

Devonian lithostratigraphic units (Belgium)

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(7 figures and 1 table)

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ABSTRACT. This contribution briefly describes seventy Devonian formations from the Dinant and Namur Synclinoria, the Vesdre Nappe and the Theux Window, that were revised or introduced during the previous two decades. The descriptions of the formations are organized in four parts, Lower Devonian, Middle Devonian, Frasnian and Famennian, corresponding to major and minor transgressive and regressive events and demonstrating each typical lithological characteristics. In each part, the following presentation has been adopted: the formations occurring in the Southern part of the Dinant Synclinorium are first described from base upwards, followed by a description of the formations restricted to the central and/or northern part of the Dinant Synclinorium, the Namur Synclinorium, the Vesdre Nappe and the Theux Window.

KEYWORDS: Devonian, Lochkovian, Pragian, Emsian, Eifelian, Givetian, Frasnian, Famennian, Belgium, lithostratigraphy.

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1. Lower Devonian lithostratigraphic units

1.1. Introduction

The Lower Devonian is divided in three stages: Lochkovian, Pragian and Emsian. The Gedinnian and Siegenian stages of the ancient terminology correspond more or less respectively to the Lochkovian and Pragian stages (see Godefroid et al., 1994). Gedinnian and Siegenian were replaced by Lochkovian and Pragian according to the decisions of the IUGS (Bassett, 1985).

The base of the Lochkovian stage is defined at Klonk, Czech Republic (Martinsson (ed.), 1977), the base of the Pragian stage is defined at Velka Chuchle, Prague, Czech Republic (Chlupáč & Oliver, 1989), and the base of the Emsian stage is defined in the Zinzilban Gorge, Uzbekistan (Yolkin et al., 1997). Numerical ages of the Lower Devonian span the interval from $410 \pm 8/5$ Ma to 390 ± 5 Ma.

After the main phases of the Caledonian orogeny, the Old Red Continent merged in Europe. A new transgression

on this continent began at the Latest Pridolian - Early Lochkovian during which the Ardenno-Rhenish geosyncline was mainly fed by arenaceous sediments starting with basal conglomerates. Late Caledonian movements during the "Bolandian phase" was responsible for the emersion and the erosion of part of the Emsian rocks.

The Lower Devonian lithostratigraphic units of Belgium are exposed in the Ardenne Nappe, i.e. in the Dinant and Neufchâteau Synclinoria, the Ardenne Anticlinorium and the Vesdre Nappe (figure 1).

The basic contributions to their study are those of Dumont (1848), Asselberghs (1946, 1954) and Godefroid et al. (1994). The present synthesis is essentially adapted from Godefroid et al. (1994) who have updated the ancient terminology and descriptions to the concept of lithological formations in the Vesdre Nappe, the Theux Window and the Dinant Synclinorium. However, Godefroid et al. (1994) did not review the terminology for the Ardenne Anticlinorium and the Neufchâteau Synclinorium. Revision of the lithostratigraphic units of

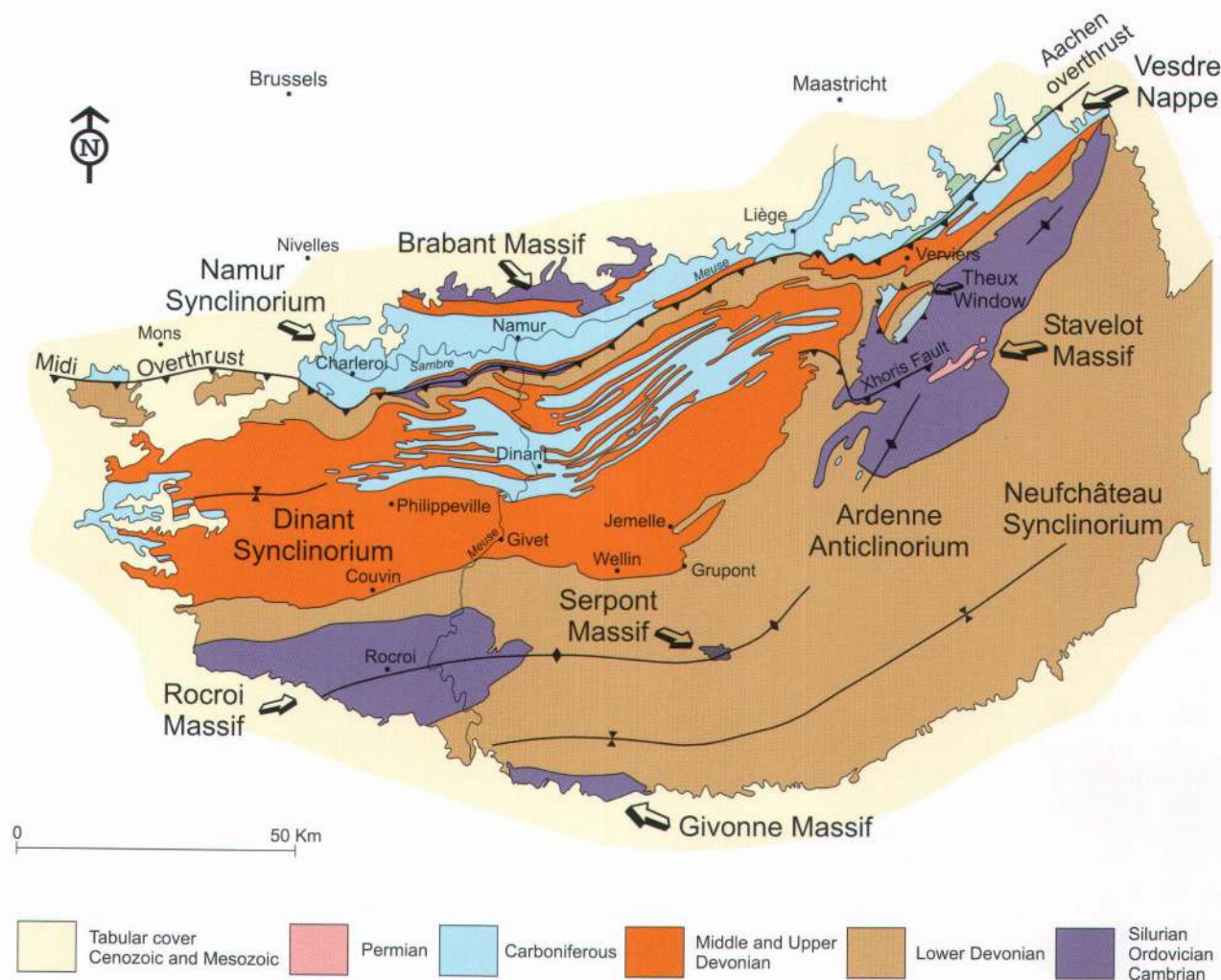


Figure 1. Structural setting of Devonian formations in the Ardennes.

these areas is in progress (Godefroid, 1985, Godefroid & Cravatte, 1999, Bultynck et al., 2000) and new geological mapping started.

Correlations with the Lower Devonian Global Stratotype sections and points are mainly based on miospore biozonation (Steemans, 1989; Streel et al., 2000). Brachiopods are important for correlations in the Ardenne area and with the Rhenish facies.

The 3D geographical extension of the Lower Devonian formations is shown in figure 2. To clarify their lateral variations at the northern and eastern sides of the Dinant Synclinorium and in the Vesdre Nappe, a SW-NE more detailed section is given in figure 3.

1.2. Descriptions

1.2.1. Fépin Formation - FEP

Authors: Dumont, 1848; Meilliez, 1984; Meilliez & Blicke, 1994a.

Description: Conglomeratic formation made up of rudites and arenites as major constituents with sandstones, siltstones, shales and breccias as interbeds. Depositional environments are either fluvial or tidal marine. The formation is interpreted as a positive megasequence corresponding to the Lower Devonian transgression on the Ardennes. The lowermost layers unconformably rest on the folded Lower Paleozoic basement. The top of the series is placed where the sandstones are passing upwards to the shales of the Mondrepuis Formation.

Stratotypes: The Fépin Fm was first described at an old quarry W of Fépin (France). However, the only place where the series is complete is the Lahonri quarry, S of Couvin.

Area: Mainly known from the northern flank of the Rocroi Massif and the SW flank of the Stavelot Massif.

Thickness: Very variable: 20 to > 40 m at Lahonri quarry, 5 to > 70 m at Fépin, 20 to > 300 m at Dochamps.

