STONY CUT, COLD HESLEDON

OS Grid Reference: NZ41714724–NZ41864744

Highlights

This shallow cutting (box 11 in Figure 3.2) uniquely exposes a transect from the reef-flat to the crest of the shelf-edge reef of the Ford Formation. The reef-flat rocks are exposed in the south-west and central parts of the cutting and comprise a partly crudely-bedded mixture of *in situ* and reworked shallow-water reef dolomite; this passes north-eastwards into massive reef dolomite in which successive positions of the reef crest appear to be marked by sharply steepening thin sheets of laminar (?algal) dolomite.

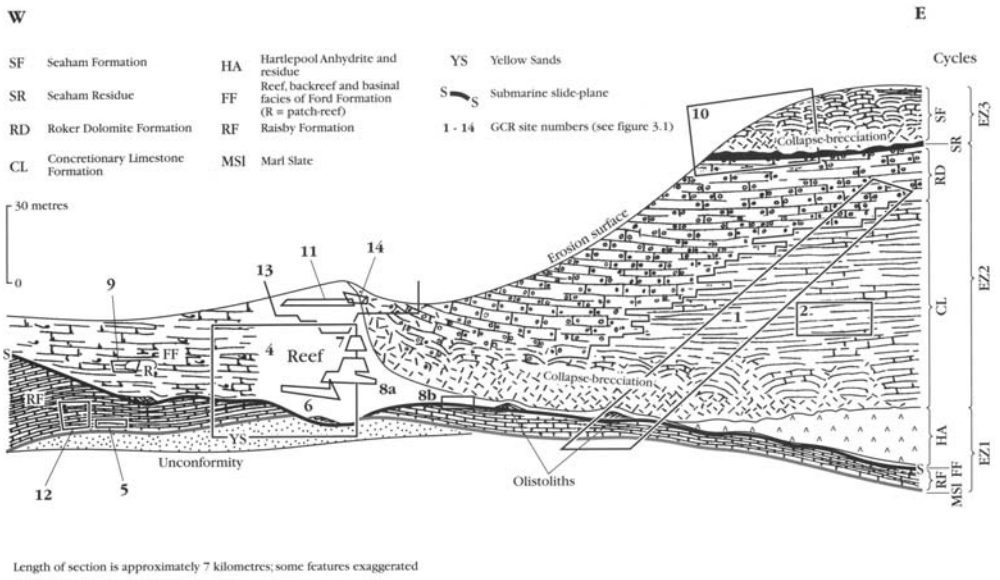

Figure 3.2: Approximate stratigraphical position of GCR marine Permian sites in the northern part of the Durham Province of north-east England (diagrammatic). Some sites in the southern part of the Durham Province cannot be accommodated on this line of section and have been omitted. The Hartlepool Anhydrite would not normally be present so close to the present coastline but is included for the sake of completeness. The biostrome is the Hesleden Dene Stromatolite Biostrome.

Introduction

Stony Cut is a disused cutting on a former colliery waggonway and exposes up to 3 m of varied reef dolomite of the Ford Formation beneath a thin cover of Late Devensian boulder clay. The reef-rock is exposed for about 260 m (Smith, 1962) and is divisible into a reef-flat sub-facies (about 190 m seen) in the south-west and a reef crest sub-facies in the north-east; the latter is important as one of only four places where the crest of the Ford Formation reef is now exposed.

The cutting gave valuable insight into the disposition of reef sub-facies as originally identified by Smith (1958) and was later described in more detail by Smith and Francis (1967) and Smith (1981a). The palaeontology of the reef here was investigated by Hollingworth (1987), who reported marked differences between the fauna of the reef-flat and reef crest sub-facies and a striking north-eastwards increase in faunal abundance and diversity. Aplin (1985) reviewed the petrology and diagenesis of the reef-rock and discussed the origin of laminar ?algal encrustations and laminar fissure-fill in north-eastern parts of the cutting.

