Proposal to NCS – Lower Devonian lithostratigraphy

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- Newly defined units are indicated in green.
- Units defined in recent literature (mostly Carte géologique de Wallonie), formally introduced here are in blue.
- Units changing of statute (formation > members, members > facies) are indicated in yellow.
- Significative changes to existing units are indicated in red.

Alle Member – ALL (Mirwart Formation)

Description. The Alle Member (*phyllades d'Alle* in Gosselet, 1888, p. 288) can be individualised in the upper part of the Mirwart Formation. It consists of a unit of dark slate with a tight cleavage and thin quartzitic laminae capped by a horizon with chloritised plant debris (dominantly *Taeniocrada decheniana*). This unit has been quarried for roof tiles in the Semois River valley (Lafôret, Frahan, Alle, etc.) where three c. 10 m thick slate horizons, namely *couche de Laspote*, *couche de Hour* and *couche de Laviot*, are separated by 5 to 50 m thick packages of sandy slate and quartzite (Asselberghs, 1924).

Anlier Facies (Mirwart Formation)

Description. The Anlier Facies (*facies d'Anlier* in Asselberghs, 1927, p. 212, 1932, p. 23, 1946, p. 111; *quartzites et phyllades* (…) *d'Anlier* in Maillieux, 1940, p. 9; Asselberghs, 1946, p. 17; also named *Schistes de Tournay* in Gosselet, 1888, p. 302) is a facie sof the Mirwart Formation that is individualised to the south of a line joining Libramont to Bastogne. Southwards, this unit is clearly different from the Mirwart Formation but the lack of good sections precludes the definition of a potential Anlier Formation. In the metamorphic zones (Bastogne, Bertrix), the slate is enriched in ilmenite, biotite and garnets and form a very compact rock without cleavage, known in the literature as *cornéite* (Stainier, 1907).

Area and lateral variations. In the Neufchâteau Synclinorium, the southern fine-grained slaty Anlier Facies dominates. The transition from one facies to the other is very transitional and located imprecisely along the southern limb of the Ardenne Anticlinorium. The Alle Member exists on both flanks of the Neufchâteau–Eifel Synclinorium but is particularly well expressed along the southern one.

Anloy Formation – ANL

Origin of name. From the village of Anloy, *Schistes bigarrés d'Anloy* in Gosselet (1888, p. 233).

Description. This unit consists of light blue-grey quartzite and siltstone in decimetre-thick regular beds with shaly laminae. Carbonate nodules, which appear decalcified and limonitic on the outcrop, occur together with decarbonated sandstone and micaceous sandstone beds. The coarser-grained lithologies form lenticular beds that display planar, oblique and cross laminations or are bioturbated. Rare desiccation cracks and bone beds occur in the upper part of the formation whereas plurimetric bundles of lenticular, coarse-grained arkosic sandstone beds are locally developed in its lower part.

In the Semois valley, the Anloy Formation can be divided into two members. The lower one, the dominantly sandy Braux Member – BRO (*quarzophyllades* [sic] *de Braux* and *Quarzophyllades* [sic] *oligistifères de Braux* in Gosselet, 1880, p. 62 and p. 67, respectively), starts with 50–100 cm thick beds of argillaceous to quartzitic (or carbonate), fine-grained sandstone overlying the slate of the Mondrepuis Formation. Some shaly and silty intercalations occur. The dominant colour is grey at the base and evolves into greenish-grey, to reddish in the upper part of the member. The upper Member, the Joigny Member – JOI (*Schistes luisants panachés de Joigny* in Gosselet, 1880, p. 69 that were formally separated from the *Schistes bigarrés d'Oignies* by Gosselet (1888, p. 225) as the *Schistes bigarrés de Joigny*), is essentially slaty. The transition between both members is progressive as the thickness and the frequency of the sandy facies decrease. Homogeneous shale and siltstone with a silky touch and variegated colours dominate. Lenses and beds of argillaceous, occasionally carbonate and micaceous sandstone are intercalated in the shale. They pass to dark grey shales with silty laminae, then to dark blueish slates with lighter-coloured lenses. Several horizons display decalcified nodules, commonly filled with limonitic material. Greenish shaly horizons with small argillaceous flat pebbles and plant debris occur occasionally. The greenish grey and blueish grey dominant colour changes to reddish and variegated near the boundary with the overlying Sainte-Marie Formation. A metamorphic facies locally occurs in the lower part of the formation and is known in the literature as a *cornéite* (Stainier, 1907), i.e. millimetric magnetite, biotite and tourmaline porphyroblasts included in a silt-sized quartzite matrix rich in chlorite and ilmenite. South of Paliseul and Carlsbourg, this yellowish, greenish or variegated rock is usually de-cemented, and corresponds to the Paliseul Facies (*Schistes aimantifères de Paliseul* in Gosselet, 1888, p. 232) sensu Asselberghs (1946).

Area and lateral variation. Between the Rocroi and Serpont inliers, in the vicinity of Gedinne, the red colour typical of the Oignies Formation disappears and the rock displays greenish, bluish or purplish grey colours, together with the appearance of chlorite, ilmenite and biotite due to the local increase of metamorphism imprint. Therefore, the Oignies Formation is not identifiable and the *facies* [sic] *d'Anloy* (Asselberghs, 1940, p. 10, 1946, p. 59), which was considered as a distinct formation on the new geological maps of Wallonia, is dominant. The Anloy Formation can be traced south of the Vencimont Fault all along the northern limb of the Neufchâteau-Eifel Synclinorium. Around the Givonne Inlier, the Oignies Formation, though hardly distinguishable from the Saint-Hubert Formation, re-appears. The Braux Member is a lenticular body that can be traced only southwest of Petit-Fays and up to Arreux (France) where it disappears below the Jurassic cover. The Joigny Member is only developed between Bohan and Carslbourg. Eastwards, it cannot be distinguished from the rest of the Anloy Formation.

Bois de Chaumont Formation – BCH

Origin of name. Section located in the Bois de Chaumont southeast of the village of Presles, *Formation du Bois de Chaumont* in Delcambre (2014, p. 23). The Bois de Presles Formation (*Formation du Bois de Presles*, as the Bois de Presles is the disused name for the Bois de

Chaumont) was introduced by Sorel et al. (2013, p. 16–17) but was based on the unpublished version of the Tamines – Fosses-la-Ville geological map of Delcambre (2014). In the meantime, the latter authors modified this name, because it was preoccupied for a member of the Ordovician Fosses Formation (e.g. Martin, 1969; Verniers et al., 2002).

Description. This unit begins with a conglomerate formed by millimetre- to decimetre-sized pebbles of quartz and quartzite, followed by beds of greenish sandstone, and greenish to blueish siltstone and shale.

Stratotype and sections. Discontinuous outcrops in the Bois de Chaumont (also named Bois de Presles), between Presles and Le Roux.