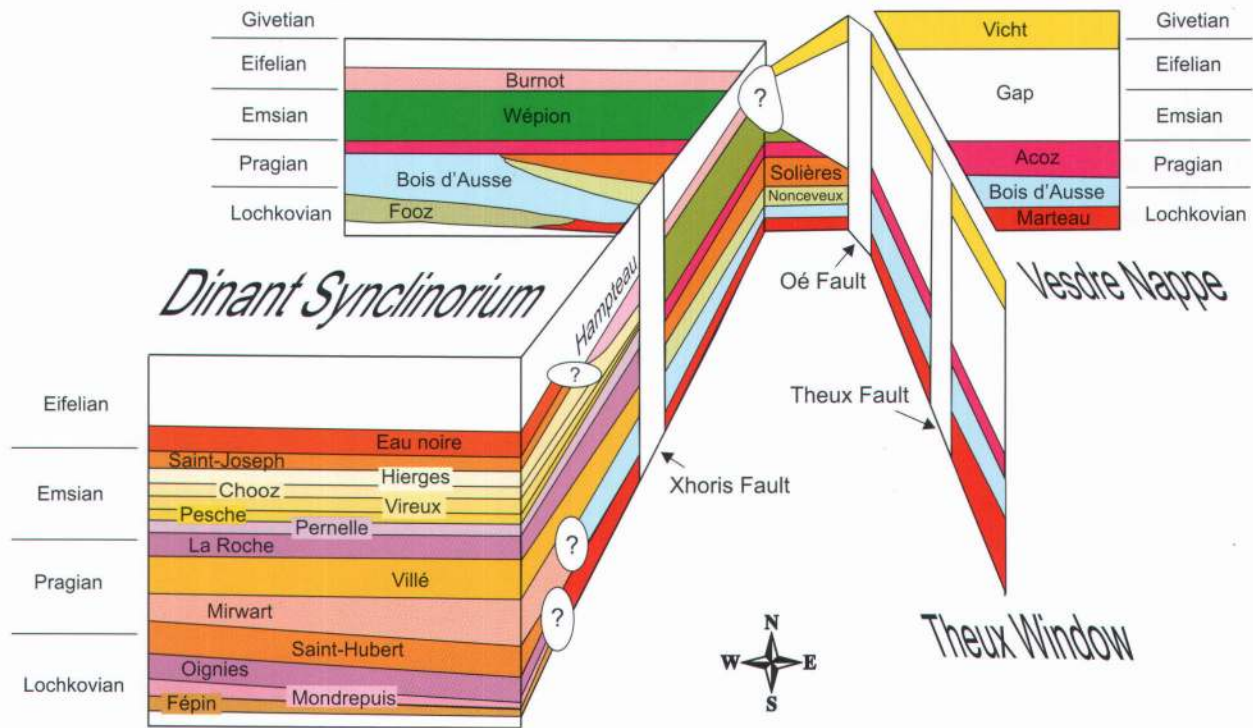


Figure 2. 3D geographical extension of the Lower Devonian formations in the Dinant Synclinorium, The Theux Window and the Vesdre Nappe (after Steemans in Godefroid et al., 1994, modified).

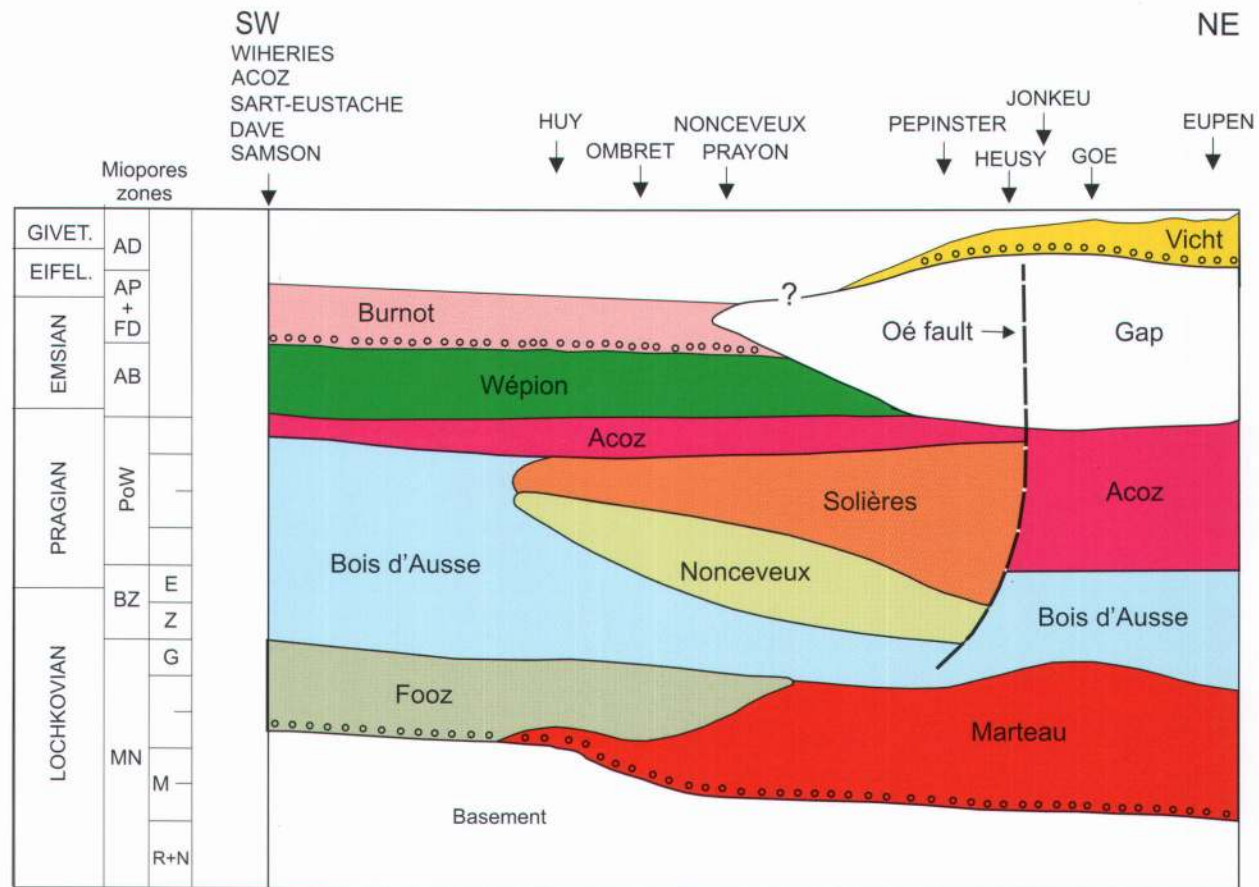


Figure 3. SW-NE schematic cross-section through the Lower Devonian formations at the northern and eastern sides of the Dinant Synclinorium and in the Vesdre Nappe. (after Hance et al., 1992, modified).

Age: Lochkovian (R subzone of the MN Opper Miospore Biozone) on the northern flank of the Rocroi Massif. However, at Muno, in the southern part of the Neufchâteau Synclinorium, Godefroid (1995a) has identified a brachiopod (*Dayia shirleyi*) of Silurian (Pridolian) age in the lower part of the Mondrepuis Fm, overlying the Fépin conglomerate (there also named "Linchamps conglomerate"). In the northern part of the Neufchâteau Synclinorium, South of the Stavelot Massif, at Gdumont, Godefroid & Cravatte (1999) have confirmed the Pridolian age of the Gdumont sandstone overlying the Quarreux conglomerate (3 to 5 m thick) resting unconformably on the Cambro-Ordovician basement. This means that the Fépin Fm is very diachronous from south to north, with ages ranging from Silurian (Pridolian) to Lochkovian.

Remarks: The rocks, which unconformably rest on the Cambro-Silurian basement, generally start with a conglomerate. In some cases, this conglomerate is not thick enough to be considered as a distinct formation (e.g. base of the Marteau and Fooz Formations).

1.2.2. Mondrepuis Formation - MON

Authors: Thorent, 1839; Maillieux, 1927; Meilliez & Blicke, 1994b; Godefroid, 1995a.

Description: Bluish shales with disseminated quartz grains (detrital or volcanic). Some sandstone layers are interbedded in the first basal meters of the series. The abundance of fossils (bivalves, brachiopods, ostracods, tentaculites, bryozoans, trilobites, crinoids) confirms its marine character.

Stratotype: There is no continuous section at Mondrepuis (France). The best section (although much degraded) is situated at Haybes (France), in the Bois du Ridoux.

Area: Southern border of the Dinant Synclinorium and northern part of the Ardenne Anticlinorium.

Thickness: Probably 175 m at the Bois du Ridoux. Thickness and facies change S of Hargnies, due to syndimentary faults.

Age: Late Pridolian at Muno (occurrence of *Dayia shirleyi*) - Early Lochkovian (R Subzone of the MN Opper Miospore Biozone).

1.2.3. Oignies Formation - OIG

Authors: Gosselet & Malaise, 1868; Gosselet, 1880a; Meilliez & Blicke, 1994c.

Description: Formation made up of detrital rocks of red colour. At the bottom, coarse-grained sandstones, with feldspathic lenses, changing upwards to finer-grained rocks (fine-grained sandstones, siltstones, shales). Sedimentological observations indicate an evolution from a marine environment to an exundated alluvial plain.

