Lithostratigraphical framework for the Carboniferous successions of northern Great Britain

From Earthwise
Jump to navigation Jump to search

Dean, M T, Browne, M A E, Waters, C N, and Powell, J H. 2011. framework for the Carboniferous successions of northern Great Britain (Onshore). British Geological Survey Research Report, RR/10/07.

☐

Contents

Lithostratigraphical framework for the Carboniferous successions of northern Great Britain – an introduction

The Carboniferous strata of Great Britain comprise a wide range of facies representing a large variety of depositional environments. This in part reflects a northward drift of Britain across the equator during the Carboniferous (Scotese and McKerrow, 1990). Both the beginning and end of the Carboniferous Period are marked by a climate that, at least seasonally, was in part arid. This led to the widespread development of commonly red, continental, alluvial, clastic-dominated facies during Tournaisian and late Westphalian to Stephanian times. The intervening time was dominated by an equatorial climate.

The diverse lithofacies that developed throughout the Carboniferous were also the consequence of tectonic processes. A phase of Late Devonian to Visean rifting produced a marked palaeorelief with numerous basins occupying subsiding grabens and half-grabens and emergent highs associated with horsts and tilt-block highs. Cessation of most rifting processes throughout large parts of Britain in the late Visean was followed by a period of regional subsidence when the resulting basins were infilled by widespread deposits.

Tectonic setting

The tectonic setting and palaeogeography of the Carboniferous of Great Britain was summarised by Waters et al. (2007)[1] (see also Browne et al., 1999 and Browne et al., 2003 regarding the Midland Valley of Scotland and Waters et al., 2009 regarding onshore southern Britain). For completeness, the sections in Waters et al. (2007) that are relevant to onshore northern Great Britain, are reproduced here virtually intact.

File:P912764.jpg
Principal structural features of the northern British Isles, onshore and offshore, that had significant influence on the deposition of Carboniferous strata. The depositional basins and highs shown are those that developed during the Mississippian. Note that some post-Carboniferous structures are shown within the North Sea to aid location of descriptions in the text. North Sea structure is taken from Cameron (1993a and b) and Bruce and Stemmerik (2003). P912764

In the Late Devonian a phase of north–south rifting started to affect all of central and northern Britain, initiating the development of a series of grabens and half-grabens, separated by platforms and tilt-block highs (Leeder, 1982; 1988). From north to south these Carboniferous blocks and basins include the Midland Valley of Scotland, Northumberland Trough, Alston Block, Stainmore Trough, Askrigg Block and Craven Basin (Figure.1). The block and basin margins commonly reflected reactivation of pre-existing basement lineaments.

The Midland Valley of Scotland is an east-north-east-trending complex graben, controlled by Caledonian basement structures. In the early Devonian the graben was flanked to the north-west by the eroded remains of the Caledonian Mountains north of the Highland Boundary Fault and to the south-east by the Southern Uplands south-east of the Southern Upland Fault. The Midland Valley of Scotland was an active tectonic feature controlling sedimentation for much of the Carboniferous. Depocentres within the graben subsided at different rates, and their locations and trend also changed (Browne and Monro, 1989). Superimposed upon this are marked thickness variations resulting from synsedimentary movement on north-east- and east-trending faults in a strike-slip regime throughout the Carboniferous. Associated with this were minor phases of compression, most notably during the mid Carboniferous (Read, 1988).

The Southern Uplands separated the Northumberland Trough, including the Tweed and Solway basins, from the Midland Valley of Scotland. However, this barrier was breached by narrow basins of north-north-west trend. The Solway–Northumberland Trough was bounded to the north by the North Solway, Gilnockie and Featherwood faults and to the south by the Maryport–Gilcrux–Stublick–Ninety Fathom fault system. Both bounding structures were active during deposition (Chadwick et al., 1995).