Area and lateral variation. The Bois de Chaumont Formation is known only from its type locality, in the Haine-Sambre-Meuse Overturned Thrust Sheets, i.e. north of the Midi–Eifel Fault. Whereas its facies is reminiscent of that of the Fooz Formation known from the Dinant Synclinorium, the thermic maturity of the palynomorphs suggests that this unit is structurally closer to those of the Condroz Inlier, which are located to the north of the Midi–Eifel Fault (Steemans, 1994). Furthermore, it cannot be ruled out that it is an isolated outlier of the Fooz Formation.

Thickness. c. 20 m.

Age. Late Lochkovian, Siβ Interval Zone (Steemans, 1994), i.e. an age equivalent of the Fooz to Bois d'Ausse formations.

Bouillon Facies (Villé Formation)

Description. In the western part of the Neufchâteau-Eifel Synclinorium, Asselberghs (1946) described a peculiar facies characterised by the presence of carbonate sandstones alternating with finer-grained lithologies in pluri-metric sequences (*calcareophyllades*) and abundant crinoidal beds and lenses. These lithologies form the Bouillon Facies (*facies de Bouillon* in Asselberghs, 1927, p. 210, 1946, p. 143).

Stratotype. Outcrops of the Bouillon Facies can be seen along the Semois River between Bouillon and Poupehan.

Area and lateral variation. In the Neufchâteau–Eifel Synclinorium, the Bouillon Facies is developed west of the Vierre River valley and extends westwards into France where it is named *Calcareophyllade de Nouzon* on the southern edge of the Rocroi Inlier and *Grauwacke de Montigny-sur-Meuse* on its northern edge (Beugnies & Waterlot, 1965).

Burnot Formation – BUR

Origin of name. Section on the western flank of the Meuse River valley at Burnot, in front of the Lustin bridge, *Poudingue de Burnot* in d'Omalius d'Halloy (1839, p. 449).

Description. The base of the Burnot Formation is defined by the first reddish (*lie-de-vin-*coloured of the literature) conglomerate bed overlying the greenish sandstone of the Wépion Formation.

The formation is typically made of rhythmical alternations of conglomerate, sandstone, siltstone and shale arranged either in cyclic or non-cyclic deposits (Corteel et al., 2004). The cyclic deposits start with conglomerate beds overlying an erosional surface and grading upwards to sandstone, then siltstone and shale. In some cycles, the basal conglomerate is reduced to a few centimetres of coarse-grained sandstone. The sandstone frequently displays oblique bedding or ripple marks and shale clasts. The shaly capping beds display occasional root traces, accumulations of thin plant debris or palaeosols (dolcretes); however, the fine-grained part of the cycle can be entirely missing due to erosion by the subsequent cycle (Corteel et al., 2004).

The non-cyclic deposits are composed of gravely sandstone, sandstone and siltstone either coarsening-upward or without trends. Conglomerate and siltstone are proportionally less abundant in these non-cyclic deposits. Parallel and oblique laminations, clasts, erosive surfaces and ripple marks are commonly observed in the sandstone.

The vertical succession of the deposits appears as an alternation of packages up to 10 m thick and 10–30 m thick packages of reddish shale, siltstone and sandstone (Delcambre & Pingot, 2017). The conglomerate and sandstone beds usually form lenses up to tens of metres in thickness. The conglomerate displays a reddish sandy matrix and centimetre to decimetre-sized pebbles (brown, black or red sandstone and quartzite, whitish quartz, black tourmalinite) that are usually well rounded but poorly sorted (some pebbles are 30 cm large). The sandstone is reddish or brownish and often has coarse-grained horizons of white quartz grains and pebbles. The siltstone and shale are finely micaceous, reddish or greenish or variegated.

In the Meuse River valley, the coarse-grained lithologies are dominant but, eastwards, the fine-grained facies locally form a larger proportion of the formation. In the Ourthe River valley (Tilff area), the conglomerate is very scarce (Fourmarier, 1910) and the Burnot Formation is largely dominated by cyclic alternations of red sandstone, variegated siltstone and shale, and frequent yellowish dolcretes. These lithologies correspond to the here introduced Sainval Facies.

Eastwards, in the Vesdre River valley, the Burnot Formation is reduced to a tongue of conglomerate resting paraconformably on the Pragian rocks and previously named Vicht Formation (*Vichter Konglomerat* in Holzapfel, 1910, p. 210; *Formation de Vicht* in Dejonghe et al., 1991a, p. 87) that is here considered as a local member (Vicht Member – VIC). It consists in metric beds of conglomerate and conglomeratic sandstone containing centimetric to pluricentimetric pebbles of quartz, quartzite, sandstone and occasional tourmalinite with frequent siltstone intercalations. The wine-red colour is dominant but tends to fade away westwards with more and more greenish to greyish intercalations (Dejonghe et al., 1991a). The member appears as a series of finning-upwards sequences with erosive bases formed by a succession of 10–100 m wide lens-like bodies (Kasig & Neumann-Mahlkau, 1969).

South of the Xhoris Fault, the colour of the conglomerate changes from red to green, greyish-green, yellowish or orange. This chromatic change is paralleled with the increase in bed thickness between the Aisne River and the Ourthe River valleys. In this area, Stainier (1994a, p. 91) introduced the Hampteau Formation (*Formation de Hampteau*) composed of the Hamoûle and Chaieneu members for the unit named *Poudingue de Wéris* by Gosselet (1873, p. 19) and Dupont (1885, p. 215). According to Barchy & Marion (2014), the establishment of a specific formation for the conglomerates observed at Hampteau is superfluous since they consider them to belong to the Burnot Formation. Recent geological mapping demonstrated that the Hamoûle Member is the local expression of the Hierges Formation whereas the Chaieneu Member is only a regional variation of the Burnot

Formation. Therefore, it is considered here that the Hampteau Facies corresponds to the conglomerate of the Burnot Formation with variegated colours.

West of the Meuse River valley, the top of the formation contains a massive unit of homogeneous conglomerate with large pebbles. In the Eau d'Heure River and Sambre River valleys, it displays a variegated matrix and was described by Bayet (1894) and Anthoine (1919) who named it as the *poudingue du Bois de Saucy* (Bayet, 1894, p. 144), *poudingue de Chevesne* (Anthoine, 1919, p. M44) and *poudingue de Cour-sur-Heure* (Bayet, 1894, p. 143). Westwards, in the Honnelle River valley, near the French border, the same beds reach 30 m in thickness and the matrix is reddish (Foucher, 1966). This unit corresponds to the Caillou-qui-Bique Member – CQB re-introduced by Marlière (1970, p. 13: *Em 3 (Poudingue du Caillou-qui-Bique)*) following Briart & Cornet (in Hanuise, 1882, p. 213: *poudingue du Caillou qui bique*).