Stratotype: The best sections are situated at Fépin (France), at the Moulin de Fétrogne along the Meuse, and N of the meeting of the Meuse and Risdoux rivers.

Area: S flank of the Dinant Synclinorium.

Thickness: < 210 m at the stratotype, 800-1000 m in the Dochamps area.

Age: Lochkovian, with a diachronous character. The Oignies Fm is younger to the W (Couvin area, Z Subzone; lower part of the BZ Opper Miospore Biozone = Lochkovian-Pragian) and older to the E (Arville-Poix St-Hubert area, E of the Rocroi Massif, Siβ Subzone, MN Opper Miospore Biozone = Lochkovian).

1.2.4. Saint-Hubert Formation - STH

Authors: Gosselet, 1880a; Maillieux, 1932; Stainier 1994a.

Description: The formation begins above the last green and mottled shales of the Oignies Formation. At the bottom, green shales with some lenticular beds of pale green quartzites. At the top, thick mass of light green quartzites. In between, green shales, frequently cellular, and green or grey green siltstones, sometimes with green, light green or grey green sandstones and quartzites beds. On the plateaus, the quartzites are often bleached or reddened.

Stratotypes: Saint-Hubert, sections along the Lhomme river and the Namur-Arlon railway track. The top is outcropping at the Mirwart railway station.

Area: Southern flank of the Dinant Synclinorium; northern part of the Ardenne Anticlinorium.

Thickness: 400 m in the Couvin area, 500 m in the Meuse valley, 500-700 m in the Dochamps area.

Age: Lochkovian/Pragian. Diachronous character based on miospore zonation. Younger age in the Couvin area, Pèrnelle section (Z Subzone at the bottom; E Subzone at the top, BZ Opper Miospore Biozone) and older age in the Saint-Hubert area (Siβ to Z Subzones, MN to BZ Opper Miospore Biozones).

1.2.5. Mirwart Formation - MIR

Authors: Hebert, 1855; Stainier, 1994b.

Description: The Mirwart Formation corresponds to the former Anor Formation. However, the lack of a good section in the Anor area has justified the abandon of the Anor name. Furthermore, the name "Mirwart" was already used in the legends of the geological maps at the scale 1:40,000 (published between 1900 and 1909) to describe the upper part of the formation.

At the bottom, the Mirwart Formation begins with greyish green shales overlying the quartzites of the St-Hubert Formation. At the top, green quartzites underly the carbonate and fossiliferous beds of the Villé Formation. In between, there are occurrences of thick lenticular masses of green, light blue, greenish blue, sometimes white or cream quartzites and sandstones, interbedded in green grey or black shales and siltstones. Sandstones often contain pebbles of black shale. Towards the top, the black shales contain plants remains. In the

100 uppermost meters, the sandstone layers may also contain rare shells.

Stratotypes: Mirwart, sections along the Lhomme river and the Namur-Arlon railway track. Other good section for the upper part at Villé, near La Roche-en-Ardenne.

Area: S and E of the Dinant Synclinorium; Halleux Anticline.

Thickness: 300 m at Couvin, 450 m in the Meuse valley, 600 m at Mirwart, 600 m on the eastern side of the Dinant Synclinorium, > 700 m N at Halleux, 1000 m W of Dochamps.

Age: Lochkovian-Pragian. On the base of miospore zonation, diachronous character from W to E. At Mirwart, top of the Z, E, Po and W Subzones, BZ and PoW Opper Miospore Biozones (= Lochkovian-Pragian border); at Couvin, in the Pèrnelle valley: Pa α Subzone of the PoW Opper Miospore Biozone (= Pragian). Former Early Siegenian (Sg1) age.

1.2.6. Villé Formation - VIL

Authors: Maillieux & Demanet, 1929; Asselberghs, 1946; Godefroid & Stainier, 1982.

Description: Dark blue shales and slates with intercalations of rust-coloured sandy laminated layers, blue sandstones, often with brown pellicular weathering, and blue carbonate sandstones, often very fossiliferous and strongly weathered at the surface (dissolved; limonitized). Also green and sometimes white sandstones and quartzites. Ripple marks occur frequently at the sandstone layers boundaries.

Stratotype: Villé near La Roche-en-Ardenne.

Area: S and SE sides of the Dinant Synclinorium, up to the Xhoris fault.

Thickness: 30 m S of Couvin, 200 m S of Grupont, 200 m at Amonines, 250-300 m in the La Roche-en-Ardenne area.

Age: Although being very rich in fossils (brachiopods, crinoids, bivalves, corals), no marker guide was up to now identified. A Pragian age is inferred, due to the ages attributed to the neighbouring formations. Former Siegenian (Sg2 or S2) age.

1.2.7. La Roche Formation - LAR

Authors: Dewalque, 1874; Asselberghs, 1946; Godefroid & Stainier, 1982.

Description: At the stratotype, from the bottom to the top, the La Roche Formation is made up of:

- 200 m of dark blue slates with thin layers of light blue sandstones or quartzites. Load casts;
- 100 m of dark blue slates and blue grey silty slates with sandy intercalations and 0.1-1 m thick banks of reddish sandstones. Rare fossils;
- 150 m of dark blue slates progressively richer to the top in thin sandy layers and blue green siltstones, sometimes fossiliferous.

Stratotypes: Lower boundary at La Roche-en-Ardenne, along the Hotton road; upper boundary S of Jupille, at the Hodister crossing.

Area: S and SE sides of the Dinant Synclinorium, up to the vicinity of the Xhoris fault.

Thickness: 215 m S of Couvin, 420 m S of Grupont, about 400 m at Amonines, 400 m at the northern flank of the La Roche Syncline increasing to > 800 m at the southern flank of the syncline.

Age: Probably Pragian, due to the age of the neighbouring formations.

1.2.8. Pèrnelle Formation - PER

Author: Godefroid, 1979, 1994.

Description: The formation begins with the first massive sandstone bank overlying the siltstones of the La Roche Formation. It finishes with the last thick sandstone bank underlying the shales, siltstones and shelly (and also sometimes carbonate) sandstones of the Pesche Formation. The Pèrnelle formation is mainly made up of massive, green blue (brownish if weathered) sandstones and quartzitic sandstones, sometimes fossiliferous, separated by thin dark shaly beds. Locally, the thickness of the dark shales and siltstones increases.

Stratotype: Couvin, Pèrnelle pond, old railway tram trench.

Area: S and SE sides of the Dinant Synclinorium.

Thickness: 39 m at the Pèrnelle pond, about 40 m at Jupille, 45 m S of Grupont, about 60 m in the Meuse valley, 150 at the northern flank of the Halleux Anticline, > 600 m in the Nisramont area.

Age: Late Pragian at the stratotype (Su Subzone of the PoW Opper Miospore Biozone).

1.2.9. Pesche Formation - PES

Authors: Maillieux, 1910; Asselberghs & Maillieux, 1938; Godefroid, 1979.

Description: Grey or blue grey (greenish or brownish by weathering) shales and siltstones with lenses en layers of sandstones, sometimes containing shells. The sandstones can also be argillaceous or with a carbonate cement and become limonitic by weathering.

Stratotype: Couvin, Pèrnelle pond, old railway tram trench.

Area: S and SE sides of the Dinant Synclinorium, up to the area between the Ourthe valley and Villers-Ste-Gertrude.

Thickness: 160 m in the Meuse valley, \pm 190 m in the Couvin area, \pm 375 m in the Lesse valley, \pm 400 m S of Grupont, \pm 400 m in the Ourthe valley; 700-800 m in the Hodister area.

Age: On the base of three species of *Brachyspirifer*, the Siegenian (\equiv Pragian) - Emsian boundary was defined in

the lower part of the Pesche Fm. *Caudicriodus celtibericus* was also identified at the base of this formation. In Spain, this conodont species is associated to *Polygnathus dehiscens* indicating a Lower Emsian age.

1.2.10. Vireux Formation - VIR

Authors: Gosselet, 1864; Godefroid & Stainier, 1988, 1994a.

Description: The Vireux Fm begins with blue grey quartzitic sandstones overlying the shales and siltstones of the Pesche Fm. This formation is mainly made up of thick masses of blue grey or greenish quartzites and sandstones (eventually argillaceous) separated by dark grey or greenish shales and siltstones interbeds. East of Olloy-sur-Viroin and W of Chooz, the shale beds increase. Some sandstone layers contain shells or plants remains. The top of the Vireux Fm is defined below the first red rocks of the Chooz Formation.

Two members are distinguished, respectively from bottom to top:

- the Ecluse Member, in which the grey and blue grey colours are dominant and in which some layers contain fossils (corals, brachiopods, bivalves, trilobites, crinoids);
- the Ruisseau de Deluve Member, in which the argillaceous character of the rock is generally more pronounced, the greenish colour frequent and plant remains present in some levels.

