Carboniferous

Commission members
Proposals and discussions
Lithostratigraphy
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2.2 Belgian Coal Measures Group - HOU

Authors: Renier, 1912, 1928; Paproth et al., 1983; Laloux et al., 1996; Delcambre & Pingot, 2000.

Description: The Coal Measures Group includes all Carboniferous coal-bearing siliciclastic sediments. Paralic facies conditions were installed during the deposition of the Belgian Coal Measures Group because of basinal sag north of the variscan deformation front, balanced by increasing supply of siliciclastic erosion products in a closing intracontinental depression. From base to top, a regression can be observed by gradual transition from marine prodelta, to lower / upper delta plain, to lower / upper alluvial plain (Langenaeker & Dusar, 1992; Dreesen et al., 1995).

Autocyclic sedimentation of coal-bearing alluvial-delta plain deposits is controlled by the internal dynamics of the depositional system (relation compaction/subsidence - fluvial system/sediment supply). Basic, fifth order autocycles normally range from the roof of a coal seam to the top of the next seam. Different major paleoenvironments related to relative sea level rise and fall are distinguished: 1) non-marine swamps rich in plant remains, containing the coal seams; 2) non-marine floodplains, with fluvial channels and lakes; 3) brackish water floodplains under influence of distant marine ingressions; 4) euryhaline floodplains and lakes at the acme of marine ingressions. Fully marine beds are rare, all sediments are supplied by the paleofluvial system. Paleofluvial sandstone deposits may intervene at all positions. Third order glacio-eustatic allocycles are characterised by the marine bands at their base (Paproth et al., 1996; Dusar, 1997).

Marker horizons such as marine bands and volcanic ash layers provide the framework for a subdivision of the Coal Measures Group, based on the cyclotheme concept (Renier, 1930; Van Leckwijck & Fiege, 1963; Paproth et al., 1996). These bands allow firm, practically isochronous correlations between different basins, also with surrounding countries. (Van Leckwijck, 1948; Delcambre, 1987, 1996). Coal seams, particular faunal assemblages and sandstone beds provide the means for a more detailed subdivision on local to basin scale.

Boundaries: The base of the Belgian Coal Measures Group coincides with the top of either the Lower Carboniferous (Dinantian) carbonate deposits or the Gottignies Formation. In the former case, a hiatus accompanied by a sharp lithological change generally marks this boundary; in the latter case, the transition is more gradual. The top of the Belgian Coal Measures Group is everywhere erosive and unconformably overlain by Permian or younger deposits.

Stratotype: Cf. the lithostratigraphic units of lower rank.

Area: All Carboniferous basins (Campine basin, Namur, Dinant and Vesdre synclinoria and associated areas below overthrusts) in Belgium and extending beyond the national boundaries into Carboniferous basins of neighbouring countries.

Thickness: More than 4000 m in the northeastern Campine coal field, in area close to depocentre under late Permian cover (Bless et al., 1977).

Age: Serpukhovian – Bashkirian – Moscovian; Arnsbergian or Namurian A to Westphalian D according to traditional subdivision; at places of more continuous sedimentation the basal unit may be of Pendleian age.

Remarks: Locally translated as ‘Terrain houiller’ or ‘Steenkoolterrein’, which were miners’ terms, encompassing all deposits containing the coal seams (Renier, 1912, 1928). Defined as formation restricted to the Westphalian part of the Upper Carboniferous in Paproth et al. (1983). Defined as group covering all Upper Carboniferous in Laloux et al. (1996) and Delcambre & Pingot (2000).

Equivalent unit in the Netherlands: Limburg Group (van Adrichem Boogaert & Kouwe, 1993).

The first appearance of coal seams in the Belgian Coal Measures is diachronous. In the eastern part of the Dinant synclinorium and in the Theux Massif , this occurs in the Bois-et-Borsu Member (Arnsbergian), whereas in the Campine basin paralic facies conditions did not appear before Alportian times and the first coal seams occur in the Châtelet Formation (Westphalian A). Thick, widely exploited coal seams are restricted to the Charleroi and Flénu Formations, however.

Especially within the Andenne to Flénu Formations (Upper Namurian to Westphalian C) the same lithologies and sequential successions are encountered. Distinction between formation and members is mainly based on the presence of marker

horizons and frequencies of particular lithologies, e.g. coal. Members without distinctive lithologies are not separately described hereunder.

2.2.1. Chokier Formation

Authors: d'Omalius d'Halloy, 1853; Dumont, 1832; Purves, 1881; Van Leckwijck, 1957, 1964; Paproth et al., 1983.