The Alston Block lies to the south of the Northumberland Trough. This horst is bounded to the south by the Closehouse–Lunedale–Swindale Beck faults, active during the Tournaisian–Visean. The Stainmore Trough, a half-graben basin, lies immediately to the south, with the southern margin defined by the Stockdale Monocline (Dunham and Wilson, 1985). This structure also marks a transition in sedimentation between the basin and the tilt-block of the Askrigg Block to the south. The Craven Fault System defines the southern margin of the Askrigg Block. The Manx–Lake District Block occurs to the west of the Alston and Askrigg blocks and is separated from them by the broadly north–south trending strike-slip Pennine–Dent Fault System.

Transtensional rifting continued to be active in the graben of the Midland Valley of Scotland during the Namurian to Stephanian. Despite possible linkages to northern England across the Southern Uplands, the Midland Valley continued to evolve as a basinal entity distinct from the area to the south.

Cessation of rifting during the late Visean in the area between the Southern Uplands and the Wales–Brabant Massif resulted in a phase dominated by thermally induced subsidence during Namurian and Westphalian times (Leeder, 1982). The Pennine Basin formed as part of this regional subsidence.

Palaeogeography

File:P912765.jpg
Palaeogeographic reconstructions for the Carboniferous of the British Isles. Adapted from Cope et al. (1992). AlB Alston Block; AsB Askrigg Block; CB Craven Basin; CB Cheviot Block; CuB Culm Basin; DB Dublin Basin; DH Derbyshire High; G–MH Galway–Mayo High; LH Leinster High; M–LD Manx–Lake District Block; MVS Midland Valley of Scotland; NT Northumberland Trough; SB Shannon Basin; ST Stainmore Trough; SUM Southern Uplands Massif; WT Widmerpool Trough. P912765

The palaeogeographical reconstructions presented for the Carboniferous of Great Britain (Figure.2) have been adapted from those illustrated by Cope et al. (1992) and, for the Midland Valley of Scotland, by Browne and Monro (1989) and Read et al. (2002).

Tournaisian

In the Midland Valley of Scotland axial flow of sediments from the south-west was established during the Late Devonian and continued into the early Carboniferous (Read and Johnson, 1967). The basin fill was composed largely of fluvial siliciclastic sediments transported along the axis of the graben, with significant contributions coming from the Scottish Highlands to the north (Browne et al., 1999). Input from the Southern Uplands, to the south, was minor (Figure.2a). Marine incursions were not common at this time. These strata were laid down whilst the climate was semi-arid and are characterised by the presence of calcareous and dolomitic pedogenic horizons (cornstones) formed on stable alluvial plains. During the mid Tournaisian a mudstone-dominated succession characterised by minor interbeds of ferroan dolostone beds (cementstones) and evaporites (mainly gypsum preserved) was deposited on alluvial plains and marginal marine flats (sabkhas) subject to periodic desiccation and fluctuating salinity.

In northern England a series of gulf-like, tideless, hypersaline basins, including the Northumberland and Stainmore troughs (Leeder, 1992), developed between evolving horst and tilt-block highs (Figure.2a). The basins developed with variable influx from river systems, notably fluvial and deltaic input into the Northumberland Trough from the Southern Uplands. The ‘cementstone’ and ‘cornstone’ deposits recognised in the Midland Valley are also developed along the southern margin of the Southern Uplands Massif, linking with the Midland Valley in the area of the Cheviot Block.

Visean

In the Midland Valley of Scotland during the early Visean there was a major reversal of the axial palaeoslope and flow from the north-east became established (Greensmith, 1965). Volcanic rocks dominate in the western half of the Midland Valley (Figure.2b). In the east, the succession is largely fluviodeltaic and lacustrine (Browne and Monro, 1989), with the development of oil shales and freshwater limestones as minor, but important, components. These reflect the development of lakes characterised by the accumulation of abundant algal remains. During the late Visean, the succession in the east of the Midland Valley was still dominated by fluviodeltaic and lacustrine deposits, but with intermittent marine incursions (Figure.2c) during the Asbian and the Brigantian. Marine incursions, associated with the formation of thin limestones, were at their most frequent during the late Brigantian, when shelf seas intermittently covered much of the Midland Valley.