The limit between the two members is defined at the top of the last bank containing macrofossils.

Stratotype: Vireux (France), Montigny quarry, left bank of the Meuse.

Area: S and SE sides of the Dinant Synclinorium, up to the surroundings of the Ourthe valley.

Thickness: > 80 m at Couvin, 120-120 m S of Chooz, 350 m in the Lesse valley, 400 m S of Grupont.

Age: Emsian.

1.2.11. Chooz Formation - CHO

Authors: Gosselet, 1868; Godefroid & Stainier, 1988, 1994b.

Description: Detrital formation essentially characterized by its red or mottled colours. At Vireux, two subunits are distinguished:

- a lower unit (\pm 50 m), which contain argillaceous sandstones or quartzitic sandstones occurring as thick masses separated by red and green, rarely grey, shales and siltstones;
- an upper unit (270-280 m), which is mainly made up of red and green shales and siltstones with intercalations of red or green sandstone lenses or beds which may reach 10-14 m thick.

East of Hampteau, the top of the Chooz Fm is situated at the bottom of the first gravelly or conglomeratic bed of the Hampteau Fm and not at the last red bed as it is the case to the west.

Stratotype: For the lower limit, Vireux (France), Mont Vireux quarry; for the upper limit, Vireux-Mazée road, W of the crossing with the Givet road.

Area: S and SE flanks of the Dinant Synclinorium.

Thickness: 320-330 m.

Age: Emsian.

1.2.12. Hierges Formation - HIE

Authors: Sauvage & Buvignier, 1842; de Dorlodot, 1901; Godefroid & Stainier, 1994c.

Description: The formation is divided into two members, from bottom to top:

- The Bois Chession Member: \pm 20 m of argillaceous or quartzitic sandstones, locally fossiliferous, forming two or three units separated by one or two grey or green grey shale units with fossiliferous beds. The Bois Chession Mbr generally begins with 2.5-2.5 m of alternating thin argillaceous sandstones and shales beds. Towards the E, from Tellin, conglomerates and gravelly sandstones are interbedded in the sandstones.
- The Barrage Member: 300-310 m of shale and siltstones, locally with carbonate cement, containing numerous fossiliferous calcareous sandstone banks and sandstone beds with or without shells. From Grupont, a sandstone unit appears in the upper part of the Barrage Mbr. Its thickness increases from Grupont to Marche-en-Famenne, reaching 160-170 m S of Hargimont. The sandstone beds with calcareous cement also increase and fossils are very abundant in some places.

The top of the Hierges Fm is below the first massive shelly limestone bed of the overlying St-Joseph Fm.

Stratotypes: There is no section at Hierges covering the entire formation. Stratotypes for the lower limit are situated at Vireux (France), and for the upper limit, at Nismes (St Joseph locality).

Area: S and SE flanks of the Dinant Synclinorium, up to the Hampteau area.

Thickness: 320-330 m at Hierges.

Age: Traditionally in Belgium, the top of the Hierges Fm was considered as the top of the Emsian (thus, also as the top of the Lower Devonian). Since 1985, the Lower Devonian-Middle Devonian boundary defined by the International Subcommittee on the Devonian Stratigraphy corresponds to the occurrence of the *Polygnathus costatus partitus* conodont. This limit is situated stratigraphically higher, in the Eau Noire Fm. The icriodid conodont assemblage (*Latericriodus cf. beckmanni*, *Icriodus culicellus culicellus*, *I. corniger ancestralis*, *I. fusiformis* and *I. rectirostratus*) found in the Hierges Fm covers the *Polygnathus laticostatus* and *P. serotinus* biozones. *Arduspirifer arduennensis*, *Brachyspirifer mixtus* and *Paraspirifer sandbergeri* are brachiopods occurring a little above the lower limit of the formation. *Paraspirifer praecursor* is a brachiopod occurring in the upper part of the formation.

1.2.13. Hampteau Formation - HAM

Authors: Gosselet, 1873; Asselberghs, 1946; Stainier, 1994c.

Description: The Hampteau Fm starts with the occurrence of gravelly or conglomeratic sandstones overlying the red, green and mottled detrital rocks of the Chooz Fm. The rocks are characterized by thick masses of sandstones, coarse-grained to gravelly sandstones with disseminated quartz and sandstone pebbles and conglomerate banks alternating with shales and siltstones. The top of the formation is placed at the last red and green bank underlying the grey shales and siltstones, quickly carbonate bearing, of the St-Joseph Fm. The colour is very variable: red, green, often mottled or greyish green. Some banks contain fossils. The Hampteau Fm is divided into two members, respectively from bottom to top:

- The Hamoûle Member (141 m thick at Hampteau), in which the sandstones contain crinoids and brachiopods. A thin sandy layer is rich in ostracods;
- The Chaieneu Member (432 m at Hampteau), in which pebbles are more abundant within the sandstone beds, conglomerates more frequent and fossils represented by plant remains. A thick level of red shale with burrows is situated close to the bottom.

The boundary between the two members is fixed at the last thick bank with macrofauna.

Stratotype: SE of Hampteau, along the road to La Roche-en-Ardenne.

Area: E side of the Dinant Synclinorium, from Hampteau up to the vicinity of the Xhoris fault.

Thickness: The thickness decreases to the N: 573 m at Hampteau; 360 m in the Aisne valley; 250 m at La Roche à Frêne; 45 m at Fagnoul, near the Xhoris fault.

Age: Upper Emsian (*Arduspirifer arduennensis*) for the Hamoûle Member. Emsian/Eifelian boundary or Eifelian for the Chaieneu Member (Pro-Vel Subzones of the AP Opper Spore biozonation).

1.2.14. Marteau Formation - MAR

Author: Gosselet, 1888; Dejonghe, Hance & Steemans, 1994a.

Description: In the Marteau stratotype, the formation unconformably rests on the Caledonian (Salmian) basement and is overlaid by the sandstones and quartzites of the Bois d'Ausse Fm. At the bottom, occur a conglomerate of 1.5 m thick at Eupen, increasing S of Eupen and in the Amblève valley (Quarreux Member, locally > 10 m thick). These rocks are overlaid by maroon (red) and mottled siltstones and argillaceous fine-grained sandstones, alternating with green, olive or mottled argillaceous sandstones. The maroon (red) colour is widely dominant. Carbonate nodules are concentrated in some beds and responsible for a cellular structure if dissolved. Light-coloured quartzite banks, sometimes gravelly, occur in the lower part. In the Gileppe valley, there are coarse-grained to conglomerate bearing kaolinic sandstones.

Stratotype: Theux Window, Marteau locality, along the Spa-Pépinster railway.

Area: W and N flanks of the Stavelot Massif.

Thickness: 163 m at Eupen.

Age: Lochkovian (M α -G Subzones of the MN Opper Miospore Biozonation in the Vesdre Nappe; R subzone in the Theux Window pointing out to an older age to the S than to the N).

1.2.15. Fooz Formation - FOO

Authors: Gosselet, 1873, 1888; Dejonghe, Hance & Steemans al., 1994b.

Description: In the stratotype of Dave, the Fooz Formation unconformably rests on Silurian shales. The formation starts with 1.5 m of conglomerate overlaid by 11.7 m of coarse-grained sandstones locally kaolinic form the Dave Member. Olive green siltstones and micaceous sandstones surmount it. A frequent cellular structure is due to the dissolution of carbonate nodules. At the top, the Fooz Fm contain a few meters of maroon (red) and mottled siltstones and sandstones. The top of the formation is defined below the first meter-thick blue grey or light beige quartzite bank of the Bois d'Ausse Fm.

Stratotypes: Fooz, left bank of the Meuse. Dave, Bois de Dave, along the Ruisseau des Chevreuils.

Area: N of the Dinant Synclinorium and in the Vesdre Nappe.

Thickness: 150-200 m at the N side of the Dinant Synclinorium. 193 m at Dave (13.2 m for the Dave Member).

Age: Upper Lochkovian (Si α - β Subzones of the MN Opper Miospore Biozonation).

1.2.16. Bois d'Ausse Formation - BAU

Authors: d'Omalius d'Halloy, 1868; Asselberghs, 1946; Dejonghe, Hance & Steemans, 1994c.

Description: The lower limit is placed at the first grey, blue grey or light-coloured quartzite bank overlying the green siltstones and sandstones of the Fooz Fm. The upper limit is situated below the red rocks of the overlying Acoz Fm. In the Treko valley, three members are distinguished, respectively from bottom to top:

- The Bôlia Member (50 m): grey or beige quartzites with cross-stratification;
- The Tréko Member (20 m): alternating siltstones and green argillaceous sandstones;
- The Masuis Member (30 m): lenticular beige grey quartzite banks with rust-coloured spots and thin grey shale intercalations. In some levels, occurrence of shale pebbles and plants remains.