Description: The Chokier Formation is composed of calcareous shales, pyrite-rich aluniferous shales ('ampelites') and silicites ('cherts' or 'phtanites'), with a rich marine fauna, devoid of coal seams or rootlet beds with the exception of the Bois-et-Borsu Member ('Shales with Posidoniellas and goniatites', Purves, 1881). Weathered, fissile black or violaceous shales dominate in the outcrop areas.

Lower unit of the Belgian Coal Measures Group ('Houiller sans houille', Dumont, 1832). The base corresponds to the top of the Dinantian carbonates and is normally corresponding to a sharp boundary at the place of a stratigraphic gap of varying importance, often developed as a karst surface. Radioactive shales rich in organic matter ('hot shales') which are often incorporated in the Chokier Formation may be used as a practical indicator for delimiting the formation both upwards and downwards.

The Chokier Formation is always overlain by the Andenne Formation, whenever the stratigraphic record is sufficiently complete. In the western Namur Synclinorium and the eastern Campine basin, with thicker and probably more complete sequences, the basal transition is more gradual.

Stratotype: Former 'ampelite' outcrops on the slopes below the castle of Chokier.

Area: As for the Belgian Coal Measures Group.

Thickness: Generally 20 to 40 m, decreasing towards the Brabant Massif (Bouckaert, 1967). Increasing to 80-150 m in the Charleroi mining district and Dinant –Theux basins (under the form of the Bois-et-Borsu Member) and possibly also in the eastern Campine basin (corresponding to Geverik Member of the Epen Formation in The Netherlands, van Adrichem Boogaert & Kouwe, 1993). The Chokier Formation becomes much thicker, reaching a thickness of 200 m, in the western part of the Namur Synclinorium ('Auge hennuyère', Blaton - Saint Ghislain area). In the St Ghislain borehole, Lower-Upper Carboniferous transitional beds (Gottignies Formation), together with undoubted Chokier beds, reach a thickness of 432 m.

Age: Serpukhovian; Arnsbergian and Chokierian, rarely Alportian, based on goniatite zonation, or Namurian A according to traditional subdivision. Transition beds such as the Tramaka Member, could be of Pendleian (E1) age.

Tramaka Member

Authors: Austin et al., 1974; Paproth, Conil et al., 1983.

Description: Grey-coloured coarse crinoidal limestone lenses, preserved in karstic dissolution structures, laterally passing into silty limestones and black finely bedded limestones ("Encrinite de Tramaka", Austin et al., 1974).

Boundaries: unconformably overlying karstified Lower Carboniferous limestones (Seilles Formation); unconformably overlaid by dark shales of the Chokier Formation.

Stratotype: Abandoned quarry of Tramaka, Seilles commune.

Area: Northern flank of Namur Synclinorium, between Namur and Huy (Andenne uplift zone)

Thickness: 3.70 m in type locality

Age: Early Serpukhovian; conodonts and foraminifers suggest a Namurian age (Arnsbergian or older), possibly equivalent of lower part of Chokier Formation or of Gottignies Formation.

Remark: The Tramaka Member was defined as a formation in Paproth, Conil et al., 1983.

Bois-et-Borsu Member

Authors: Newly defined, after the Bois-et-Borsu commune, mining village in the 19th century.

Description: The Bois-et-Borsu Member contains marine 'ampelites' typical for the Chokier Formation, interbedded with 3 coal seams and sandstone rootlet beds. Despite irregular thickness distribution and complex tectonics, coal seams with thickness of 30-70 cm have been mined.

The Bois-et-Borsu Member overlies Lower Carboniferous (Warnantian) deposits. The upper boundary is erosive. It is lateral equivalent to the Chokier Formation.

Stratotype: Bois road section and abandoned mining galleries (cf Vandercammen, 1948).

Area: Deep synclines in the eastern part of the Dinant Synclinorium (Clavier, Bois-et-Borsu and Bende coalfields) and the overturned beds in the Theux tectonic window.

Thickness: Possibly up to 250 m; due to poor exposure and presence of thrust faults, real thickness is not known.

Age: Early Serpukhovian, Arnsbergian and Chokierian, or Namurian A according to traditional subdivision, as for the Chokier Formation.

2.2.2. Andenne Formation

Authors: Dumont, 1832; Purves, 1881; Stainier 1901; Van Leckwijck, 1957, 1964; Paproth et al., 1983.