Remark. South of the Pépinster Fault, where the Burnot Formation is developed, the conglomeratic beds of supposed Emsian age were mapped under this name (e.g. Bellière, 2015; Marion & Barchy, in press, b; Marion et al., in press) but north of it, the Emsian is supposedly absent, the conglomeratic beds resting directly on the Pragian sandstones were mapped as the Vicht Formation (e.g. Laloux et al., 1996). The difference between both lithostratigraphic units is mostly the age: supposed Emsian for the Burnot Formation, Eifelian–Givetian for the Vicht Formation, regarded here as a member of the former (see above). However, in the Ourthe River valley (Hampteau), the conglomerate is Eifelian (Stainier, 1994a). Therefore, the Burnot Formation should be considered as post-Emsian in the northeastern part of the Dinant Synclinorium. As a consequence of this age getting younger northeastwards, the Burnot Formation passes in continuity to the Vicht Conglomerate. Knowing that the conglomeratic facies are extremely diachronous, it is more reasonable to consider the Vicht Formation as a younger extension of the Burnot Formation towards the east and north.

Stratotype and sections. The original type locality is a discontinuous section along the Burnot River on the western bank of the Meuse River valley. A good section is located in the latter valley along the road Namur–Dinant at Profondeville, 200 m north of the Lustin bridge and continuing along a path on top of the valley western flank. The top of the formation can be observed on the eastern side of the Meuse River valley, south of the Lustin bridge, along the road from Lustin to Godinne. Good exposures exist in the Hoyoux River valley north-east of

Marchin and in the Ourthe River valley, north of Tilff (Sainval Facies). The Hampteau Facies are exposed along the Ourthe River, south of Hampteau, and in Roche-à-Frêne in the Aisne River valley. The Caillou-qui-Bique Member crops out in the eponymous locality in the Honnelle River valley, north of Roisin. The Vicht Member crops out in the Vicht River valley southeast of Stolberg in Germany. The section is however discontinuous, and Dejonghe et al. (1991) proposed the section in the Helle River south of Eupen as a parastratotype.

Area and lateral variation. The formation is known all along the northern limb of the Dinant Synclinorium from Roisin to Tilff, along its north-eastern flank up to the Xhoris Fault and in the Vesdre area. South of the Xhoris Fault and up to the Ourthe area south of Hotton, the Hampteau Facies develops than fades away westwards (Dupont, 1885). The Vicht Member is known from the Aachen area (Germany) to Fraipont and in the Theux Window. The proportion of conglomerate is variable and tends to decrease towards the north-east, where the Sainval Facies are almost devoid of coarse-grained lithologies. In Fechereux and in the Ry de Mosbeux, the formation is reduced to a metric bed of conglomerate with quartz pebbles and plant remains (Asselberghs, 1955; Liégeois, 1955). East of Gomzée, the development of the conglomerate increases irregularly. The upper conglomeratic unit (Caillou-qui-Bique Member) tends to individualise west of the Eau d'Heure River valley.

Thickness. More than 500 m thick in the type section (Stainier, 1994b), the formation thickness decreases eastwards: 350 m in the Hoyoux River valley (Mottequin et al., 2021), 240 m in the Amblève River valley (Asselberghs, 1946; Marion et al. in press), 250 m in the Aisne River valley, only 45 m north of the Xhoris Fault, Marion & Barchy, in press, b). In the Vesdre area, the Vicht Member reaches 80 m in Pépinster, and decreases to less than 5 m west of Verviers (Laloux et al., 1996), 2 m in the Theux Window (Marion et al., in press) and only 1.6 m in the Soumagne borehole (Graulich, 1977). In the western part of the Dinant Synclinorium, the thickness also varies considerably: 300 m in the Eau d'Heure River valley (Delcambre & Pingot, 2000a), 200 m in the Honnelle River valley (Hennebert & Delaby, in press), including 30 m for the Caillou-qui-Bique Member (Foucher, 1966).

Age. Up to now, no biostratigraphic element allows to date the Burnot Formation, especially in the stratotypic area (Stainier, 1994b). A late Emsian to early Eifelian age was inferred only through the age of the overlying and underlying formations. The top of the underlying Wépion Formation belongs to the upper Emsian FD Zone (Steemans et al., 2002) and the base of the overlying Rivière Formation yielded conodonts characteristic of the Eifelian *partitus* Zone (Bultynck, 1991a). In Hampteau, some fine-grained beds of the Hampteau Facies yielded miospores indicative of the Pro-Vel Zones suggesting an Eifelian age (Lessuise et al., 1979; Stainier, 1994a). In the Heusy section, shales intercalated within conglomerate beds and above it both yielded palynological assemblages indicative of the Lem Zone, i.e. earliest Givetian (Hance et al., 1992, 1994). In Eupen and Goé, the shaly beds, within and above the conglomerate of the Vicht Member yielded a palynological assemblage devoid of the spore *Geminopsora lemurata*, and therefore is referred to the 'pre-Lem' AD biozone, i.e. latest Eifelian in age (Hance et al., 1994).

Clervaux Formation – CLE

Origin of name. Town of Clervaux in Luxembourg, *Schistes rouges de Clervaux* in Gosselet (1885, p. 269).

Description. The formation starts with olive-green and greyish shale and siltstone with greenish sandstone lenses and beds. The fine-grained lithologies typically have a silk-soft touch. Upwards, the reddish colour appears in the shale, but the sandstone keeps its greenish or greyish colour (Dejonghe, 2020). Härebësch Member – HAR, *Membre de Härebësch* in Dejonghe, 2021, p. 23), and are better individualised in Luxembourg (Dejonghe, 2021). In the upper part of the formation, small limonitic nodules aligned in thin horizons occur. Usually light grey, quartzitic and argillaceous sandstone beds with flaser-bedding occur sporadically and locally (called At the top of the formation, a second package of sandstone beds form a distinct unit called *Quarzites* [sic] *de Berlé* (Gosselet, 1885, p. 265) in Luxembourg, *Koblenzquartzit* or *Emsquartzit* in Germany (Ribbert et al., 1992) and *Quarzites* [sic] *de Traimont* (Gosselet, 1885, p. 293) in Belgium (Ghysel, 2023). These Berlé Quartzitic Beds (called *Q1* in Asselberghs, 1946) are made of lenticular beds of argillaceous and quartzitic sandstone with planar and oblique stratifications, mud chips, dissolved coquinas and bioturbations (Michel et al., 2010). The quartzitic horizon is laterally very discontinuous and, where not developed, the overlying Wiltz Formation rests directly on the Clervaux Formation. Similar quartzitic beds also occur within the upper third of the Clervaux Formation (*Q2* and *Q3* in Asselberghs, 1946).

Stratotype and sections. The section along the road CR325, southwest of the Clervaux town (Luxembourg), offers a good exposure of the formation, including its contact with the underlying Our Formation. The upper part of the Clervaux Formation and the Berlé Quartzitic Beds are exposed along the N10 road, south of the bridge on the Our River at Dasbourg-Pont (Luxembourg). In Belgium, the Clervaux Formation is poorly exposed, but a correct section is situated along the road N848, south of Volaiville, where the quartzites were extracted in small quarries (Ghysel, 2023). The Härebësch Member is exposed in disused quarries along the Wiltz River near Weidingen (Luxembourg, see Dejonghe, 2021).

