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# Harper Clough, Smalley Delf and Closebrow Quarries

## Highlights

Harper Clough, Smalley Delf and Closebrow Quarries together provide the best known sequence through the upper Marsdenian and lower Yeadonian of the Craven Basin, and includes examples of the unusual Haslingden Flags deposits, thought to represent birdfoot-delta deposits.

## Introduction

Three disused quarries [SD 717 317], [SD 720 320], [SD 718 314] between Great Harwood and Blackburn, Lancashire, provide an almost complete sequence through the upper Marsdenian and lower Yeadonian, as developed in the Craven Basin. The geology is described by Wright *et al.* (1927).

## Description

### Lithostratigraphy

The combined sequence exposed in these old quarries is some 200 m thick. At the base are two thick sandstones separated by a shale, which belong to the Revidge Grit Formation. They are both coarse-grained units, and the upper one has an intraformational conglomerate at the base. There are a variety of sedimentary structures, including different types of ripples, cross-bedding and sole marks, as well as large casts of plant stems. This all suggests fluvial-channel, probably point-bar style deposition.

Above the Revidge Grit is a thick unit of shales, with siltstone ribs and occasional ironstone nodules. There are also numerous seat earths and at two levels the development of coal, suggesting that they are flood-plain deposits subject to periodic emergence.

Above this are about 3 m of flaggy micaceous sandstone, representing the Helmshore Grit Formation. It is a very condensed development of this formation, which further to the south and west thickens to up to 30 m. Of interest here, however, is the presence on the upper surface of the formation of a cast of an arborescent lycophyte stump (? *Lepidodendron*) showing the radially arranged *Stigmaria* rooting structures (Figure 9.15). This is further evidence of emergence in this interval, and that swamps were able to develop on the deltas.

Above the Helmshore Grit are more shales, with siltstone ribs and thin beds of flaggy sandstone. Unlike the shales between the Revidge and Helmshore grits, however, there is less evidence of emergent conditions, and at one level (1.5 m above the Helmshore Grit) there are shales representing a marine band. They thus represent a reversion to shallow water and possibly even at times basinal sediments, more typical of the argillaceous deposits lower in the Millstone Grit.

The next part of the succession cannot be seen here, but from other nearby exposures probably includes the Hazel Greave Grit, Brooksbottom Sandstone and Holcombe Brook Grit (Wright *et al.*, 1927). The next highest visible stratum here is a thin coal known as the Holcombe Brook Coal, which normally overlies the grit of the same name. There then succeeds a series of shales. Near the base of this interval, the shales are dark, and at one level contain fossils of the Cancellatum Marine Band. Above the marine band the shales show a evidence of penecontemporaneous slumping (Williamson, 1953), similar to that seen at the same level further south in Staffordshire (e.g. Gib Tor). The succeeding shales become much paler in colour, possibly indicating a transition to deltaic flood-plain deposits.

The top part of the sequence here belongs to the lower member of the Haslingden Flags. They consist of 3.5 m of massive white quartzitic sandstone, known locally as 'lonkey, overlain by flaggy, fine-grained sandstone. The exposure exhibits a number of sedimentary structures, with some bedding faces being covered in ripple-marks, trace-fossils and plant debris. It is very much a local development of the Lower Haslingden Flags, which disappears 2 km to the south. The

formation is in itself a relatively local development, extending in a narrow belt, at most only about 30 km wide, between Blackburn and Halifax. It is thought to be the remains of an elongate, birdfoot-type delta, similar to that seen at the mouth of the Mississippi River today, and is unique in the deltas that formed the Millstone Grit in the Central Province (Collinson and Banks, 1975; Collinson, 1988).

## Biostratigraphy

As stated above, there are two marine bands exposed in this sequence. The lowest, just above the Helmshore Grit, was reported by Wright et al. (1972) to yield *Bilinguites bilinguis* and is probably the Eometabilinguis Marine Band (middle Marsdenian). The marine band above the Holcombe Brook Coal yields *Bilinguites superbilinguis* (Bisat) and *Cancelloceras cancellatum* (Bisat), and is probably the Cancellatum Marine Band (Yeadonian).

## Interpretation

This is the best exposed sequence through the upper Marsdenian and lower Yeadonian in the Craven Basin. This part of the Millstone Grit is well exposed elsewhere in the Central Province, in particular in the Huddersfield Basin (e.g. Rake Dike, Pule Hill) and Edale Basin (e.g. Jumble Coppice, Hathersage Moor), but the Craven Basin shows a number of distinct features. These include the Revidge Grit and Helmshore Grit formations, and perhaps most significantly the birdfoot-delta-type deposits of the Haslingden Flags Formation. The nearest comparison is with the sequence developed in the Rossendale Basin, which lies south of the Craven Basin, separated by the Pendle Monocline (i.e. the uplifted part of the Rossendale Block Lee, 1988). Here, sandstone units have been identified as being the same as the Helmshore Grit and Hazel Greave Grit formations, although otherwise the sequence follows that present in the more typical parts of the Central Province.