Description: The Andenne Formation consists of non-marine mostly silty shales, sandstones, thin coal seams (30 to 75 cm) or rootlet beds, with some intercalations of thin marine, goniatite-bearing shales and limestone beds (paralic facies). The cyclic nature is the most characteristic feature of the paralic sediments (Fiege & Van Leckwijck, 1964). Many grits (up to 30 m thickness) and ganisters (bleached quartzitic rootlet beds) have been distinguished at different stratigraphic levels within this formation. Local unit names such as Poudingue houiller, Grès d'Andenne, Gives, Java, Villerot, Salzinnes have been in use (Renier, 1912, 1928).

The Andenne Formation is conformably overlying the much thinner Chokier Formation, but may exceptionally rest directly on older Dinantian strata, as is the case on the Heibaart dome (Campine basin)(Bouckaert, 1967). The Andenne Formation is always overlain by the Châtelet Formation whenever the stratigraphic record is complete.

Stratotype: Java gallery, former Andenne coalfield (cf Paproth et al., 1983).

Area: As for the Belgian Coal Measures Group. Thin coal seams (30 to 75 cm) have been exploited in the Namur and Verviers (Herve) synclinoria.

Thickness: 300 to 800 m, with thinnest sediments in the Namur synclinorium (Andenne transversal ridge) or Dinant synclinorium and increased thicknesses in the Campine basin. Thickness attaining 1800 m is postulated in the northern Campine basin, north of the Hoogstraten listric fault, according to Vandenberghe (1984).

Age: Latest Serpukhovian to early Bashkirian (Chokierian or Alportian to Yeadonian, based on goniatite zonation) or Namurian B-C according to traditional subdivision.

Remark: Originally defined by Dumont (1832) as 'Houiller avec houille', including all overlying coal-bearing formations of Westphalian age. More restrictively used by Purves (1881) as 'Schistes et psammites avec houille maigre'. Used in the actual sense by Stainier (1901) as 'Assise d'Andenne'.

2.2.3. Châtelet Formation

Authors: Renier, 1912, 1928; Stainier, 1932; Delmer, 1963; Delcambre & Pingot, 2000.

Description: The Châtelet Formation consists of non-marine partly silty shales, sandstones, thin coal seams (30 to 75 cm) or rootlet beds (paralic facies). It is still poor in coal but mineable seams occur in all coal basins. Two widespread goniatite-bearing marine horizons, at the base of thick cyclothemes and overlying beach barrier sandstone units, characterise this unit.

The following members have been distinguished (names and definition according to latest revision in Paproth et al., 1983), from bottom to top:

- Ransart Member (base: Ransart = Fraxhisse = Sarnsbank marine band; boundary Namurian - Westphalian), formerly known as 'Sous-zone d'Oupeye';

- Floriffoux Member (base: Floriffoux = Bouxharmont = Finefrau Nebenbank marine band), formerly known as 'Sous-zone de Beyne'.

The Châtelet Formation is conformably overlying the Andenne Formation; its base coincides with the Ransart (=Sarnsbank) Marine Band. It is conformably succeeded by the Charleroi Formation.

Stratotype: Charleroi coal basin (Stainier, 1932).

Area: As for the Belgian Coal Measures Group.

Thickness: 200 m (Hainaut), 300 m (Liège), 500 m (Campine).

Age: Early Upper Bashkirian, Lower Westphalian A according to traditional subdivision.

Remark: The "Assise de Châtelet" as defined by Renier is equivalent to the "Assise de Beringen" as defined by Delmer.

2.2.4. Charleroi Formation

Authors: Renier, 1912, 1928; Delcambre & Pingot, 2000.

Description: The Charleroi Formation (originally defined as "Assise de Charleroi") is characterised by a rhythmic succession of coal-mudstone-sandstone sequences. Coal seams are frequent and much thicker (up to 3 m). It was the main coal-producing unit in Belgium. Weakly marine incursions allow a further subdivision.

The following members have been distinguished (names and definition according to Renier, 1928; Delmer, 1963; Paproth et al., 1983), from bottom to top:

- Mons Member (base: Wasserfall = Stenaye = Gros Pierre marine band), formerly known as 'Assise de Genk'. Parastratotype: Winterslag colliery, Campine coal field;

- As Member (base: Quaregnon = Katharina marine band; boundary Westphalian A - Westphalian B), named Quaregnon Member in Paproth et al. (1983). Stratotype: Waterschei colliery, Campine coal field;

- Eikenberg Member (base: Eisden = Domina marine band), named Eisden Member in Paproth et al. (1983). Stratotype: borehole KB14 Meeuwen-Eikenberg.

The Quaregnon marine band is not known in the thrusted massifs of the Hainaut basin; the Eisden marine band has not been recognised at all in the southern Belgian coal basins, thus limiting the possibilities for generalised subdivision of the Charleroi Formation.