Area and lateral variation. Neufchâteau–Eifel Synclinorium, east of Ebly and eastwards in Luxembourg and Germany (Eifel). The red colour, dominant in the western part of this synclinorium, tends to fade eastwards where the green colour dominates. The unit is also present in some synclines east of the Stavelot–Venn Inlier near Bullange (Büllingen) and Manderfeld.

Thickness. In the type area, the Clervaux Formation reaches 500 m in thickness. It decreases westwards to c. 200 m at the border between Luxembourg and Belgium and increases eastwards to 700–800 m at the Germany–Luxembourg border (Dejonghe, 2020). The Berlé Quartzitic Beds are 2–5 m thick in Belgium (Ghysel, 2023) and their thickness reaches 8–9 m in Luxembourg.

Age. The Clervaux Formation yielded spores indicative of the FD and AP Zones (Steemans et al., 2000), i.e. middle to late Emsian in age. The Berlé Quartzitic Beds yielded an upper Emsian macrofauna and therefore are equivalent to the upper part of the Clervaux Formation (Asselberghs, 1941).

Remarks. In the German lithostratigraphic terminology, the *Klerf Schichten* (Klerf Beds) cover a wider package of rocks than the Luxembourger and Belgian Clervaux Formation, as this unit covers the shaly upper part of the Our Formation. Recent investigations of the palynological content in Germany confirm that the base of the *Klerf Schichten* might be older (early–middle Emsian, Steemans et al., 2022). Note also that the German stratigraphic commission considers the Berlé Quartzitic Beds as a formation (Jansen, 2016).

Fépin Formation – FEP

Origin of name. From the locality Roches à Fépin, on the eastern flank of the Meuse River valley at Haybes (France), *Poudingue de Fepin* in Dumont (1836, p. 334).

Description. The Fépin Formation groups two units of varying thickness: the basal conglomerate –*poudingues de Fepin* and *poudingue pisaire de Fepin* (Dumont, 1848, p. 88, p. 194), *poudingue de Linchamps* (Gosselet, 1888, p. 207), *poudingue de Tournavaux* (Gosselet, 1888, p. 212), or *Poudingue de Muno* (Lecompte, 1967, pl. 5) – and a sandstone unit, known in the literature as *arkose d'Haybes* (Gosselet, 1884a, p. 194) and *arkose de Haybes* (Renard, 1884, p. 119). The *arkose de Macquenoise* (Picavet et al., 2017, p. 270) (also named the Macquenoise sandstone in Picavet et al., 2018, p. 29) denotes a particular facies of the second unit.

Around the Rocroi Inlier, the formation begins with the Linchamps Conglomeratic Beds, a poorly sorted conglomerate that consists of an argillaceous sandstone matrix enclosing boulders and pebbles of dark quartzitic sandstone and quartz. This basal unit underlines the very irregular surface of the epi-Caledonian unconformity. The conglomerate displays finning-upwards sequences with erosive base. Coarse-grained sandstone, with occasional planar or oblique stratifications, forms meter-thick lenses within the conglomerate. Around the Givonne Inlier, the conglomerate displays less matrix and the boulders are often bound by a siliceous cement.

Upwards, lenses and beds of fine-grained sandstone increase in frequency, passing to the Haybes Member – HAY. The sandstone is greyish or blueish, contains up to 6–10% of feldspar and alternates with dark or greenish sandy shale. The matrix of the coarser-grained facies is often kaolinitic. Shale and sandstone yield rare and poorly preserved fossils (e.g. bivalves, brachiopods). Rare impure limestone forms thin beds locally. Around the Givonne Massif, the upper part of the formation corresponds to the Roche à l'Appel Member – RAA (*Membre de la Roche à l'Appel* in Belanger & Ghysel, 2017b, p. 14), a lenticular unit of dark green quartzitic sandstone with oblique stratifications alternating with argillaceous micaceous sandstone and dark grey shale.

Stratotype and sections. The sections situated near Fépin and Haybes (France) are discontinuous but illustrate the facies variations (Meilliez, 1984, 1989). Godefroid et al. (1982) defined the stratotype of the Fépin Formation in the Lahonry quarry, south of Couvin. The

Linchamps Conglomeratic Beds are defined in the disused quarry at Muno (Godefroid & Cravatte, 1999) whereas the Roche à l'Appel Member is defined in the eponymous locality (Belanger & Ghysel, 2017b).

Area and lateral variation. The Fépin Formation covers the Cambrian and Ordovician rocks of the Rocroi, Givonne and Serpont Inliers. It was mapped along the southwestern digitation of the Stavelot–Venn Inlier but the facies corresponds to the Weismes Member and, therefore, should be included in the Fooz Formation rather than in the Fépin Formation between Dochamps and Manhay and near Harre. The Linchamps Conglomeratic Beds pass to the Quareux Conglomeratic Beds whereas the Haybes Member passes to the lighter-coloured Weismes Member. Meilliez & Lacquement (2006) described very strong variations of facies and thickness in the Fépin locality. Similar variations have been documented in Lahonry (Godefroid et al., 1982) and elsewhere.

Thickness. The conglomeratic part is very variable in thickness, even over very short distances, and strongly depends on the palaeo-topography of the Caledonian basement. It varies from a few metres up to 70 m in Fépin (Meilliez, 1984), but usually c. 20 m in average. The Fépin Formation varies from 20 m on the southern edge of the Rocroi Inlier, to 50 m on its northern edge and on the Givonne Inlier (Belanger & Ghysel, 2017b), to 30 m on the southwestern edge of the Stavelot–Venn Inlier (Dejonghe, 2008; Dejonghe & Hance, 2008). It is missing around the Serpont Inlier. The Roche à l'Appel Member is 0–80 m thick (Belanger & Ghysel, 2017b). The Haybes Member varies in thickness from 0 to a few tens of metres (Meilliez, 1984).

Age. The Fépin Formation, which is younger northwards, yielded a poorly preserved miospore assemblage indicative of the R Zone in Lahonry and of the N Zone in Willerzie (Steemans, 1982a, b, 1989a).

Fooz Formation – FOO

Origin of name. Section located in the Potisseau River valley at Fooz, near Wépion, *Psammites et schistes compactes de Fooz* in Gosselet (1873, p. 5).

Remarks. In the northern areas of the Dinant Synclinorium as well as in the Vesdre and Theux areas, Hance et al. (1992) and Dejonghe et al. (1994e, 1994f) distinguished two formations at the base of the Devonian sequence: the Fooz Formation to the west and the Marteau Formation to the east. Both units display the same dominant siliciclastic facies but differ by their dominant colour. The Fooz Formation is supposed to be greenish whereas the Marteau Formation is supposed to be reddish. Geological mapping of these formations demonstrated that on the one hand red beds exist in the Fooz Formation and on the other hand green or variegated beds are developed within the Marteau Formation. The distinction between the two is therefore only geographical, with the inconvenient that both units were recognised in the Vesdre area (Goé Tectonic Unit, Goemaere et al., 1997). It is here proposed that only one unit should be preserved. *Psammites et schistes compactes de Fooz* is the older designation (Gosselet, 1873). The *Schistes bigarrés et psammites du Marteau* introduced later by Gosselet (1888, p. 258) is therefore a subsequent synonym. However, the *Psammites de Fooz* stricto sensu (i.e. the beds overlying the conglomerate and so-called arkose) form a unit rather well individualised and deserve a formal definition. The Marteau Member is here introduced to cover the fine-grained variegated sandstone unit forming the upper part of the Fooz Formation.