Stratotypes: Bois d'Ausse, Sart-Bernard, Namur-Arlon railway; Vitival, Treko valley; Dave, Ruisseau des Chevreuils.

Area: N and E sides of the Dinant Synclinorium and in the Vesdre Nappe.

Thickness: 100 m in the Treko valley, 135 m in the Vesdre Nappe, 180 m at Acoz, 360 m in the Meuse valley.

Age: Lochkovian (Si β Subzone of the MN Opper Miospore Biozonation) to Upper Pragian (Su Subzone of the PoW Opper Miospore Biozonation).

1.2.17. Nonceveux Formation - NON

Authors: Asselberghs, 1946; Monseur, 1959; Hance, Dejonghe & Steemans, 1992.

Description: Detrital formation with strong sequential character. At Nonceveux, 19 sequences for a total thickness of 107.6 m are distinguished. Each sequence is made up of scouring arenaceous rocks at the bottom passing progressively upwards to pelites which are often maroon (red) to the top.

Stratotypes: Nonceveux, right bank of the Amblève; El Fagne locality, Pépinster-Spa railway section.

Area: N of the Dinant Synclinorium, E of Andenne; E of the Dinant Synclinorium, N of the Xhoris fault; Vesdre Nappe, W of Stembert.

Thickness: 102.5 m at Huy, 100 to 120 m at Pépinster, > 107.6 m at Nonceveux.

Age: Diachronic formation from W to E, between Pépinster (Z subzone of the BZ Opper Miospore Biozone = Upper Lochkovian) to Huy (Pa α Subzone of the PoW Opper Miospore Biozone = Pragian).

1.2.18. Solières Formation - SOL

Authors: Maillieux & Demanet, 1929; Hance, Dejonghe & Steemans, 1992

Description: The formation is essentially made up of shales and siltstones with rare sandstones and quartzite interbeds. Colours are grey, blue grey or blue. Light colours may also characterize sandstones and quartzites. Maroon (red) colours are very accessory ones (only a 4 m thick bed of maroon (red) shale occurs at Nonceveux). The bottom of the formation is fixed, at Nonceveux, below a 0.65 m thick quartzite bed overlying the maroon (red) siltstones of the 19th sequence of the Nonceveux Fm. The top is below the first maroon (red), green or mottled pelites of the Acoz Fm.

Stratotype: The name is from a small excavation situated at Solières locality, in the Ben-Ahin municipality. A much better stratotype is N of Nonceveux, right bank of the Amblève, along the Remouchamps - Trois-Ponts road.

Area: N of the Dinant Synclinorium, E of Andenne; E of the Dinant Synclinorium, N of the Xhoris fault; in the Vesdre Nappe, W of Stembert.

Thickness: 125 m at Nonceveux, 130 m at Huy.

Age: Lochkovian to Pragian. Diachronic formation with younger ages to the east (Pa α and Pa β Subzones of the

PoW Opper Miospore biozonation at Solières; E to Su Subzones of the BZ to PoW Opper Miospore Biozonation in the Pépinster area).

1.2.19. Acoz Formation - ACO

Authors: Legend of the geological map of Belgium at the scale 1/40,000, 1892; Asselberghs, 1946; Dejonghe, Hance & Steemans, 1994d.

Description: Detrital rocks mainly of maroon (red) colours characterize the Acoz Fm. The lower boundary is fixed at the first maroon (red) siltstone and argillaceous sandstone layer overlying the quartzites of the Bois d'Ausse Fm. The upper boundary is situated below the sandstones and quartzites of the Wépion Fm. Two members are distinguished at the stratotype, respectively from bottom to top:

- The Bième Member (140 m): essentially made up of maroon (red) siltstones and shales;
- The Ruisseau d'Hanzinne Member (160 m): containing progressively more maroon (red) sandstones and m to several m-thick layers of quartzites, generally light-coloured in the maroon (red), pinkish, greenish or yellowish shades. Quartzites often contain pebbles of maroon (red) shales.

This division in two members is questionable at other places and is certainly not valid in the Vesdre Nappe (there, light-coloured quartzites are concentrated at the bottom and not at the top of the formation).

Stratotype: Acoz, Bième and Hanzinne valleys, between the old quarries of the Bois de Châtelet and the Bois d'Acoz.

Area: N and E flanks of the Dinant Synclinorium and in the Vesdre Nappe.

Thickness: 300 m to the W of the Meuse and 400 m to the E. The thickness varies much in the Vesdre Nappe, depending on the erosion level of the Vicht Conglomerate (thickness = 250 m at Eupen, < 50 m at Pépinster, 0 m at Heusy).

Age: Pragian (Su Subzone of the PoW Opper Miospore Biozonation N and E of the Dinant Synclinorium; Po-W to Su Subzones of the PoW Opper Miospore Biozonation in the Vesdre Nappe).

1.2.20. Wépion Formation - WEP

Authors: Gosselet, 1888; Stainier, 1994d.

Description: The Wépion Fm begins with the first green quartzitic thick bed overlying the red siltstones and sandstones thin beds of the Acoz Fm. The very bottom of this quartzitic unit is underlined by a conglomerate made up of pebbles of white quartz, green or red sandstone and tourmalinite. The top of the formation is situated below the sandstone and conglomerates with red cement of the Burnot Fm. In between, the Wépion Fm is mainly made up of quartzites and blue grey, blue or greenish argillaceous sandstones. The beds are often lenticular. Thick interbeds of grey, black or mottled shales and siltstones, sometimes containing pebbles often separate sandstone

beds. Plant remains and, less frequently, fish remains also occur. Pelitic units may also contain red and green sandstones beds, generally well stratified. To the top, the green sandstones contain more and more pebbles. The siltstone interbeds are cellular and ferruginous. The Wépion Fm is divided into two members, respectively from bottom to top:

- The Grand Ri Member (260 m): blue grey, greenish or reddish sandstones and quartzites, often conglomeratic bearing, forming thick units separated by grey, green or red shales, siltstones and thin sandstone beds.
- The Bois des Collets Member (40 m): green, very coarse-grained and even conglomeratic bearing sandstones. The rocks are cellular and ferruginous (also the green shales interbeds).

Stratotype: Dave and Wépion, Dave quarry, Bois des Collets quarry and surroundings.

Area: N and E flanks of the Dinant Synclinorium, up to the Mormont fault. The Bois des Collets Mbr is observed from Binche to the Fond d'Oxhe.

Thickness: 200 m in the Honelle valley, 223 m at Wépion, 280 m at Acoz, 400 m S of Huy.

Age: Emsian (AB Oppel Miospore Biozone).

1.2.21. Burnot Formation - BUR

Authors: d'Omalius d'Halloy, 1839; Gosselet, 1873; Stainier, 1994e.

Description: The Burnot Fm is mainly made up of red, coarse-grained sandstones and conglomerates with frequent tourmalinite pebbles occurring in lenticular beds interlayered with red and, less frequently, green shales. Plant remains may occur in the shales. The lower limit is fixed above the greenish sandstones, locally gravelly, of the Wépion Fm; the upper limit is below the red siltstones and shales containing small pebbles of white quartz and crinoids articles belonging to the Rivière Fm.

Stratotype: Profondeville, N of the Burnot valley and surroundings.

Area: N and E flanks of the Dinant Synclinorium, up to the Xhoris fault.

Thickness: 200 m in the Honelle valley, 330 m S of Acoz, 535 m in the Meuse valley, 350 m in the Huy area.

Age: Probably Emsian. However, up to now, no biostratigraphical attempts for dating this formation have succeeded. It is not impossible that its upper part is of Eifelian age, as it is the case for the Hampteau Fm which is a lateral equivalent.

2. Middle Devonian lithostratigraphic units

2.1. Introduction

The Middle Devonian of the Ardenne was initially subdivided into Couvinian and Givetian stages. In a vote at Sigüenza (Spain) in 1979 a majority of the Devonian

Subcommission was in favor of Eifelian as the name for the lower stage of the Middle Devonian. The base of the Eifelian is defined in the stratotype section of Wetteldorf in the Eifel area by the first occurrence of the conodont *Polygnathus costatus partitus* (Werner & Ziegler, eds, 1982). This boundary is well above the base of the Couvinian and is recognized in the upper part of the Eau Noire Fm. Because the underlying St.-Joseph FM corresponds to the lowest part of the local Couvinian stage this formation is described here together with the Middle Devonian formations. The base of the Givetian is defined in the Global Stratotype Section and Point at Jebel Mech Irdane in the Tafilalt of Morocco and coincides with the first occurrence of the conodont *Polygnathus hemiansatus* (Walliser et al, 1995). This boundary is below the base of the Givet Limestone of the Ardenne as defined by Errera et al (1972) and within the lower part of the Hanonet Formation, representing the uppermost part of the Couvinian (Bultynck & Hollevoet, 1999).