Description

The position and outlines of Stony Cut are shown in Figure 3.42. The rock faces are generally

only 1–2 m high and are commonly overgrown and obscured in high summer; the floor of the cutting falls gently north-eastwards at about the regional dip in the Magnesian Limestone, and the north-eastern end of the cutting coincides with the edge of the strong topographic bench that marks the basinward margin of the Ford Formation reef.

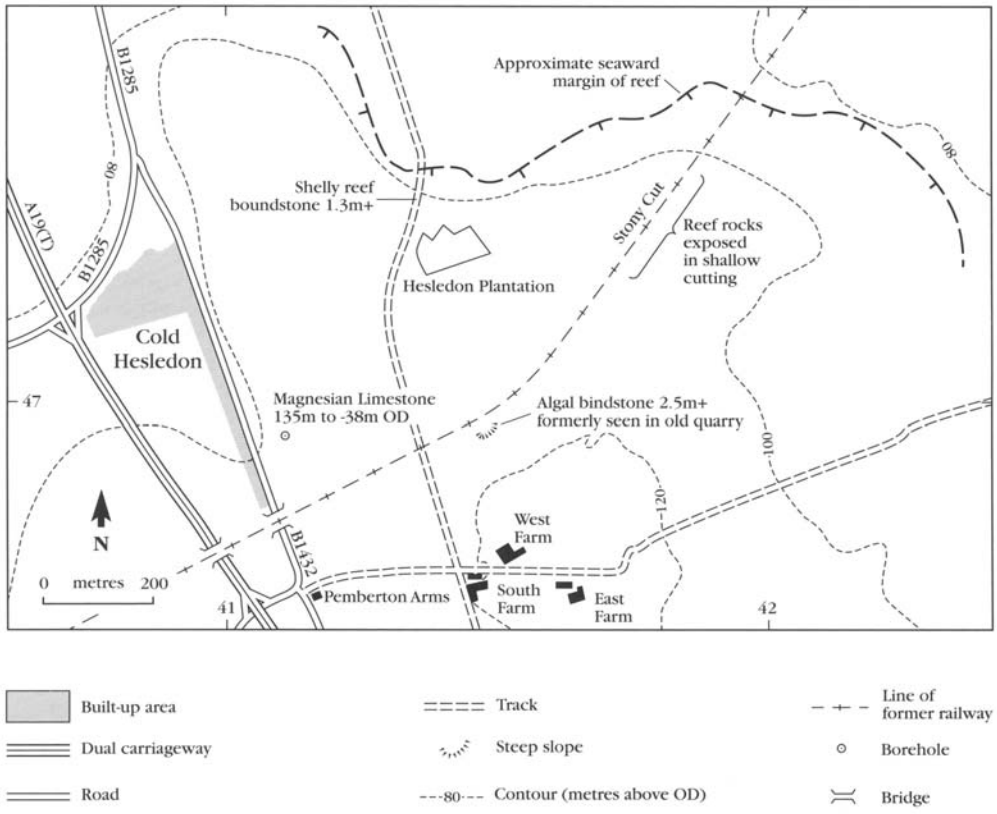

Figure 3.42: Location of Stony Cut, Cold Hesledon.

Dolomitized reef-flat rock in the south-western part of the exposure is buff algal–bryozoan boundstone with lenses and pockets of oncoids (coated reworked algal chips) and skeletal debris. The rock is generally unbedded and is a heterogeneous assemblage of mutually interfering masses up to 0.5 m across of boundstone (some rolled) and abundant draped sheets of laminar ?algal bindstone; the boundstone masses have a sparse framework of ramose bryozoans (almost exclusively *Acanthocladia* according to Hollingworth, 1987) which are thickly to very thickly coated with concentric ?algal encrustations (Smith, 1958, plate VIB, and 1981b, fig. 12 A,B).

Central parts of the cutting, extending for more than 100 m, are in crude and very uneven thick-bedded dolomitized algal–bryozoan boundstone; this includes many minor primary boundstone domes (some rolled), a wide variety of complex laminar (?algal) sheets and encrustations, and scattered to abundant lenses and pockets of fine boundstone debris, skeletal remains and oncoid rudstone. The overall dip is roughly parallel with the floor of the cutting, but is widely varied and local primary dips of up to 30ø in all directions testify to contemporary reef-top relief of up to 1 m.

