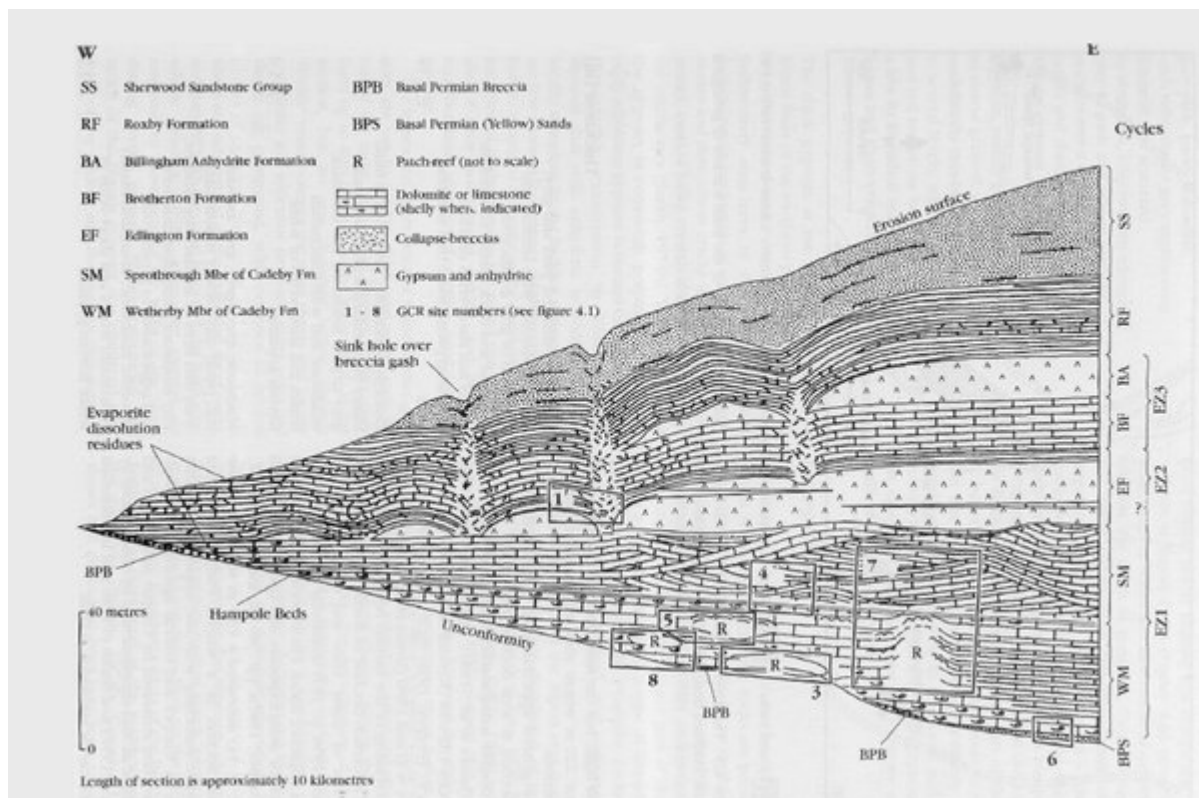
## [References](#)



(Figure 1.4) Late Permian (Zechstein) lithostratigraphical units in north-east England; names as in the Durham Province with Yorkshire Province names (where different) in brackets. In Yorkshire, the Wetherby Member and Sprotbrough Member together comprise the Cadeby Formation. The erosion surface shown between the Wetherby and Sprotbrough members is the Hampole Discontinuity which lies up to 3 m below the top of the Wetherby Member; it has not been recorded in the Durham Province. Slightly modified from Smith (1989, fig. 1).



(Figure 4.1) The distribution of Permian marine rocks in the Yorkshire Province, showing the location of Permian marine GCR sites: 1, River Ure Cliff; 2, Quarry Moor; 3, Newsome Bridge Quarry; 4, Micklefield Quarry; 5, South Elmsall Quarry; 6, Bilham Quarry; 7, Cadeby Quarry; 8, Ashfield Brick-clay Pit; 9, New Edlington Brick-clay Pits; 10, Wood Lee Common, Maltby.



(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.