Middle Devonian rocks of the Ardenne are exposed in the Dinant and Namur Synclinoria and in the Vesdre Nappe. The initial stratigraphic subdivisions of the Middle Devonian of the Ardenne were established by Gosselet (1860, 1873) and Maillieux (1912 to 1938). Recently the Middle Devonian formations of the Ardenne were described by Bultynck et al (1991) resulting from discussions within the Belgian Subcommission on Devonian Stratigraphy. The present summary description of the Middle Devonian formations is based on the latter paper.

Cross-sections of Middle Devonian formations of the Dinant Synclinorium are shown in figure 4 (southern and south-eastern border) and figure 5 (southern and northern border).

2.2. Descriptions

2.2.1. St-Joseph Formation - STJ

Authors: Bultynck & Godefroid, 1974; Bultynck, 1991a.

Description: The most striking characteristics are the light-greyish shelly and crinoidal limestones, occasionally silty, intercalated in a chiefly grey-greenish silty shaly succession. The macrofauna is essentially composed of brachiopods.

Stratotype: Nismes, hamlet St-Joseph, local road to Regniésart.

Hypostratotype: Olloy-sur-Viroin, cut along path 200 m south-west of the village church.

Area: Southern and south-eastern flank of the Dinant-Synclinorium up to Hotton-Hampteau; from Villers-Ste-Gertrude on the St-Joseph Fm and the overlaying Eau Noire Fm cannot be clearly separated.

Thickness: About 40 m between Couvin and Olloy-sur-Viroin, 160 m in the Wellin-Halma area, about 50 m at Grupont and 30 m near Marche.

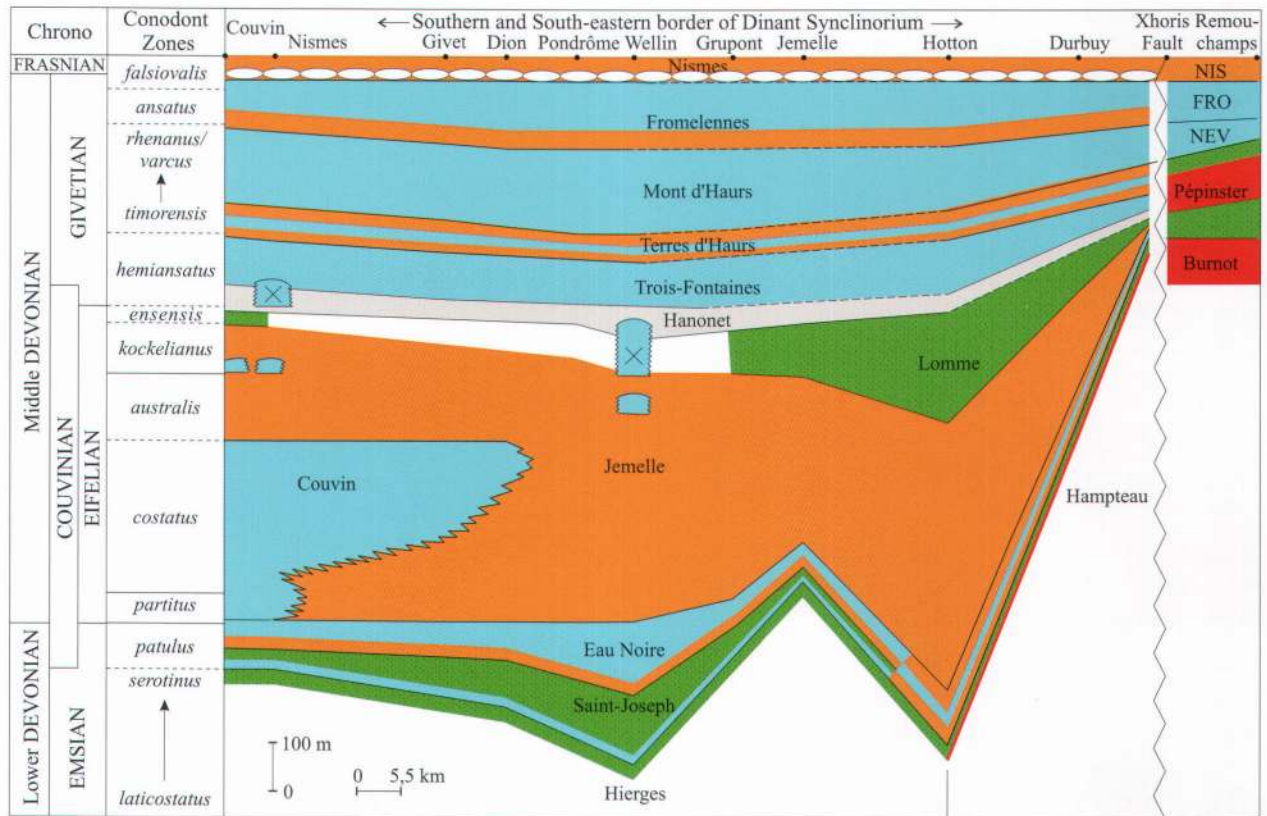


Figure 4. Generalized lithostratigraphic cross-section of Middle Devonian formations across the southern and south-eastern border of the Dinant Synclinorium.

Age: Latest Emsian; conodonts from the St-Joseph Fm belong to the *patulus* Zone (Bultynck & Godefroid, 1974).

Remarks: The St-Joseph Fm corresponds to Formation 2 described by Bultynck & Godefroid (1974). The St-Joseph Fm constitutes the lowest part of the Couvinian, formerly used as lower stage of the Middle Devonian in the Ardenne.

2.2.2. Eau Noire Formation – ENR

Authors: Bultynck & Godefroid, 1974; Bultynck, 1991b.

Description: The lower part consists essentially of greyish calcareous shales with bioclasts and a few nodules and argillaceous mostly nodular limestone beds. The upper part alternates between calcareous shales with bioclasts and crinoidal limestone beds. The macrofauna consists mainly of solitary rugose and tabulate corals.

Stratotype: Couvin (La Foulerie), section along the west banks of the Eau Noire river, about 100 m north of the foot-bridge.

Area: Southern and south-eastern flank of the Dinant Synclinorium up to Hotton-Hampteau; from Villers-Ste-Gertrude on it becomes difficult to separate the Eau Noire Fm from the underlying St-Joseph Formation.

Thickness: About 60 m between Couvin and Olloy-sur-Viroin, farther to the east the thickness increases to a maximum of 160 m in the Wellin-Halma area; east of this area the thickness decreases, 55 m at Grupont, 45 m at Jemelle and about 15 m at Hampteau.

Age: Latest Emsian-earliest Eifelian. The base of the Eifelian, recognized by conodonts belonging to the *partitus* Zone, is 50 m above the base of the formation in the Eau Noire section at Couvin (Bultynck et al., 2000).

2.2.3. Couvin Formation - CVN

Authors: Gosselet, 1860; Bultynck & Godefroid, 1974; Bultynck, 1991c.

Description: In the type area the formation consists chiefly of biostromal beds and it is subdivided into two members, the Foulerie Member and the overlying Abîme Member.

The lower part of the Foulerie Mbr is made up of bedded dark bluish crinoidal limestones with laminar and domical stromatoporoids and rugose corals; thin calcareous shale intercalations occur near the base. The middle part consists of dark bluish argillaceous limestone beds with occasionally thin calcareous nodular shales; the macrofauna consists of solitary rugose and tabulate corals, brachiopods gastropods and trilobites. Crinoidal limestone beds, frequently dolomitised, with domical