The dolomitized reef-rock in the north-easternmost 70 m of the cutting is, by contrast, relatively uniform. It contains less skeletal and boundstone debris and mainly comprises massive *in situ* brown-buff algal-bryozoan boundstone divided into steeply dipping panels a metre or more thick by thin finely laminar sheets. The boundstone has a sparse framework of ramose and fenestrate bryozoans, most of which are thickly coated with fine concentric ?algal encrustations that locally form up to half of the rock (Aplin, 1985, p. 385). Some of the thin laminar sheets are subvertical to vertical and were interpreted by Aplin as fissure-fill, but many are gently north-east dipping at the top of the section and steepen sharply to up to 85ø below (Smith, 1981a; Aplin, 1985) (Figure 3.43); these appear to be algal coatings of reef masses or

successive positions of the reef crest and remains of algal filaments were identified in such laminite by Aplin (1985, fig. 2.16C).

Figure 3.43: Laminar ?algal bindstone sheets with high primary east-northeastwards dip, in reef boundstone of the Ford Formation near the north-east end of Stony Cut, Cold Hesledon. The sheets are thought to mark the temporary position of the upper part of the reef foreslope and grade upwards into the reef-crest and reef-flat dolomite. Hammer: 0.33 m. (Photo: D.B. Smith.)

Early selective fossil collections from Stony Cut by Pattison (in Smith and Francis, 1967, p. 133) were augmented by more detailed sampling by Hollingworth (1987); both authors noted a sharp north-eastwards increase in faunal abundance and diversity and Hollingworth (1987, fig. 6.38) convincingly illustrated this trend and showed that the increase is not uniform, but is interrupted by a low-diversity belt in central parts of the cutting where bryozoans are less common. Hollingworth noted that *Acanthocladia* persists across the full width of the reef tract, but is accompanied by *Dyscritella*, *Synocladia* and *Fenestella* in the north-eastern sector; a number of species of gastropods, bivalves and brachiopods are also confined to this sector. He commented that the absence or rarity of infaunal and quasi-infaunal forms suggested a measure of contemporaneous lithification of the substrate, supporting the evidence of such lithification by the rolled boundstone blocks and reef gravels (Smith, 1981a).

Interpretation

The complex and varied rocks of Stony Cut provide a unique transect across much of the shelf-edge reef of the Ford Formation; this reef extends sinuously from near Sunderland to West Hartlepool and also features in the GCR sites at Hylton Castle, Claxheugh Rock, Humbledon Hill, Tunstall Hills, Ryhope, Hawthorn Quarry and Horden Quarry. Indications from topography, the exposures in the cutting and from other excavations nearby suggest that the reef at Cold Hesledon may be about 400 m wide, compared with estimates of 250–400 m in the Sunderland area and at least 300 m at Hawthorn Quarry. The only other transects are at the Claxheugh Rock site, where the rocks are probably somewhat older, at the Hawthorn Quarry site where the reef-rock is probably of about the same age, but is now partly covered, and in Castle Eden

Dene where much of the section is almost inaccessible.

The lithology of the heterogeneous roughly-bedded carbonate rocks in most of the cutting, together with their indigenous and derived fauna, strongly suggests that they were formed on a sub-horizontal, but somewhat rugged reef-flat under water no more than a few metres deep and perhaps at times intertidal (Smith, 1981a; Aplin, 1985; Hollingworth, 1987). Salinity was probably normal to slightly above normal, and energy slight to high according to location and weather conditions. Other, larger, sections in reef-flat dolomite are in theHawthorn Quarry site and in Townfield Quarry (NZ 4343 4380), Easington Colliery.