The early Visean depositional environment of the Northumberland Trough was dominated by lacustrine and fluviodeltaic clastic sedimentation. The main deltaic deposits were derived from the north-east and prograded gradually along the axis of the trough (Figure.2b). Meanwhile, south of the Northumberland Trough, a period of marine transgression resulted in the establishment of platform carbonates, which gradually onlapped raised horst and tilt-block highs. During late Visean times a cyclic succession of fluviodeltaic clastic rocks, marine-reworked sandstones and shallow shelf marine carbonate rocks (‘Yoredale’ facies) built up across northern England (Figure.2c), terminating deposition of the platform carbonates.

Namurian

The Midland Valley of Scotland is characterised by a continuation of cyclic (‘Yoredale’ facies) sequences with interbedded fluviodeltaic clastic strata, coals and marine shelf limestones, the last mentioned marking highstands of sea level. This succession exhibits a progressive diminution of marine influence with time. Fluvial sediment input continued from the north-east (Figure.2d). During Pendleian times, coal-forming environments with *Lingula* and nonmarine bivalves were common, but with intermittent marine incursions. The mid to late Namurian succession is characterised by alluvial deposits (Browne and Monro, 1989), with palaeosols. In parts of Northumberland, major sand bodies elongated parallel to the axis of the trough, occupy tectonically controlled erosive channels cut through the 'Yoredale' facies succession (Young and Lawrence, 2002).

During Pendleian times a fluviodeltaic system ('Millstone Grit' facies) transported siliciclastic sediment into the northern margin of the Central Pennine sub-basin, located to the south of the area covered by this report (see Waters et al., 2009). Equivalent, though more condensed, successions are recorded on the Askrigg Block and in the Stainmore Trough. Although the term 'Millstone Grit' is widely used on old geological maps of the north Pennines and Northumberland, and remains embedded in the associated literature, the facies is absent from these areas. Major distributary channels of Pendleian and Arnsbergian age, present on the Alston Block (Dunham, 1990), may represent the feeder channels for the fluviodeltaic successions found farther to the south.

Westphalian

From early in the Westphalian a coal-forming delta-top environment became established across the Midland Valley of Scotland and the Pennine Basin. Although both 'Coal Measures' cyclic successions are lithologically similar, the basinal areas were, largely, isolated by the raised area of the Southern Uplands. Marine incursions were relatively rare during deposition of these successions (Figures.2e and 2f), but those that did occur gave rise to widespread marine bands.

Chronostratigraphy

File:P912779.jpg
Chronostratigraphical framework for the Carboniferous System of Great Britain. Ages derived from Menning et al. (2000), Davydov et al. (2004) (the dates shown in brackets are international stage boundary determinations from Gradstein and Ogg, 2004); Carboniferous chronostratigraphy from Heckel and Clayton (2006); seismic sequences from Fraser et al. (1990); mesothems from Ramsbottom (1973, 1977a).P921779

The Carboniferous System in Western Europe comprises two subsystems, an older Dinantian and younger Silesian, traditionally corresponding to Lower Carboniferous and Upper Carboniferous, respectively (Table.1). The Dinantian–Silesian boundary was chosen to represent a regional facies transition in Britain from dominantly carbonate (Carboniferous Limestone Supergroup) to terrigenous clastic strata and does not reflect a global change in flora or fauna. The lower boundary of the Silesian is defined as the base of the ammonoid *Cravenoceras leion* Zone.

The terms ‘Dinantian’ and ‘Silesian’ are now redundant and the Mississippian and Pennsylvanian of the USA have become recognised internationally as the only accepted main divisions (subsystems) of the Carboniferous, strictly representing the Lower and Upper Carboniferous, respectively, in international usage. The mid Carboniferous boundary separating the two subsystems occurs within the Chokierian Stage of the Namurian Series in Western Europe.

Difficulties in direct comparison between North America and Western Europe have resulted in Britain maintaining usage of the regional Western European chronostratigraphical nomenclature. The new, official subdivision of the Carboniferous System, as voted for by the Subcommission on Carboniferous Stratigraphy, and ratified by the International Commission on Stratigraphy and the International Union of Geological Sciences during the period 1999–2004, has not been applied to this report. However, the reader is referred to Davydov et al. (2004) and Heckel and Clayton (2006) for further information. Whilst the authors are fully aware of the changes to Carboniferous stratigraphical nomenclature, for sound practical reasons the old style has had to be maintained for the present.