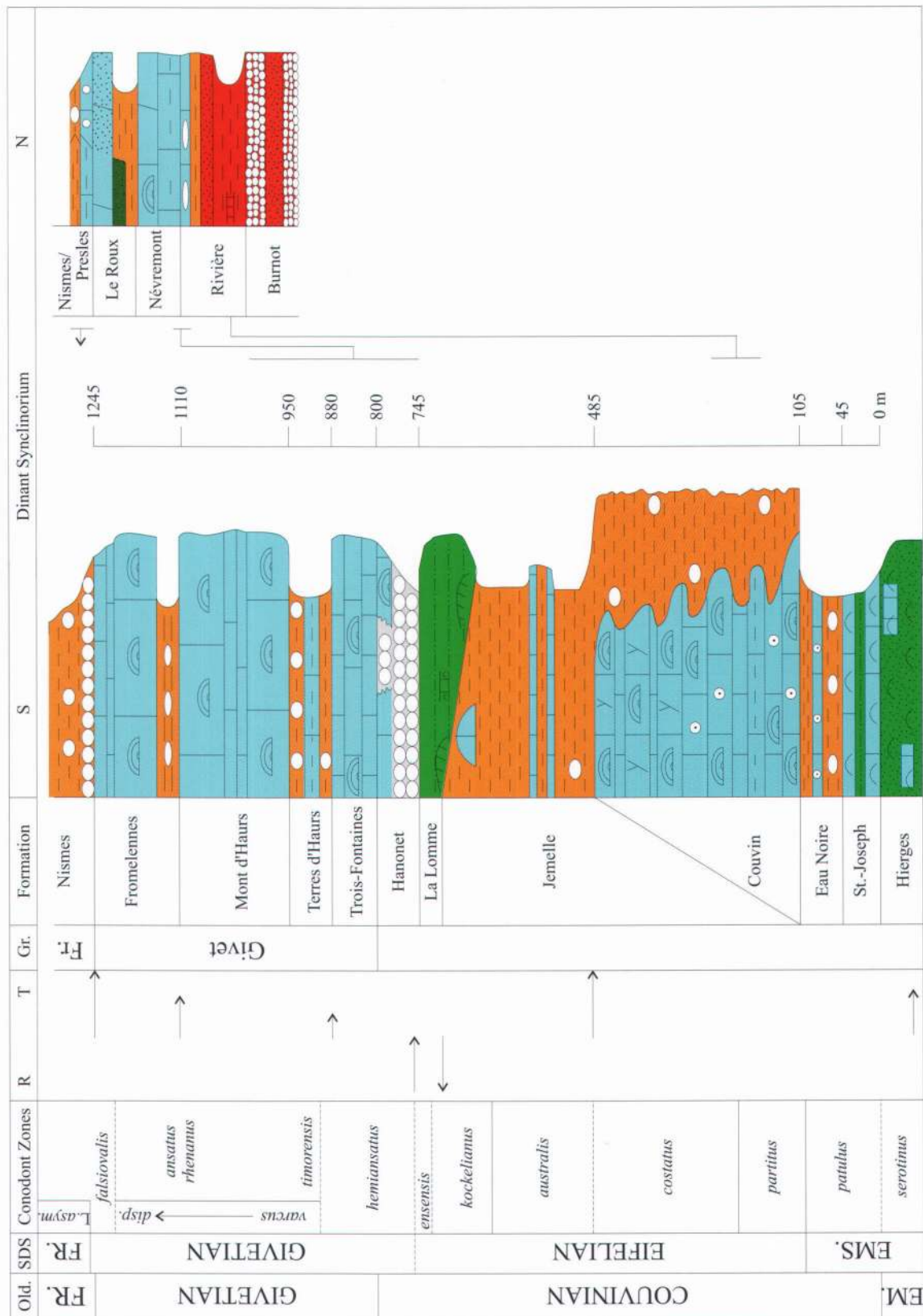


Figure 5. Generalized lithostratigraphic cross-section of Middle Devonian formations across the southern and northern border of the Dinant Synclinorium.

stromatoporoids and branched tabulate corals make up the upper part. In the Abîme Member biostromal beds with globular stromatoporoids, branched tabulate corals and phaceloid colonial rugose corals alternate with micritic limestones mostly barren of megafauna.

Stratotype: The Foulerie Mbr and the lower part of the Abîme Mbr are exposed along the west banks of the Eau Noire river at Couvin (La Foulerie); the upper part of the Abîme Mbr is exposed in the cliff above the "Trou de l'Abîme" cavern downtown on the east side of the Eau Noire river.

Area: Southern flank of the Dinant Synclinorium between Macon to the west and Dion east of the Meuse river.

Thickness: Estimated at about 380 m between Couvin and Nismes (Foulerie Mbr 220 m thick and Abîme Mbr about 160 m thick). More eastward the thickness gradually decreases, the lower part being replaced by the Jemelle Formation.

Age: Lower to middle Eifelian, *partitus* and *costatus* conodont Zones (Bultynck & Godefroid, 1974; Bultynck et al., 2000).

2.2.4. Jemelle Formation – JEM

Authors: Bultynck & Godefroid, 1974; Godefroid, 1991a.

Description: The Jemelle Fm is a chiefly shaly unit, in the type area it is subdivided into three members, from base to top the Station, "Cimetière" and Chavées Members. The Station Mbr consists of sandy shales with a few thin sandstone beds and rare calcareous nodules. Sandy shales occasionally with nodules and intercalation of dark, micritic thin limestone beds or lenses make up the "Cimetière" Mbr. In the Chavées Mbr thicker shale beds with nodules and limestone lenses alternate with thinner bedded or nodular argillaceous or crinoidal limestones; this member contains a rich macrofauna with rugose and tabulate corals, brachiopods, bivalves and trilobites.

Stratotype: Jemelle, section along the N849 road to Forrières, about 300 m south of the railway station (Station Mbr overlaying the Eau Noire Fm and "Cimetière" Mbr) and section along the disused railway Jemelle-Rochefort, immediately west of the bridge over the Lomme river (Station, "Cimetière" and Chavées Members).

Area: Southern and south-eastern flank of the Dinant Synclinorium up to the Xhoris Fault.

Thickness: 345 m at Jemelle; north-eastwards the thickness increases up to Hotton (550 m) and then gradually decreases. Westwards from Jemelle the thickness also increases, about 600 m in the Wellin-Resteigne area. In the area between Givet and Couvin the upper part of the Jemelle Fm overlays the Couvin Limestone and the lower part passes laterally into the Couvin Limestone.

Age: Early to late Eifelian, *partitus* into *ensensis* conodont Zones (Bultynck & Godefroid, 1974; Bultynck et al., 2000).

Remarks: Small biohermal lenses occur in the upper part of the formation at Wellin, Nismes, Couvin and Macon. For the Ponderôme area, Godefroid (1995b) defined the Ponderôme Member at the top of the Jemelle Fm and overlaying the Chavées Mbr.

2.2.5. Lomme Formation – LOM

Authors: Godefroid, 1991b.

Description: The formation is subdivided into two members. The Fond des Valennes Member, corresponding to the lower part of the formation, chiefly consists of sandy, occasionally micaceous or feldspathic, shales with intercalations of massif or micaceous sandstones. The overlying Wamme Member consists of massif, micaceous sandstones in the lower part and alternating calcareous sandstones and shales in the upper part.

Stratotype: Jemelle, section along the disused railway Jemelle-Rochefort, near km² and section in the Lhoist quarry, about 500 m north-east of the village church.

Area: South-eastern flank of the Dinant Synclinorium between Tellin and the Xhoris Fault;? Couvin area.

Thickness: About 110 m in the Jemelle area, thickness increasing eastward up to the Hotton area and then gradually decreasing up to the Xhoris area.

Age: Late Eifelian, *kockelianus* and *ensensis* conodont Zones (Godefroid, 1968; Bultynck, 1999; Bultynck et al. 2000).

Remarks: At Couvin a thin unit at the top of the Jemelle Fm and about 15 m thick, consisting of silty shales alternating with argillaceous, calcareous, micaceous siltstones may represent the Lomme Fm.

2.2.6. X Formation – WEL

Authors: Coen-Aubert, 1991a.

Description: Lenticular limestone bodies consisting of bedded or massif crinoidal limestones, occasionally argillaceous or dolomitic and including parts with abundant corals and stromatoporoids.

Reference section: Wellin, Fond des Vaux about 1 km north of the village church.

Area: Locally on the southern flank of the Dinant Synclinorium at Wellin and? Nismes.

Thickness: About 120 m at Wellin and 115 m at Nismes.

Age: Late Eifelian-? early Givetian; *ensensis*-? *hemiansatus* conodont Zones (Bultynck et al., 2000).

2.2.7. Hanonet Formation – HNT

Authors: Tsien, 1976; Preat & Tourneur, 1991a.

Description: The lower, most typical part of the Hanonet Fm consists of blackish, argillaceous, pyritic nodular thin limestone beds alternating with thin calcareous shale beds; in the lowest part the limestones are slightly silty and micaceous; the megafauna contains chiefly brachiopods and rugose corals. The middle part is composed of dark thin bluish limestone beds with thin laminar anastomosed and globular tabulates. The upper part is made up of two biostromal units with stromatoporoids, rugose and tabulate corals and separated by an interval with argillaceous limestones and shales.

Stratotype: Couvin, La Couvinoise Quarry about 400 m north-east of the railway-station.

Area: Southern and south-eastern flank of the Dinant Synclinorium up to the Xhoris Fault.

Thickness: 50 to 70 m between Couvin and Givet; about 30 m at Pondrôme, 70 m at Resteigne and 30 to 70 m in the Wellin area where the formation passes laterally into the X Formation.

Age: Latest Eifelian-Early Givetian; in the stratotype section the *hemiansatus* conodont Zone defining the base of the Givetian has been recognized near the top of the lower part of the Hanonet Fm.

2.2.8. Trois Fontaines Formation - TRF

Authors: Gosselet, 1876; Bonte & Ricour, 1949; Errera, Mamet & Sartenaer, 1972; Preat & Tourneur, 1991b.

Description: The lowest part, only a few meters thick consists of bedded argillaceous crinoidal limestones. The overlying part consists of thick biostromal beds with locally coquinoid beds with stringocephalids. The major, upper part of the formation, consists of micritic, occasionally laminated limestones.

