

British Upper Carboniferous Stratigraphy

C.J. Cleal and B.A. Thomas

Department of Botany
National Museum of Wales, Cardiff

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Chapter 8

North Wales

Surface Red Fossils
Productive Coal
Millstone Grit

The map shows the geographical distribution of these geological features in North Wales. The Millstone Grit is shown in a light grey color, covering a large area in the north and west. The Productive Coal is shown in a darker grey color, primarily in the central and southern parts of the region. The Surface Red Fossils are indicated by small black dots, scattered across the map. The map also includes a legend in the bottom right corner, a scale bar, and a north arrow.

Both Namurian and Westphalian deposits are found in North Wales (Figure 8.1). The best known occur in a belt up to 11 km wide, that extends between the Dee Estuary and Oswestry. This includes the Flint-Derbyshire Coalfield which, until relatively recently, was still being actively mined. The Westphalian also outcrops in the Vale of Clwyd (between Dyserth and Ruthin), near Caernarvon, and on Anglesey.

The Westphalian deposits here do not differ significantly from the homotaxial sequences in the English Midlands (see Chapter 7). Since there are rather better exposures in the latter area, no GCR sites have been selected for these strata in North Wales. However, the North Wales Millstone Grit is of greater interest, and justifies the selection of GCR sites to represent it. The rest of this chapter is thus limited to a discussion on the Millstone Grit of this area (for further details on the Westphalian of this area, see Wood *in* Trueman, 1954 and Calver and Smith, 1974).

History of research

The first mention of the Millstone Grit of North Wales appears to be by Conybeare and Phillips (1822), who concluded that the Holywell Shales were probably correlatives of what is now called the Edale Shales in Derbyshire. Many later workers disagreed with this; Green (1867) regarded them as Lower Carboniferous, while Walker (1878), Morton (1878) and Strahan (1890) included them in the Coal Measures. Their position in the Millstone Grit was eventually confirmed by King (1914), based on ammonoids found therein.

Work on the more arenaceous sequences further south, near Llangollen, was pioneered by Morton (1876). He established the main features of the stratigraphy there, using sites such as Dee Bridge, and his classification is the basis of that still used today.

As elsewhere in the Central Province, real progress in the study of the North Wales Millstone Grit came with the use of ammonoid biostratigraphy. King's (1914) pioneering efforts, were soon followed by Jackson (1925a), Sargent (1927), Wood (1936) and Jones and Lloyd (1942). From their work, it was possible to establish detailed correlations between the rather different sequences in the north and south of the area, as summarized by Ramsbottom (1974) and Ramsbottom *et al.* (1978).

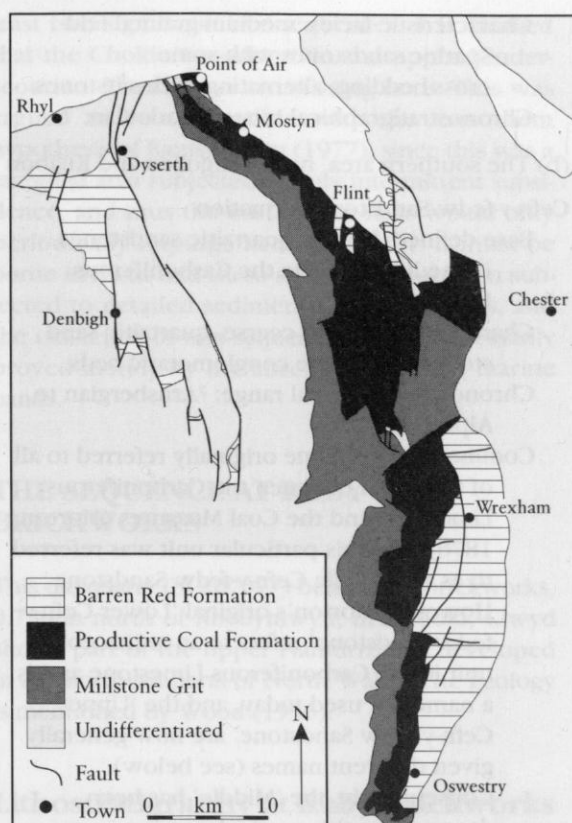


Figure 8.1 Upper Carboniferous outcrops in North Wales. Based on Ramsbottom (1974, fig. 38), and Calver and Smith (1974, fig. 41).

Lithostratigraphy

The Millstone Grit of North Wales is generally divided into different units in the north and the south of the area.