The Dinantian is subdivided into the Tournaisian and Visean series, whereas the Silesian is subdivided into three series, the Namurian, Westphalian and Stephanian. These series do not represent global faunal or floral events, but were chosen to represent prominent facies variations in Western Europe. In northern Britain, the Tournaisian is dominated by continental and peritidal lithofacies, whilst the Visean is largely represented in the Midland Valley of Scotland by heterolithic clastic and nonmarine carbonate lithofacies, and in northern England by a mixture of open marine, platform and ramp carbonates, ‘Millstone Grit’ and ‘Yoredale’ lithofacies. In northern Britain the Namurian is dominated by ‘Yoredale’ and ‘Millstone Grit’ lithofacies, and the Westphalian is very largely represented by ‘Coal Measures’ lithofacies. The base of the Westphalian is taken at the base of the ammonoid *Gastrioceras subcrenatum* Zone, which broadly equates with the first incoming of thick coal seams. However, *G. subcrenatum* has not been found in Scotland so the base of the Westphalian there cannot be defined accurately. In Scotland the base of the Coal Measures is taken at the base of the Lowstone Marine Band, its local correlative, or at a plane of disconformity. The Stephanian is restricted to strata of limited geographical extent in onshore northern Britain.

File:P912766.jpg
Extent of Carboniferous rocks of onshore northern Great Britain. P912766

Internationally, the Tournaisian and Visean are now formally defined as stages, and work is in progress to define subsequent stages using nomenclatures defined in Russia. However, until this work is complete it is considered prudent to maintain usage of the well-established chronostratigraphical nomenclatures established in Britain and Western Europe.

Stage names for the Visean, Namurian and Westphalian are based on basal stratotypes defined by George et al. (1976) for the Visean, Ramsbottom et al. (1978) for the Namurian, and Owens et al. (1985) for the Westphalian, largely from localities in northern England. The distribution at outcrop of the main chronostratigraphical units and the location of the stage stratotypes is shown in Figure 3.

The Stephanian Series was originally defined in the Massif Central of France with three stages, referred to as Stephanian A, B and C. The Stephanian A has been formally renamed the Barruelian

Stage. The recognition of a non-sequence in the Massif Central and identification of an additional Stephanian succession in Cantabria, northern Spain, led to the recognition of a Cantabrian Stage, which is older than the Barruelian. No strata of Cantabrian age have been recognised in northern Britain.

Biostratigraphy

File:P912780.jpg
Tournaisian and Visean biostratigraphical zonations, derived from Riley (1993). Grey shading indicates interzones (conodonts and miospores) or non-sequences (brachiopods). anch. bis. *Scaliognathus anchoralis — Polygnathus bischoffi; Arnsb. Arnsbergites; B. Bollandoceras; bouc. Dollymae bouckaerti; bul. Eotaphrus bultyncki; bur. Eotaphrus burlingtonensis; C. Caninophyllum; coll. Gnathodus girtyi collinsoni; G. Goniatites; Gn. Gnathodus; has. Dollymae hassi; hom. Gnathodus homopunctatus; in. Polygnathus inornatus/Siphonodella; L. Lochriea; lat. Doliognathus latus; Lusit. Lusitanoceras; Lyrog. Lyrogoniatites; Mono. mononodosa; Neoglyph. Neoglyphioceras; Parag. Paraglyphioceras; prae. Mestognathus praebeckmanni; Ps. Pseudopolygnathus; S. Siphonophyllia; Siph. Siphonodella; spic. Polygnathus spicatus; V. Vaughania; Z. Zaphrentis*. P912780.