There have been attempts to integrate at least part of the Craven Basin sequence with that found in the rest of the Central Province. For instance, it has been suggested by Ramsbottom (1977) that the Hazel Greave and Holcombe Brook grits are lateral extensions respectively of the Ashover and Chatsworth grits, seen in the Edale Basin. Although there is at least an approximate time-correlation between these deposits, there is little sedimentological evidence to support them being the remains of the same deltaic depositional unit. As the Craven Basin seems to have been subject to its own discrete bathymetric controls, the sandstone units probably represent separate parts of the overall delta complex.

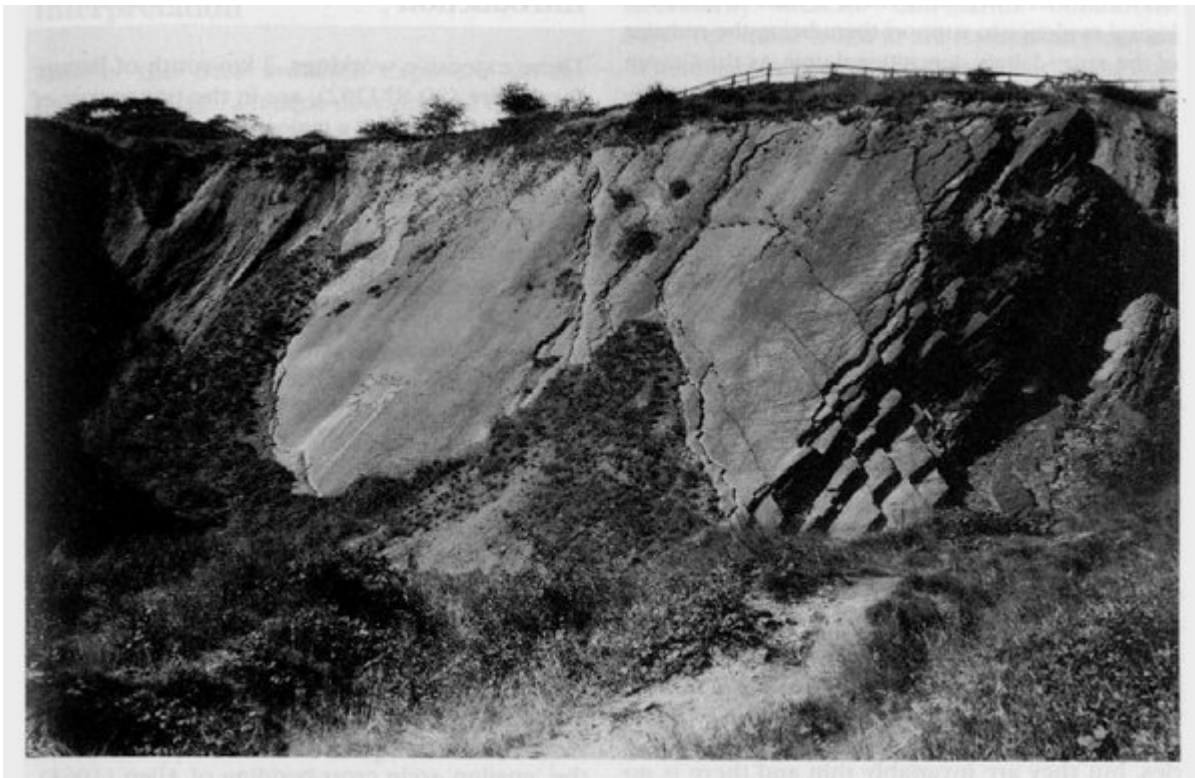
It is significant that a major part of the shales here are non-marine, flood-plain deposits. Marine deposits are present, but are limited in vertical extent. This contrasts with the lower parts of the Millstone Grit, where marine shales are significantly more abundant. It can be seen as marking the transition between a mainly marine sequence with intermittent non-marine, deltaic incursions, and a predominantly delta-plain succession with intermittent marine incursions; in other words, the transition from typical Millstone Grit to typical Coal Measures.

The progressive environmental change occurring in the late Namurian is further indicated here by the presence of *in situ* remains of arborescent lycopsids, evidence of swamp vegetation on the Millstone Grit deltas. Coals occur at many levels through the Millstone Grit, including in these quarries, but they are invariably thin and there is no clear evidence as to whether they are the remains of arborescent swamp vegetation, or of herbaceous, scrub vegetation. The presence of clastic swamps (*sensu* Gastaldo *et al.*, 1989) in the Millstone Grit is a clear preface to the more extensive coal-forming swamps that develop on these deltas later in the Westphalian.

## Conclusions

Harper Clough, Smalley Delf and Closebrow Quarries are amongst the best exposures in northern England of rocks of late Marsdenian and early Yeadonian age (just over 310 million years old). They include examples of the Haslingden Flags, thought to represent deposits formed in the distinctive type of dissected, birdfoot-delta.

## [References](#)



*(Figure 9.15) Upper Millstone Grit of the Craven Basin exposed at Harper Clough, including the famous Stigmaria rooting system. Reproduced by permission of the Director, British Geological Survey: NERC copyright reserved (A2646).*