(a) The northern area, near the Dee Estuary.

Holywell Shales Formation

Base defined: base of shales immediately above the Carboniferous Limestone.

Characteristic facies: shales, with numerous marine bands, some of which become thin, shelly limestones.

Chronostratigraphical range: Pendleian to basal Yeadonian.

Lower Gwespys Sandstone Formation

Stratotype: Abbey Mills Boreholes, near Holywell

Base defined: lowest feldspathic sandstone above the Holywell Shales.

North Wales

Characteristic facies: medium-grained feldspathic sandstones with some cross-bedding, alternating with siltstones.
Chronostratigraphical range: Yeadonian.

(b) The southern area, near Llangollen and Ruabon

Cefn-y-fedw Sandstone Formation

Base defined: base of quartzitic sandstones immediately above the Carboniferous Limestone.

Characteristic facies: coarse, quartzitic sandstones with some conglomeratic beds.

Chronostratigraphical range: ?Arnsbergian to Alportian.

Comments: This name originally referred to all of the strata between the Carboniferous Limestone and the Coal Measures (Morton, 1876), and this particular unit was referred to as the Middle Cefn-y-fedw Sandstone.

However, Morton's original 'Lower Cefn-y-fedw Sandstone' refers to an arenaceous unit in the Carboniferous Limestone and is a name not used today, and the 'Upper Cefn-y-fedw Sandstone' are now generally given different names (see below).

Consequently, the 'Middle' has been dropped for this particular unit.

Lower Shale Formation

Stratotype: Dee Bridge

Base defined: base of shale overlying the Cefn-y-fedw Sandstone.

Characteristic facies: shales, including a marine band.

Chronostratigraphical range: topmost Alportian to basal Kinderscoutian.

Dee Bridge Sandstone Formation

Stratotype: Dee Bridge

Base defined: base of sandstone overlying Lower Shale Formation.

Characteristic facies: medium to fine-grained, yellow quartzitic sandstone.

Chronostratigraphical range: lower Kinderscoutian to upper Marsdenian.

Upper Shale Formation

Stratotype: Dee Bridge

Base defined: base of shale overlying Dee Bridge Sandstone.

Characteristic facies: shales, including a marine band.

Chronostratigraphical range: topmost Marsdenian to lower Yeadonian.

Aqueduct Grit Formation

Stratotype: Dee Bridge

Base defined: base of sandstone overlying Upper Shale.

Characteristic facies: coarse-grained, feldspathic sandstone, with some pebbly horizons.

Chronostratigraphical range: Yeadonian.

Geological setting

Whereas the English Midlands provides exposures of the southern marginal facies of the Westphalian of the Central Province, North Wales is the area which typifies the southern marginal development of Millstone Grit. In fact, the North Wales sequences clearly demonstrate the rapid southwards attenuation of the Millstone Grit; near the Dee Estuary, boreholes have yielded some 275 m of Millstone Grit (including the Pendleian and Arnsbergian parts - Wood, 1936; Jones and Lloyd, 1942), whereas near Oswestry it has thinned to a mere 30 m (Smith and George, 1961).

In the northern part of the area, deposition was almost exclusively of fine-grained basinal deposits (Holywell Shales). The large-scale deltas that extended over most of the rest of the Central Province (e.g. the Kinderscout delta) never reached this area until the Yeadonian, when northerly derived sandstones, possibly related to the Rough Rock, make their first appearance (Lower Gwespyr Sandstone).

Further south, the sequences are characterized by deltaic, mainly quartzitic deposits derived from the Wales-Brabant Barrier (Cefn-y-fedw and Dee Bridge sandstones), with only occasional intercalations of marine deposits. The southerly derived deltas eventually disappeared in the Yeadonian, when the Wales-Brabant Barrier appears to have ceased to be a significant area of erosion, to be replaced by northerly derived, feldspathic deposits (Aqueduct Grit).

GCR site coverage

Exposure of the Upper Carboniferous sequence is very limited, much of the area being covered by thick drift deposits, which partially limits the potential GCR coverage. Although no GCR sites have yet been identified for the stratigraphy in this area, two potential sites are described here, one epitomizing the more condensed sequences in the south of the area (Dee Bridge), and one showing the more typical Millstone Grit further north (Ruby Brickworks).