The sections at Hawthorn Quarry (now covered) and Horden Quarry, provided the key to understanding Stony Cut, for they showed (a) that massive boundstone at the self-evident reef crest at the two quarries was lithologically and faunally indistinguishable from that in the north-eastern part of the Cold Hesledon cutting and (b) that boundstone at the progradational reef crest, as in the cutting, is divided into steeply-dipping panels by thinner upwards convex steeply-dipping laminar sheets (Smith and Francis, 1967, especially plate 1X; Figure 3.47) that strike parallel with the reef foreslope. The origin of these laminar sheets is uncertain and some could fill former tension gashes like those in reef-rock at theMaiden Paps site, Tunstall Hills, Sunderland. The author believes, however, that their upwards-and-outwards convexity is more in keeping with a succession of reef crest ?algal coatings and if this is so, they indicate reef foreslopes approaching vertical and an extremely sharp reef crest. From his analysis of the biota at and near the supposed reef crest here, Hollingworth (1987) inferred that these rocks were formed subaqueously in turbulent water slightly deeper than that covering the reef-flat, and that the vicissitudes of reef growth provided a wide range of ecological niches that were exploited by the abundant and varied invertebrates. The origin of the thick concentric encrustations that freely coat the skeletal framework here and in many other parts of the Ford Formation reef were discussed by Smith (1981a), who concluded that they were probably formed by blue-green algae.

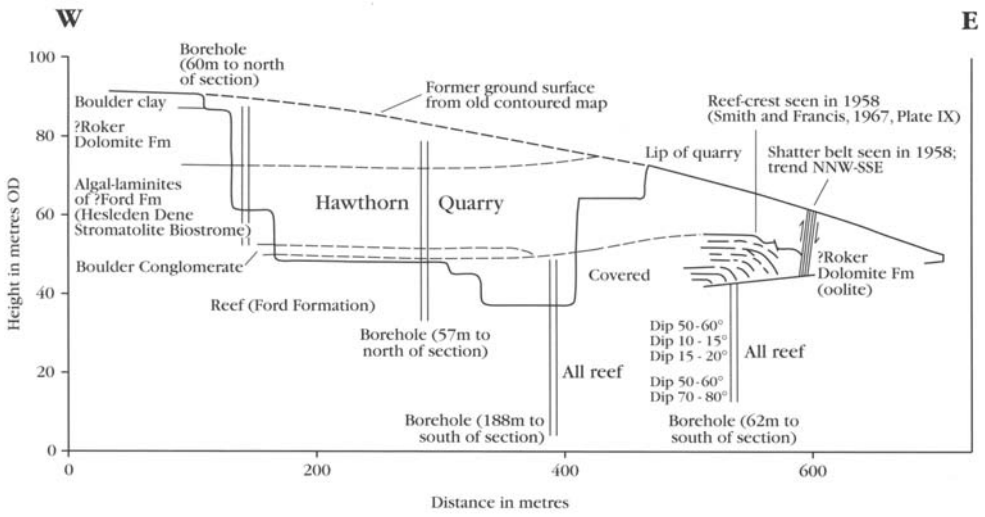

Figure 3.47: Section across Hawthorn Quarry, showing the relationships of the main geological features. The line of section is shown in Figure 3.46.

Future research

The palaeontology, ecology and petrology of the rocks in Stony Cut have all recently been investigated in detail (Aplin, 1985; Hollingworth, 1987) and there is little immediate scope for further work on these aspects. The curved laminar sheets near the inferred reef crest are worthy of further research, however, because of their importance and probable significance in the interpretation of reef crest and high reef slope morphology and evolution.

Conclusion

This site comprises a unique cross-section from the reef-flat to the crest of the shelf-edge reef

of the Ford Formation. It is additionally important in that it is now one of only four places where the crest of the reef is exposed. Reef-flat carbonate rocks in the form of sub-horizontally bedded dolomite, sharply pass into steeply-dipping laminar sheets at this crest. Indications that the reef-flat was subject to very shallow water, possibly intertidal conditions, are the presence of oncoids, of algal encrustations on the reef-building framework and of large rolled boulders of reef-rock that had already become hard.

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