The Charleroi Formation is conformably overlying the Châtelet Formation along the Gros Pierre = Wasserfall horizon. It is conformably succeeded by the Flénu Formation along the Maurage marine band.

Stratotype: Charleroi coal basin. Reference section trench of the canal Charleroi-Brussels in Gosselies (Delcambre & Pingot, 2000).

Area: The mining districts of the Campine basin and Namur-Vesdre synclinoria (= Wallonian basin) in Belgium and extending beyond the national boundaries into Carboniferous basins of neighbouring countries.

Thickness: Preserved thicknesses of 500 m (central part of Wallonian basin) up to 1300 m (Borinage) and 1100 m (northeastern Campine basin).

Age: Late Upper Bashkirian; upper Westphalian A to Westphalian B according to traditional subdivision.

2.2.5. Flénu Formation

Authors: Renier, 1912, 1928.

Description: Originally defined as “Assise du Flénu” is largely similar to the Charleroi Formation, also characterised by a rhythmic succession of coal-mudstone-sandstone sequences. Coal seams are frequent and may be rather thick (up to 5 m), though mining was mostly limited to the Borinage and the eastern Campine. Weakly marine incursions but especially tonsteins (volcanic ash layers in coals) allow a further subdivision.

The following members have been distinguished (names and definition according to Renier, 1928; Delmer, 1963; Paproth et al., 1983), from bottom to top:

- Meeuwen Member, according to Delmer (1963); base: Maurage = Petit Buisson = Aegir marine band, boundary Westphalian B - Westphalian C; named Maurage Member by Renier (1928) and Paproth et al. (1983). Stratotype: borehole KB121 Meeuwen-Bullen;

- Wasmes Member, according to Renier (1928); base Tonstein Hermance (Nord) = Hanas (Borinage) = Hagen 1 (Campine, Ruhr);

- Neerglabbeek Member, according to Dusar (1989); Dusar et al. (in press); named Hornu zone by Renier (1928); base weakly marine ‘Geisina’ band, overlying the coal seam with Tonstein Nibelung. Stratotype: borehole KB146 Neerglabbeek

The Flénu Formation is conformably overlying the Charleroi Formation along the Maurage = Aegir marine band. This marine band of glacio-eustatic origin is recognised everywhere and forms the best marker horizon within the Westphalian, above the marine bands of the Châtelet Formation. The boundary with the overlying Neeroeteren Formation is marked by the onset of coarse grained stacked sandstones.

Stratotype: Mons (Borinage) coal basin.

Area: The eastern Campine basin and nappes in the Borinage coalfield (western part of the Wallonian basin) in Belgium and extending beyond the national boundaries into Carboniferous basins of neighbouring countries.

Thickness: 1100 m preserved thickness in the Borinage; max 950 m in the Campine.

Age: Lower Moscovian; Westphalian C and basal Westphalian D according to traditional subdivision.

2.2.6. Neeroeteren Formation

Authors: Renier, 1944; Van Leckwijck, 1957; Delmer, 1958; Paproth et al., 1983.

Description: The formation starts with the onset of massive, partly coarse-grained to conglomeratic, kaolinitic white sandstones, characterised by high porosities and permeability. Interbedded with variegated mudstones, which tend to become predominant upwards, and rare coal seams. Deposited in braided alluvial channels of large extension and associated floodplain.

The Neeroeteren Formation is succeeding to the Flénu Formation. Locally, contacts may seem regular, taking into account the geometry of the sandstone bodies. On regional scale, however, a slight unconformity may be present.

The top of the formation coincides with the top of the Belgian Coal Measures Group and is always eroded.

Stratotype: Borehole KB113 (Neeroeteren-Neerheide).

Area: The unmined northeastern Campine basin (Neeroeteren-Rotem area). An extension in the neighbouring part of the Roer Valley Graben is probable (no borehole reconnaissance yet).

Thickness: Maximum thickness traversed in exploration boreholes is 300 m. Based on seismic evidence, preserved thickness attains 500 m (Dusar, 1989).

Age: Upper Moscovian; practically coinciding with the Westphalian D, according to traditional subdivision. The Westphalian C-D boundary, recognised by means of microflora, lies about 30 m below the base of the Neeroeteren Formation (Paproth et al., 1983).

Remark: First described by Renier (1944) as 'Grès de Neeroeteren' and defined at formation level by Van Leckwijck (1957) and Delmer (1958) but restricted as a member of the Belgian Coal Measures Formation in Paproth et al. (1983).