Description. The formation rests unconformably on the lower Paleozoic basement and starts with a conglomerate named Ombret Conglomeratic Beds (*Poudingue d'Ombret* in Gosselet, 1873, p. 19; Mourlon, 1876, p. 327) in western areas and Quareux Conglomeratic Beds (*poudingue de Quarreux* in Gosselet, 1888, p. 253) in eastern areas. Both are characterised by pebble-supported conglomerate with centimetric to decimetric quartz and quartzite pebbles in a very hard greyish to greenish quartzitic matrix. Dark sandstone and tourmalinite pebbles also occur. The conglomerate tends to fade away in some places, passing to coarse-grained sandstone. On the contrary, it locally becomes very coarse-grained with poorly rounded sub-metric blocks (e.g. Ninglinspo River valley). The conglomerates deposited in fluviatile settings (Graulich, 1951; Neumann-Mahlkau, 1970). Note that the Ombret Formation was introduced by Martin et al. (1970) for an Ordovician unit of the Condroz Inlier (see Verniers et al., 2002).

Where developed, the conglomerate passes upwards to light-coloured, kaolinitic coarse-grained sandstone or micro-conglomerate known in the old literature as arkose: e.g. *Arcose von Weims* in Kayser (1870, p. 850), *Arkose de Dave* in Gosselet (1873, p. 5), *arkose de*

Weismes in Gosselet (1888, p. 253, 255), *grès et arkoses de Gdoumont* in Maillieux & Demanet (1929, p. 122, table 2), *arkoses et grès de Gdoumont* in Asselberghs (1943, p. 3). It should be noted that these lithologies are almost devoid of feldspars, but patches of whitish clayey material are mostly composed of weathered slate fragments and less than 5% of weathered feldspars (Michot, 1969). The Weismes Member – WEI is composed of kaolinitic coarse-grained sandstone with few micro-conglomeratic recurrences and siltstone intercalations. Centimetric pyrite cubes are frequent. The siltstone and fine-grained sandstone, beige in colour, have yielded a diverse fauna (brachiopods, corals, bivalves, trilobites) preserved as steinkerns. These facies display a clear marine influence. On the northern flank of the Dinant Synclinorium, they were named *Arkose de Dave* but as the lithologies are similar and the thickness rapidly decreasing westwards, it is preferable to give up this denomination. Note that the name *schistes de Dave* was proposed by Michot (1932, p. B136) for designating a Silurian formation in the Condroz Inlier (see Verniers et al., 2002).

The upper part of the Fooz Formation is largely dominated by variegated fine-grained siliciclastics grouped in the Marteau Member – MAR corresponding to the *Psammites de Fooz* of the literature. Olive-green and variegated fine-grained sandstone, argillaceous or not, and siltstone alternate in the lower part of the member. They are arranged in fining-upward sequences that begin with poorly sorted sandstone with shale clasts and small quartz pebbles, oblique stratifications and lenses, and that end with shale displaying desiccation cracks. The reddish colour progressively appears upwards. The upper part of the member is richer in well-sorted sandstone beds that commonly display coarsening-upward trend and mega-ripples. The numerous horizons with dissolved carbonate nodules (centimetric to decimetric in size) give a cellular aspect to the formation. These nodules are interpreted as concretions within calcrete and are therefore of paedogenetic origin (Stroink & Simons, 1995; Goemaere et al., 1997). Silcretes and ferricretes are also developed (Goemaere et al., 2012). This member reflects the depositional environment of an alluvial plain with braided rivers evolving towards a coastal plain with wandering meanders (Goemaere et al., 1997).

Along the southeastern edge of the Stavelot–Venn Inlier, the Marteau Member displays blueish to purple colour, due to slight metamorphism here named Reinhardstein Facies.

Stratotype and sections. The stratotype designated for the Fooz Formation is situated along the Chevreuils River in Dave (Dejonghe et al., 1994e) where both the lower and upper boundaries are exposed, as well as the Dave Member introduced by Dejonghe et al. (1994e) that included the *Poudingue d'Ombret* and the *Arkose de Dave*. The basal beds are exposed in Ombret (Pierre Falhotte) and in the Amblève River valley in the Fond de Quareux. The type section of the Marteau Member is situated along the Helle River south of Eupen (Dejonghe et al., 1994b) as the historical section in Spa (Marteau locality) is too discontinuous and strongly tectonised. The Weismes quarry and section along the former railway acts as type section for the Weismes Member. The Reinhardstein Facies are exposed in the Warche River valley near the Reinhardstein castle.

Area and lateral variation. The formation is present in the Vesdre area, around the Stavelot–Venn Inlier and the Theux Tectonic Window. It also occurs along the northern limb of the Dinant Synclinorium between Wihéries and Engis, and along its northeastern limb between Tancrémont and Dochamps. The Marteau Member is also recorded in the Theux Tectonic Window and Bolland borehole (Graulich, 1975). The Bois de Chaumont Formation is an equivalent resting locally on the Condroz Inlier north of the Midi Fault.

Age. The base of the formation is diachronous, becoming younger from the south-east to the northwest. Southeast of the Stavelot–Venn Inlier, the Weismes Member, overlying the basal conglomerate yielded brachiopods (e.g. *Quadrifarius dumontianus*, *Shaleria rigida*) indicative of the Přídolí (Boucot, 1960). In the Theux Tectonic Window and Vesdre area, the miospores present in the lower fossiliferous horizon indicate the Lochkovian R to Mα Zones. In the type section at Dave, the oldest beds indicate the Lochkovian Siα Zone, hence a slightly younger age. The age of the upper part varies also from the Lochkovian Siβ Zone in the west, to the G Zone in the east (Steemans, 1989a).

Jupille Member – JUP (La Roche Formation)

Description. East of the Lomme River valley, the upper part of the formation gets richer in lenticular sandstone beds (Barchy & Marion, 2014). In the Ourthe River valley, this unit is better individualised and was described as the Jupille Formation by Dejonghe et al. (2008). However, the impossibility to pinpoint a boundary between the La Roche and the Jupille formations, as well as the very variable development of sandstone make it complicated to separate both lithostratigraphic units. Therefore, we here chose to retrograde the sandy unit to the member level, which is also more concordant with the previous studies (Asselberghs, 1946; Stainier, 1994c). In its stratotype, the Jupille Member is composed of decimetric beds of dark grey to brownish sandstone and siltstone alternating with dark micaceous shale. The sandstone and siltstone beds, which are locally micaceous and bioturbated, display a wide range of sedimentary structures (oblique stratifications, toolmarks, ripples, lenticular bedding, oblique and cross stratifications, load casts, etc.). They typically have a brownish-orange weathering colour due to their limonitic content. In the upper part of the member, the sandstone is slightly arkosic and displays ball-and-pillow structures. Eastwards (Nisramont, Lengeler), the proportion of sandstone decreases, and the dark shale (and slate locally) becomes dominant.