Ammonoids (goniatites) are crucial to Carboniferous biostratigraphy, notably within the Visean, Namurian and early Westphalian series, where they provide the greatest biostratigraphical resolution. The nektopelagic habit of ammonoids allows biozones to be recognised across Western Europe and some are applicable globally. Thick-shelled ammonoids occur within thin hemipelagic marine beds (known as 'marine bands'), which developed during marine transgressions and typically comprise distinct ammonoid faunas. Ammonoid biozones are units defined by the successive first appearance of ammonoid taxa, with the base of the biozones coinciding with the bases of specific marine bands (Tables.2, 3 and 4). Very little is known of the early Courceyan ammonoid faunas in Britain and Ireland, and goniatite occurrences are rare in Britain in beds older than late Visean. Diagnostic goniatites are also uncommon in the Namurian of northern Britain, though work initiated by Currie (1954) showed that the classification of the Pennines area could be applied to part, at least, of the Scottish succession. Ramsbottom et al. (1978) applied a standard nomenclature based on the names of the principal diagnostic goniatites for the six most important marine bands in the coalfields of the British Isles. Apart from the Cambriense Marine Band, these bands can be traced throughout Western Europe, except in some marginal areas.

File:P912781.jpg
Summary of the chronostratigraphical units of the Namurian and the main biozones for the most important fossil groups. P912781.

Foraminifers are of biostratigraphical importance within Tournaisian and Visean carbonates. They are particularly abundant in mid-ramp and platform settings, but also present within basinal deposits in limestone turbidites (Riley, 1993). The formal foraminiferal zonation for Belgium, established as the standard for north-west Europe, has been applied to British and Irish sequences by Conil et al. (1980) and Conil et al. (1991) and is summarised in Table.2.

Conodonts are present within marine facies, notably carbonate turbidites and hemipelagic shales, and conodont zones are particularly important for Tournaisian and Visean correlation. Varker and Sevastopulo (1985) included zonations for both 'shelf margin and basin facies' and 'shelf facies'. Conodonts are also important in recognising the mid Carboniferous boundary and the base of the Pennsylvanian Subsystem. Palynomorphs (miospores) are present in both marine and terrestrial environments and have been used for biozonation up to and including the Asturian (Westphalian D) (Tables.2, 3 and 4). They are particularly useful for facilitating correlation in nonmarine rocks lacking stratigraphically useful macrofossils, and they can be used to correlate between nonmarine and marine sequences. Recent advances in macrofloral zonation show the importance of plant fossil biostratigraphy, particularly for the Asturian (Westphalian.D) and Cantabrian (Cleal, 1991).

Coral/brachiopod biozonation has been of historical importance in the classification of Tournaisian and Visean platform carbonates, though they are now considered strongly facies controlled. However, the zonation nomenclature of Vaughan (1905) for Bristol and South Wales and Garwood (1913) is still widely used and was summarised by George et al. (1976) and Riley (1993). Riley (1993, fig..1) showed the interrelationship between the coral/brachiopod zones of Vaughan (1905) and the modified conodont zones of Varker and Sevastopulo (1985) and the relationship of these and other zones to the former stages (now partly redefined substages) of the Tournaisian and Visean.

In the Visean to Namurian, marine bivalves present within hemipelagic shales and occurring in association with ammonoids are of greatest stratigraphical importance (Riley, 1993). However, this lithofacies is unknown in the Midland Valley of Scotland and is very rare in northern England. In the former region, the relatively diverse molluscan fauna is considered and treated as part of the total assemblage of macrofossils in marine facies.

Nonmarine bivalves are fundamentally important to the zonation of late Namurian and Westphalian sequences in the Midland Valley of Scotland and the Northumberland Trough (Table.4). They tend to occur in association with fish material and ostracods.

Estheriids are small crustaceans that occupied brackish waters. They can occur in prominent marker 'bands' in the Westphalian.

The plethora of local group and formation names and the inconsistent application of lithostratigraphical hierarchies for the Carboniferous has, to an extent, hindered the regional understanding of the Carboniferous successions of Great Britain.

From an early, relatively simple framework, subsequent surveys and publications have greatly added to the complexity of the nomenclature. Much of this existing nomenclature has evolved from work carried out long before guidance was available for best practice in lithostratigraphical procedures (Rawson et al., 2002). Consequently, a haphazard approach to the establishment of the hierarchy of units has resulted.