Stratotype: Quarry at Les Trois Fontaines on the north-west bank of the Meuse, about 1.5 km south-west of Givet.

Area: Southern and south-eastern flank of the Dinant Synclinorium, west of the Xhoris Fault.

Thickness: In the Couvin-Givet area the thickness is about 80 m and about 100 m between Wellin and Resteigne. From Hotton on the thickness decreases in north-eastern direction.

Age: Early Givetian. Based on conodont data, the base of the Trois Fontaines Fm is a few dozens of meters above the Eifelian-Givetian boundary and belongs entirely to the *hemiansatus* Zone (Bultynck, 1987).

Remarks: On the south-eastern flank of the Dinant Synclinorium, west of the Xhoris Fault, there is an increasing influx, of terrigenous material.

2.2.9. Terres d'Haus Formation - THR

Authors: Pel, 1975; Preat & Tourneur, 1991c.

Description: The formation mainly consists of alternating argillaceous, crinoidal bedded or nodular

limestones and mostly calcareous shales with corals, brachiopods and trilobites. Locally the base of the formation is characterized by the development of patch-reefs with stromatoporoids and rugose and tabulate corals.

Stratotype: South-eastern walls of Mont d'Haus fortress, 1 km south-east of Givet.

Area: Southern and south-eastern flank of the Dinant Synclinorium, west of the Xhoris Fault.

Thickness: Between 65 and 70 m in the stratotype. Due to the more argillaceous-shaly character than the underlying Trois Fontaines Fm and the overlying Mont d'Haus Fm, the formation is generally not well exposed and lateral thickness changes cannot be accurately established.

Age: Early Givetian. Conodonts from the stratotype section are assigned to the *timorensis* Zone (= lower part of Lower *varcus* Zone; Bultynck, 1987).

Remarks: As for the Trois Fontaines Fm an increasing influx of terrigenous material is noticed on the south-eastern flank of the Dinant Synclinorium. In former literature the Terres d'Haus Fm was designed as a transitional zone between the Trois Fontaines and the Mont d'Haus Formations (Bonte & Ricour, 1949) or partially included respectively in the upper part and lower part of the two latter formations (Errera et al., 1972).

2.2.10. Mont d'Haus Formation - MHR

Authors: Bonte & Ricour, 1949; Errera, Mamet & Sartenaer, 1972; Preat & Tourneur, 1991d.

Description: The formation chiefly consists of alternating thick bedded biostromal limestones with stromatoporoids, rugose and tabulate corals and occasionally stringocephalids and mostly thinner bedded micritic limestones. Dolomitic shales and limestones occasionally occur near the top of the lower part and in the middle part of the formation.

Stratotype: South-eastern walls of the Mont d'Haus fortress, 1 km south-east of Givet.

Area: Southern and south-eastern flank of the Dinant Synclinorium, west of the Xhoris Fault and Philippeville Massif.

Thickness: About 160 m in the stratotype and along the southern flank of the Dinant Synclinorium; from Hotton on the thickness decreases in north-eastern direction. In the Philippeville Massif only the upper part of the formation is exposed and about 100 m thick.

Age: Early Givetian. According to the conodont data from the stratotype section the Mont d'Haus Fm belongs to the *timorensis* Zone (= lower part of Lower *varcus* Zone; Bultynck, 1987).

2.2.11. Fromelennes Formation - FRO

Authors: Maillieux, 1922; Errera, Mamet & Sartenaer, 1972; Coen-Aubert, 1991b.

Description: In an unpublished Ph. D. dissertation Errera (1976) subdivided the Fromelennes Fm into three members, in ascending order the Flohimont, Moulin Boreux and Fort Hulobiet Members. These subdivisions were subsequently adopted in several publications. The lowest part of the Flohimont Mbr consists of thin bedded argillaceous limestones with brachiopods. The major part of the member consists of alternating nodular shales and argillaceous limestones with a rich brachiopod fauna. The Moulin Boreux Mbr consists of alternating biostromal beds with domical and branched stromatopora and micritic, occasionally dolomitic limestones, sometimes finely laminated. The Fort Hulobiet Member is made up of platy limestones typically with bivalves and phaceloid colonial rugose corals in the upper part. In some sections the platy limestones are less developed and biostromal beds with globular and branched stromatopora occur.

Stratotype: Section along the local road D46 between Fromelennes and Flohimont (France), about 3 km south-east of Givet completed by the nearby Cul de Houille quarry.

Area: Southern and south-eastern flank of the Dinant Synclinorium and Philippeville Massif. To the north the Fromelennes Fm passes into the Le Roux Fm.

Thickness: About 135 m in the stratotype. The formation is 10 to 15 m thicker to the east between Dion and Hotton. More to the north-east the thickness decreases. In the Philippeville Massif the thickness is about 80m.

Age: Middle to late Givetian. In the stratotype section the lowest part of the Flohimont Mbr is assigned to the *rhenanus/varcus* conodont Zone (= upper part of Lower *varcus* Zone) and the overlying part to the *ansatus* Zone (= Middle *varcus* Zone). Not any conodont fauna was obtained from the Moulin Boreux Member. In Nismes and Wellin the Fort Hulobiet Mbr can be assigned to the Lower *falsiovalis* Zone (Bultynck, 1987; Bultynck et al., 2000).

2.2.12. Rivière Formation - RIV

Authors: de Dorlodot, 1895; Bultynck, 1991d.

Description: The Rivière Fm is subdivided into two members, in ascending order the Rouillon and Claminforge Members. The Rouillon Mbr chiefly consists of sandy red and greenish shales and some sandstone beds. Bioclastic limestone lenses and coquinoïd brachiopod layers occur in the lower part, overlying in the stratotype section a conglomeratic bed (= Tailfer Conglomerate of Stainier, 1891). The Rouillon Mbr succeeds the last thick conglomerate bed of the Burnot Fm.

The Claminforge Mbr is composed essentially of light-greyish calcareous very fine sandstones and calcareous shales with intercalations of reddish and greenish shales and occasionally calcareous nodular and rare limestone beds. Some of the calcareous sandstones are laminated.

Composite stratotype: The stratotype for the lower boundary is exposed along the west side of the N96 Namur-Dinant between km14 and km15 at Rivière. The

boundary between the Rivière Fm and the overlying Névremont Fm is exposed at Godinne (Tantachau) along the south side of the road Rivière-Mont, about 600 m east of the bridge over the railway Namur-Dinant.

Area: Northern flank of the Dinant Synclinorium and southern flank of the Namur Syncline.

Thickness: In the central part of the northern flank of the Dinant Synclinorium the thickness of the Rivière Fm varies between 50 and about 80m, in the western part it is about 50 m thick. In the Aisemont section situated in the central part of the southern flank of the Namur Syncline the formation is about 75 m thick.

Age: Eifelian-? early Givetian. In the type area of the formation the lower part of the Rouillon Mbr belongs to the boundary interval between the *partitus* and *costatus* conodont Zones and the top of the Claminforge Mbr probably belongs to boundary interval between the *ensensis* and the *timorensis* (= lower part of Lower *varcus* Zone) Zones. There may be a stratigraphic gap between the Rivière and Névremont Formations (Bultynck & Boonen, 1976; Bultynck et al., 2000).

Remarks: The Rouillon Mbr approximately corresponds to the "Grauwacke rouge de Rouillon" of Gosselet (1873) and the Claminforge Mbr to the "Macigno de Claminforge" of de Dorlodot (1895).

In the stratotype section of the Névremont Fm at Aisemont the base of this formation is lowered herein in comparison to its position indicated in Bultynck et al. (1991, p.71). The boundary between the Rivière and the Névremont Formations should be at the top of the argillaceous limestone bed 11.30 m above the base of the column. The arguments for this change are expressed in Coen-Aubert (2000, pp.10-11).

2.2.13. Névremont Formation - NEV

Authors: Lacroix, 1974, 1991a; Coen-Aubert, 2000.

Description: The lower part consists of alternating shales and micritic or fine bioclastic limestones with solitary and colonial rugose corals and more rare tabulates and brachiopods. The upper part is composed essentially of dolomitic limestones with stromatopora and rugose corals. The uppermost part consists of nodular limestones.

Stratotype: Fosses-la-Ville (Aisemont), section along the disused railway, 200 m east of the former railway station of Aisemont between km 6.1 and 6.2.

Area: Northern flank of the Dinant Synclinorium, southern flank of the Namur Syncline, south-eastern flank of the Dinant Synclinorium north of the Xhoris Fault and in some parts of the Vesdre Nappe.

Thickness: About 70 m in the stratotype section in the central part of the southern flank of the Namur Syncline, the thickness decreases to the east.

Age: Early Givetian, conodont data are scarce and the formation most likely belongs to the *timorensis* and