Stratotype and sections. The top of the La Roche Formation and the Jupille Member can be observed along the road N833 from La Roche-en-Ardenne to Hotton, c. 600 m south of Jupille (Dejonghe et al., 2008).

Area and lateral variations. Southern and southeastern limbs of the Dinant Synclinorium from the French border to Amonines. Northwards, the typical facies tend to disappear and there is no trace of them anymore south of the Xhoris Fault (Marion & Barchy, in press, a, b). Locally, sandstone beds are present throughout most of the formation and were mapped as the Jupille Formation, notably in the Lomme River valley (Blockmans et al., 2019) and between the Aisne River and Amblève River valleys (Marion & Barchy, in press, a). In the north-eastern part of the Neufchâteau–Eifel Synclinorium, the La Roche Formation passes to the monotonous slaty facies of the Kautenbach-Troisvierges Formation – the *facies de Saint-Vith* sensu Asselberghs (1927, p. 209, 1946, p. 179) – named *Wüstebach-Formation* on the German territory (Ribbert et al., 1992). In the Neufchâteau–Eifel Synclinorium, the upper part of the La Roche Formation tends to be richer in sandstone and quartzitic sandstone beds, which probably corresponds to the transition to the overlying Our Formation (Brichant, 1928; Brül, 1966).

Thickness. The Jupille Member is very variable in thickness, c. 600 m in Jupille and Nisramont (Dejonghe et al., 2008) but only 250 m in Lengeler and decreases to 0 m in the Grand Duchy of Luxembourg (Dejonghe, 2019).

Kautenbach-Troisvierges Formation – KAT

Origin of name. From the villages of Kautenbach and Troisvierges, in the Wiltz River valley (Luxembourg), *Schistes de Kautenbach* and *Phyllades de Trois-Vierges* in Gosselet (1885, p. 283 and 285, respectively). Both names were associated by Dejonghe et al. (2017, p. 36) to create a single lithostratigraphic unit.

Description. The Kautenbach-Troisvierges Formation is a lateral facies of the La Roche Formation (*facies de Saint-Vith* in Asselberghs, 1927, p. 209, 1946, p. 179) developed east of Wibrin and characterised by a slaty facies. Its lower part is made of homogeneous dark bluish slate that probably corresponds to the expression of the laterally equivalent Martelange Member of the La Roche Formation. Upwards, the slate is richer in thin light grey or greenish sandstone laminae and show the typical *quartzophyllade* facies. Light greenish quartzitic sandstone beds with ripple marks and rare decalcified coquinas occur (*Grès vert du bois de Liherain* in Leblanc (in Asselberghs & Leblanc, 1934, p. 8)). Large pyrite crystals, up to 1 cm wide, often pseudomorphosed into limonite are locally very abundant, especially in the sandstone laminae. The Kautenbach-Troisvierges Formation recorded the deposition of distal turbidites.

Stratotype and sections. Section along the railway in Troisvierges and along the Wiltz River at Kautenbach (Luxembourg). There is no good section exposing these facies in Belgium, but discontinuous outcrops in the western Ourthe River valley, upstream Houffalize, allow to see these facies.

Area and lateral variation. Northeastern part of the Neufchâteau-Eifel Synclinorium, east of Wibrin and towards the Luxembourg where Colbach (2003) named it *Formation de Grumelange* (name abandoned in further publications). In Germany, this slaty unit is named *Wüstebach-Formation* (Ribbert et al., 1992) and *Herdorfer Schichten* in the Eifel Hills (Zitmann & Grünig, 1987).

Thickness. The formation is 1300–1500 m thick in Luxembourg (Dejonghe et al., 2017).

Age. The formation is not dated precisely. As its lateral equivalent (La Roche Formation), it is considered as mostly late Pragian in age.

Laforêt Formation – LAF

Origin of name. From the village of Laforêt, on the western bank of the Semois River valley, *Phyllades de Laforêt sur la Semoy* in Gosselet (1884b, p. 177).

Description. This unit comprises alternations of greenish grey to grey shale and silty to sandy shale, commonly laminar and micaceous, with occasional carbonate nodules that are decalcified and limonitic on the outcrop. Chlorite, pyrite and magnetite crystals of millimetric size are frequent. The shale has a characteristic silky touch. The upper part of the formation displays decimetre- to metre-thick beds of sandstone with micaceous shaly intercalations.

Stratotype and sections. Sections along the left bank of the Semois River, south of Laforêt, complemented by a section along its right bank south of Chairière.

Area and lateral variation. This lithostratigraphic unit is a lateral equivalent of the Sainte-Marie and Saint-Hubert formations. It passes to the former east of the Mogimont Fault near Vivy. Westwards, the Laforêt Formation is traced up to the Meuse River valley near Joigny-sur-Meuse (France) where it disappears under the Jurassic sedimentary cover.

Thickness. At least 300 m in the type area (Belanger & Ghysel, 2017a), 450 m in the French Meuse River valley (Hatrival & Beugnies, 1973).

Age. The Laforêt Formation has not yielded any biostratigraphic elements but by extrapolation with the lateral equivalent Saint-Hubert Formation, it is most probably Lochkovian.

Longlier Formation – LOG

Origin of name. Section along the Namur–Arlon railway line, NNE of the Longlier (Neufchâteau) station, *Quartzophyllades de Longlier* in Asselberghs (1912b, p. B203).

Description. The Longlier Formation is dominated by brownish sandstones that are usually fine-grained, argillaceous and limonitic, and commonly micaceous; they alternate with laminar siltstones (*quartzophyllades*). These sediments are commonly bioturbated. The fossils are abundant and diverse (brachiopods, crinoids, bryozoans, bivalves, ramose tabulate corals) but they are concentrated in lenticular beds. Furthermore, they are usually dissolved and therefore preserved as steinkerns. Westwards, the carbonate content (both bioclasts and calcitic cement) increases, passing to the carbonate facies of the Villé Formation. North-eastwards, the carbonate content virtually disappears, and the sediments tend to become finer-grained, with a larger proportion of siltstone and quartzophyllade, and sandstone beds occur as plurimetric bundles.

Stratotype and sections. The type section, situated along the Namur–Arlon railway north of the Longlier station, was described notably by Asselberghs (1912b, 1913, 1946) and Maillieux (1936). Nevertheless, this outcrop, which exposed the upper part of the formation, has been concealed by infrastructure work to extend the Longlier station (Godefroid, 1994b); nowadays, only a small part of it remains visible around km 160.6 (Ghysel, 2023). Though no section exposes the entire formation, good outcrops are visible in the Ourthe orientale River valley downstream Houffalize (Dejonghe, in press).