The local nomenclatures can be attributed to the following:

- restriction of deposits to individual basins
- isolation by faulting or erosion of once laterally contiguous deposits following end Carboniferous and subsequent tectonic events
- the former BGS methodology of mapping geological sheets in isolation
- where a formal lithostratigraphical nomenclature has not been defined on BGS maps, scientific publications have created their own, commonly conflicting, schemes.

The Geological Society Special Reports for the Dinantian and Silesian (George et al., 1976; Ramsbottom et al., 1978) provided useful stratigraphical correlations between key sections across the British Isles. However, the reports did not give a unified lithostratigraphical framework. Their preference was to promote a unified approach to lithostratigraphy, biostratigraphy and chronostratigraphy (Holland et al., 1978, p..4).

File:P912782.jpg
Westphalian chronostratigraphy and biostratigraphical zonations. P912782.

In order to review the existing nomenclature it was decided to follow the guidance of the North American Stratigraphic Code (NASC) (Anon., 1983) and more recently, Geological Society of London guidance (Rawson et al., 2002), as these are commonly accepted standards. The nomenclature chosen should aid communication of British Carboniferous geology to others. However, it is acknowledged that many names are so entrenched in the literature that their replacement would result in confusion. As a consequence, this report uses existing nomenclature where suitable, whilst providing full definitions consistent with the guidance from the NASC and the Geological Society of London.

Group framework

In rationalising the stratigraphy it was decided to follow a ‘top-down’ approach by which the group nomenclature was based upon the recognition of major lithofacies. The committee considered the possibility of having a single group name for each lithofacies applicable to all Great Britain. However, the lithofacies were commonly developed within distinct basinal areas and a single Britain-wide group nomenclature would not aid the understanding of the evolution of the basins. Hence, it was agreed that separate group names should be employed for each distinct depositional area. Where it was believed useful to provide a single term for a Britain-wide lithofacies, it was recommended it should be defined as a supergroup.

Nine major lithofacies associations (Figure.4) have been identified for the Carboniferous of onshore Great Britain, all of which are recognised in the northern provinces. The main lithologies, environments of deposition, distribution and age ranges were first described by Waters et al. (2007; see also Figure.2). A *continental and peritidal facies* is widespread across northern Britain including from the Midland Valley of Scotland to central England. It was deposited from Late Devonian to Visean times. There are two subfacies, which are commonly found to interdigitate. A continental fluvioclastic (‘cornstone’) subfacies commonly forms the first basin infill and extends onto horst and tilt-block highs. A peritidal marine and evaporite (‘cementstone’) subfacies is generally limited to troughs associated with grabens and half-grabens.

A *heterolithic clastic and nonmarine carbonate facies*, of Visean age, is principally present in the eastern part of the Midland Valley of Scotland where it passes laterally westward into dominantly volcanic rocks. It is also present as early Visean strata in parts of the Northumberland Trough.

An *open marine, platform and ramp carbonates facies* accumulated during the Visean on platforms and ramps that developed on horst blocks and half-graben tilt blocks over the Alston and Askrigg blocks, and fringing the Manx–Lake District Block. A *hemipelagic facies* was deposited in quiet and relatively deep basinal prodelta and carbonate slope environments that developed in the Furness and Cartmell area (south Cumbria) and the Askrigg Block–Craven Basin ‘Transition Zone’ during the early Namurian.

A *mixed shelf carbonate and deltaic (‘Yoredale’) facies* is widespread across the Midland Valley of Scotland and northern England as far south as the Craven Fault System. It is found in strata of Visean to Namurian age.

A *fluviodeltaic (‘Millstone Grit’) facies* extends from the Midland Valley of Scotland, across northern and central England in strata of Namurian to early Westphalian age. Similar deposition may have occurred within the Northumberland Trough during early Visean times.

A *fluviodeltaic (‘Coal Measures’) facies* extends from the Midland Valley of Scotland across northern England in strata of Westphalian age.