THE SEQUENCE AT DEE BRIDGE

Exposures in the bank of the River Dee (SJ 269420) near the bridge at Pontcysyllte, 5 km east of Llangollen, Clwyd, Wales show part of the upper Namurian as developed in the more southerly part of its exposure in North Wales. The geology has been described by Morton (1876) and Wedd *et al.* (1927).

The exposed sequence here is about 43 m thick, and ranges between the Lower Shale Formation and the Productive Coal Formation (315–319 million years old). Two major sandstone units occur, the Dee Bridge Formation, for which this is the type locality (Morton, 1876), and the Aqueduct Formation. The former is about 9 m of medium to fine-grained, yellow, quartzitic sandstone. In contrast, the Aqueduct Formation is about 20 m of coarse-grained, feldspathic sandstone with pebbly horizons, that developed in a sequence of fining-upwards units.

Only one marine band has been recorded from here, within the Lower Shale Formation. Ramsbottom (1974) records from this band *Reticuloceras paucicrenulatum* Bisat and Hudson. This belongs to the *R. circumplacitile* Biozone, indicating the lower Kinderscoutian.

The shales immediately above and below the Aqueduct Formation have not here yielded fossils. However, at nearby localities, evidence of the Cancellatum and Subcrenatum marine bands has been reported (Wood, 1936; Ramsbottom, 1974).

Significance of the site

This is the best exposure of upper Namurian in North Wales, and the only one showing a more or less complete sequence from the lower Kinderscoutian to upper Yeadonian. It is also of historical interest, as the type locality for the Dee Bridge Formation. Of broader significance is that it is the only place where the two principal and contrasting sandstone lithologies can be seen on the southern margins of the Central Province: (1) the quartzitic sandstones (Dee Bridge Formation) representing the remains of fluvio-deltaic systems derived from the Wales-Brabant Barrier to the south; and (2) the feldspathic, more typically Millstone Grit type sandstones (Aqueduct Formation), from a northerly provenance.

According to Ramsbottom *et al.* (1978), the Millstone Grit in the Ruabon-Llangollen area, and exemplified by the Dee Bridge section, contains at

least two significant non-sequences: it is claimed that the Chokierian-Alportian and upper Kinderscoutian-Marsdenian are missing here. This was argued to be compatible with the mesothem hypothesis of Ramsbottom (1977), since this was a marginal area subjected to only intermittent subsidence, and thus the eustatic sea-rises would only periodically impinge here. However, it must be borne in mind that these strata have not been subjected to detailed sedimentological analysis, and the existence of non-sequences is not necessarily proved merely by the absence of certain marine bands.

THE SEQUENCE AT RUBY BRICKWORKS

This old quarry (SJ 207677) behind the brickworks, 0.75 km north of Rhydymwyn, near Mold, Clwyd shows part of the upper Namurian, as developed in the northern parts of North Wales. The geology is mentioned by Wood (1936).

Lithostratigraphy at Ruby Brickworks

There are two separate exposures at this site, from which it is impossible to establish a continuous sequence. The stratigraphically lower part of the sequence is about 15 m of shales, siltstone and thin sandstones. Particularly in the coarser-grained strata are coal smuts and casts of stems (mainly *Calamites*), suggesting they were littoral or terrestrial deposits. However, there are also at least two other horizons representing marine conditions.

The higher strata are more arenaceous, consisting mainly of alternating sandstones and siltstones, the former becoming more dominant towards the top of the section. Except at the very base of this unit, where they are quartzitic, the sandstones are mainly feldspathic, sometimes with cross-bedding. The siltstones are very soft and friable, often with ripple laminations. These beds are thought to belong to the Lower Gwespys Sandstone Formation, about 315 million years old.

Biostratigraphy at Ruby Brickworks

Two marine bands occur within the shales in the lower part of the sequence. Full species lists have not been published, but they are claimed to yield the index ammonoids for the Superbilinguis and

Cancellatum marine bands (Wood, 1936). The exposed sequence here thus ranges from upper Marsdenian to lower Yeadonian.

Significance of the site

This is the best exposure of the Lower Gwespyr Sandstone, a major unit of fluvio-deltaic deposits in the upper Namurian of the northern part of North

Wales. It correlates with the upper part of the Aqueduct Formation near Llangollen (see section discussing Dee Bridge), but is significantly finer grained and thus more like the topmost sandstones of the Millstone Grit in the main part of the Central Province (e.g. the Haslingden Flags - Bristow, 1988). It thus demonstrates the progressive increase in subsidence going away from the Wales-Brabant Barrier.