Area and lateral variations. The Longlier Formation is recognised in the Neufchâteau–Eifel Synclinorium, east of a line joining Saint-Médard and Cugnon and up to the southeast of the Stavelot–Venn Inlier where it passes to the *Rurberg Schichten* of the German terminology (Ribbert et al., 1992). Along the northern margin of the Neufchâteau–Eifel Synclinorium, east of the Stavelot–Venn Inlier, the formation is not discriminable and is included in the Warche Group. Westwards, the carbonate content increases, and the Longlier Formation passes to the Villé Formation (*facies de Bouillon* in Asselberghs, 1927, p. 210, 1946, p. 143).

Thickness. At least 400 m in the type section, probably thicker eastwards (900 m in Houffalize, Dejonghe, 2019).

Age. The type section yielded an abundant fauna (Maillieux, 1936; Asselberghs, 1946), among which brachiopods are the most diverse. Few of them bears a precise biostratigraphic signal and the Longlier Formation is traditionally considered to be equivalent in age with the Villé Formation. However, based on the presence of *Euryspirifer dunensis* and the absence of *E.* sp.

1 in the stratotype of the Longlier Formation, Godefroid (1994b) suggested correlating the upper part of this section with the La Roche Formation, which would indicate that in the Neufchâteau–Eifel Synclinorium, the boundary between the Longlier and La Roche formations is slightly younger than in the Dinant Synclinorium (see also Godefroid, 2001).

Moulin de la Foulerie Formation – MFL

Origin of name. From the Moulin de la Foulerie on the west bank of the Eau Noire River, south of Couvin (Denayer & Mottequin, this paper).

Remarks. Whereas Tsien (1974) introduced the Bure Formation, composed of two members (Saint-Joseph and Eau Noire members), Bultynck & Godefroid (1974), Bultynck et al. (1982) and Bultynck (1991b, 1991c) considered both members as distinct formations and consequently abandoned the name Bure Formation. In the type area, near Couvin, these members can be separated but eastwards, their lithological composition changes and they are hardly recognisable as separate units. On recent geological maps, they are mostly mapped as a single unit (Saint-Joseph–Eau Noire grouping). Hence it is proposed here to demote the Saint-Joseph and Eau Noire units to members of the newly introduced Moulin de la Foulerie Formation.

On the geological map Chimay–Couvin (Barchy & Marion, 1999) the composition and boundaries correspond to those of the stratotypes but on the neighbouring map Olloy-sur-Viroin–Treignes, a c. 25 m thick carbonate unit (Sohier Beds, see below) was included in the Saint-Joseph–Eau Noire grouping by Dumoulin & Coen (2008) based on lithological similarities. Eastwards, on the maps Sautour–Surice (Dumoulin & Marion, 1997, 1998) and Agimont–Beauraing (Lemonne & Dumoulin, 1998, 1999), the siliciclastic unit identified as the Vieux Moulin Member of the Jemelle Formation (Dumoulin & Blockmans, 2008) was mapped indistinctly with the Eau Noire Formation whereas the lower sandy part of the Saint-Joseph Formation was mapped as the Hierges Formation. On the maps Felenne–Vencimont (Dumoulin & Blockmans, 2013a) and Pondrôme–Wellin (Dumoulin & Blockmans, 2013b), the lower limit of the Saint-Joseph–Eau Noire grouping follows the stratotypic definition and its upper limit still falls at the top of the Sohier Beds. In the Aisne River valley (Villers-Sainte-

Gertrude), the sandy facies dominates and the members cannot be distinguished anymore (Bultynck, 1991b).

Description. The base of the Saint-Joseph Member – STJ (Tsien, 1974) is defined by the first laterally-continuous bed of light grey or bluish argillaceous limestone overlying the siltstone and sandstone of the Hierges Formation. Its passes upwards to a mixed silty and shaly limestone succession including beds of coarse-grained crinoidal limestone commonly rich in crinoids, brachiopods and other bioclasts, often dissolved in surface (*Grauwacke de Bure* in the old literature). A horizon of haematitised bioclasts and oolites occurs in the Lomme River valley (e.g. Denayer et al., 2011). Calcareous sandstone beds still occur sporadically. The top of the member is marked by a 2 m thick limestone bed in the type section. The Eau Noire Member – ENR (Tsien, 1974) consists of greyish and bluish calcareous shale and bioclastic nodular limestone beds. The macrofauna is abundant and diverse (rugose and tabulate corals, brachiopods, trilobites, crinoids). The carbonate content increases upwards, announcing the calcareous Couvin Formation. East of Nismes, the Villers-la-Tour Member of the Couvin Formation disappears but a 10–20 m thick basal carbonate unit remains between the Eau Noire Formation and the Vieux Moulin Member (see Denayer et al., this volume). This unit of argillaceous crinoidal limestone can be traced up to the Jemelle area. The term Sohier Beds was proposed by Denayer (2019) for this unit corresponding to the lithological sub-unit i of Bultynck (1970).

Stratotype and sections. The historical stratotype of the Bure Formation is situated along the disused railway of the Lomme River east of Bure but it is nowadays very overgrown (Godefroid, 1968; Blockmans et al., 2019). The stratotypes of the Saint-Joseph Member in Nismes and Olloy-sur-Viroin have completely disappeared. The best section for the Moulin de la Foulerie Formation and its two members is the section along the west bank of the Eau Noire River, about 100 m north of the foot-bridge south of Couvin near the Moulin de la Foulerie (Bultynck, 1970; Barchy & Marion, 1999).

Area and lateral variations. Southern and south-eastern limb of the Dinant Synclinorium up to the Ourthe River valley. East of the Lomme River valley, the carbonate character of the upper member is less expressed. In the Ourthe River valley, shaly facies are dominant in both members (Lessuise et al., 1979) whereas in the Aisne River alley, sandy facies appear in the

Eau Noire Member. North of Izier, the marine character disappears progressively, and the formation is diluted into the red siliciclastics deposits of the Pepinster Formation.

Thickness. The Moulin de la Foulerie Formation is about 100 m thick between Couvin and Olloy-sur-Viroin (60 m for the Saint-Joseph Member and 40 m for the Eau Noire Member, Marion & Barchy, 1999); further to the east, its thickness increases to a maximum of 320 m in the Wellin–Halma area (Dumoulin & Blockmans, 2013a), and east of this area, it decreases, reaching 100 m at Grupont (Blockmans et al., 2019), 75 m in Jemelle and Marche-en-Famenne, and only 35 m in the Aisne River valley (Lessuise et al., 1979).