An *alluvial (‘Barren Measures’) facies* occurs as two subfacies in Britain (see Waters et al., 2007). However, only the ‘red-bed’ subfacies occurs in northern Britain in west Cumbria, the Ingleton Coalfield and the Solway Basin. It was deposited during the Westphalian.

A *volcanic facies* is most thickly present as the Clyde Plateau Volcanic Formation (Arundian to Asbian) and Bathgate Group (Asbian to Arnsbergian) of the Midland Valley of Scotland, but it is also significantly developed in the Tournaisian and Visean age rocks of the Solway and Tweed basins (Cockermouth, Birrenswark and Kelso volcanic formations), in the Namurian of the western Midland Valley (Troon Volcanic Member) and in Namurian to Westphalian rocks of the eastern Midland

Valley. It will be noted in the report that some groups designated in northern Britain may comprise two or more lithofacies associations (excluding volcanics). For example, in the case of the Clackmannan Group of Scotland, this resulted from a desire not to have a large number of single-formation groups where several main lithofacies are represented, and in the case of the Yoredale Group of northern England it dealt with local variances in the main lithofacies.

Formation framework

In most cases a nomenclature of formations, and to a lesser extent members, has been established. Those formations present within areas of recent geological resurvey already have a full formal lithostratigraphical description, which is replicated in this report. In some circumstances, the definition of existing formations has been revised, with the new definition reproduced in this report. Some formations have been redefined as a group or member. Elsewhere, it was decided that there was a requirement to rationalise several local formation names into a single unit. In these circumstances the new formation names generally utilise an existing, widely used name, which conforms to the NASC criteria (Anon., 1983). In relatively few cases, formation names did not exist and new terms have been introduced as part of this study.

A formation is a mappable unit that possesses internal lithological homogeneity or distinctive lithological features that distinguish it from adjacent formations (see Rawson et al., 2002; Anon., 2005 for a full definition). Individual coals, sandstones and limestones, whilst they may be 'mappable units' are treated as beds of informal level and are not described in this report. Some limestones within the Yoredale Group were considered to be amalgamated units of great lateral extent that warranted member status.

The text in this report is largely based on entries in the BGS Lexicon of Named Rock Units for which lithological information has been compiled from many different sources using different classifications. Where possible, limestone nomenclature uses the Dunham (1962) scheme based on texture, modifying other terminologies where obvious. Otherwise the Folk (1959; 1962) scheme, based mainly on composition, has been used.

Where possible, the nomenclature used for all igneous and sedimentary rock names follows the recommendations of the BGS Rock Classification Scheme (RCS). However, in some circumstances it has been necessary to use the original descriptions and 'legacy' names.

Where relevant, the classification of basaltic rock in the Midland Valley of Scotland devised by MacGregor (1928) is included to permit comparison with previous maps and literature. To avoid repetition the six classes are listed here with their RCS-compatible translations for reference:

- *Markle:* plagioclase-macrophyric basalt to trachybasalt (hawaiite)
- *Dunsapie:* olivine-clinopyroxene-plagioclase-macrophyric basalt
- *Craiglockhart:* olivine-clinopyroxene-macrophyric basalt to basanite (referred to formerly as ankaramite)
- *Jedburgh:* plagioclase-microphyric basalt to trachybasalt (hawaiite)
- *Dalmeny:* olivine-microphyric basalt
- *Hillhouse:* olivine-clinopyroxene-microphyric basalt to basanite.

These translations are compatible with the approach to rock classification and nomenclature set out in the BGS Rock Classification Scheme (Volume 1 Igneous rocks) by Gillespie and Styles (1999).

References

1. ↑ Waters, C N, Browne, M A E, Dean, M T, and Powell, J H.2007.Lithostratigraphical framework for Carboniferous successions of Great Britain (Onshore).*British Geological Survey Research Report*, RR/07/01.

Categories:

- Pages with broken file links
- Lithostratigraphy - summaries
- Carboniferous lithostratigraphy

Navigation

- Main page
- Recent changes
- Random page
- Help about MediaWiki

Tools

- What links here
- Related changes
- Special pages
- Permanent link
- Page information
- Cite this page
- Browse properties

- This page was last modified on 26 July 2021, at 16:07.