Age. The Saint-Joseph and Eau Noire members correspond to the lower Couvinian 'Co1' of the classic literature (i.e. Maillieux, 1912; Bultynck, 1970). The Emsian–Eifelian boundary based on the first entry of the conodont *Icriodus retrodepressus*, a characteristic species of the *partitus* conodont Zone, falls c. 5 m below the top of the Eau Noire Member in its (holo)stratotype (Bultynck et al., 2000). Consequently, the abundant fauna of the Moulin de la Foulerie Formation (e.g. Maillieux, 1938; Tsien, 1969; Godefroid, 1977) is mostly late Emsian in age (*patulus* conodont Zone; Bultynck & Godefroid, 1974; Weddige et al., 1979).

Nonceveux Member – NON (Bois d'Ausse Formation)

Description. Locally, the upper part of the Bois d'Ausse Formation displays a sequential character and was previously considered as a distinct unit, i.e. the Nonceveux Formation (Hance et al., 1992; Dejonghe et al., 1994d). It consists of a succession of thinning-upward sequences, ranging from 1.6 to 15 m in thickness, divided into a lower, light-coloured, sandy part an upper, grey, beige or reddish, silty and shaly one, but with no clear boundary. The base of the sequences is well marked, sometimes erosive and recurrence of sandy and/or silty beds are observed in the fine-grained parts. These lithologies were described as *facies du Bois de Fraipont* by Asselberghs (1946) and individualised as the Nonceveux Formation by Hance et al. (1992), based on the Nonceveux section in the Amblève River valley. Michot (1953) and Monseur (1959) pointed out the rhythmic character of the upper part of the Bois d'Ausse Formation at Huy on the northern limb of the Dinant Synclinorium. On the new geological maps of this part of the Dinant Synclinorium (Mottequin et al., 2021; Delcambre, 2023;

Marion et al., in press), these rhythmical facies were not mapped distinctively. Therefore, it is here considered that they form the of the Bois d'Ausse Formation.

Our Formation – OUU

Origin of name. From the numerous outcrops located in the Our valley at the border between Germany and the Grand Duchy of Luxembourg, Our Formation in Dejonghe et al. (2017, p. 37).

Description. The Our Formation is a thick unit made up of shale, siltstone and sandstone, usually finely micaceous, bluish to greenish-grey, but brownish when weathered. A lower Stolzembourg Member – STO (*Schiefer von Stolzemburg* in Lucius, 1950, p. 10) is dominated by the fine-grained lithologies but sandstone beds occur in the lower part and become more abundant upsection. The sandstone is badly washed, poorly sorted, argillaceous and frequently arkosic. At the base of the member, many horizons with load-casts are present. Some of these structures are up to 50 cm in diameter and affect preferentially the siltstone and fine-grained sandstone (Macar & Antun, 1950). The upper Schuttbourg Member – SCH (*quarzophyllades* [sic] *de Schuttbourg* in Gosselet, 1885, p. 276) is still dominated by the shale and siltstone but sandstone beds become locally very abundant. The former are decimetre- to metre-thick and grouped in bundles of tens to several tens of metres. The sandstone is 'cleaner' than those of the Stolzembourg Member, arkosic or quartzitic, with planar to oblique stratifications and ripples. Decalcified brachiopod coquinas are occasional, plant fragments are less common.

Stratotype and sections. The historical type sections of Schuttbourg (Schüttburg) and Stolzembourg (Stolzemburg) in the Grand Duchy of Luxembourg are not accessible anymore, but Dejonghe (2019) proposed the sections along the Our River between Kalborn (Grand Duchy of Luxembourg) and Burg-Reuland (Belgium). However, none of these sections fully exposes the formation. Its base can be observed in the Reelerfurtbach River valley at Stoubach and its top is exposed along the Our River south of Ouren.

Area and lateral variations. The Our Formation is developed on the north-eastern limb of the Neufchâteau Synclinorium, east of the Troisvierges Fault. Westwards, the Our Formation rapidly loses its sandy facies and is less individualised from the underlying La Roche Formation. These poorly sandy facies were mapped as the *Quartzophyllades de Schüttburg* by Brichant (1928) but were assimilated to the La Roche Formation by Ghysel (2023) and Belanger (in press). Eastwards, in Germany, these lithologies are included in the *Shleiden-Schichten* and the *Wüstebach-Schichten* (Ribbert et al., 1992).

Thickness. Dejonghe (2019) indicates a thickness of 1400 m for the Soltzemburg Member and 1100 m for the Schüttburg Member; therefore, a thickness of c. 2500 m is proposed by this author for the whole formation.

Age. Asselberghs (1932) reported the presence of an invertebrate fauna typical of the lower Emsian in the *Quartzophyllades de Schuttbourg.* In Burg-Reuland, the formation yielded the brachiopods *Arduspirifer antecedens*, *Euryspirifer* cf. *latissimus*, and *Meganteris ovata* indicating the middle to upper part of the Lower Emsian (De Baets et al., 2013).

Ruisseau de la Forge Formation – RDF

Origin of name. From the Ruisseau de la Forge flowing along the Pèrnelle pond section south of Couvin (Denayer & Mottequin, this paper).

Remarks. Godefroid (1994c, d) introduced the Pèrnelle and Pesche formations for two relatively thin units that are poorly outcropping. In the type area, south of Couvin, these units can be separated but eastwards, their lithological composition changes and they are hardly recognisable as separate units. On recent geological maps, they are mostly mapped as a single unit (Pèrnelle-Pesche grouping). Hence it is proposed here to demote the Pèrnelle and Pesche units to members of a newly introduced Ruisseau de la Forge Formation.

Description. The formation begins with the first thick sandstone bed overlying the siltstone of the La Roche Formation. The **Pèrnelle Member – PRN** (*Formation de Pèrnelle* in Godefroid, 1994c, p. 59; *Formation B* in previous papers), in its type area, comprises thickly-bedded greenish-grey and bluish-grey sandstone and quartzitic sandstone, separated by thin dark grey shaly interbeds. Decarbonated coquina beds occurs within the sandstone. Eastwards, the sandstone beds tend to fade out in the lower part of the formation whereas, in the upper part, they are thinner and separated by thicker shaly interbeds (Godefroid et al., 2002;

Blockmans et al., 2019). The last continuous bed of sandstone defines the top of the Pèrnelle Member. The overlying Pesche Member – PES (*Grauwacke, grès et psammite de Pesche et de Grupont* in Maillieux, 1910, p. 217) is composed of grey to bluish-grey shale and siltstone with lenses and beds of bluish sandstone. Many of these sandstone beds are slightly carbonate and contains brachiopods and molluscs shells. Where weathered, the rock is brownish, the fossils dissolved or replaced by limonitic clayey material (*Grauwacke de Grupont* in the literature, Maillieux, 1910, 1940, 1941; Godefroid, 1979). Upsection the fossiliferous horizons are scarcer. The first continuous dark coloured sandstone bed defines the base of the overlying Vireux Formation.

Stratotype and sections. Couvin, along the old tramway trench in the Ruisseau de la Forge River valley, near the Pèrnelle ponds (Godefroid, 1979, 1994c, 1994d).

Area and lateral variation. The formation is present along the southern limb of the Dinant Synclinorium, and eastwards up to the Xhoris Fault, though in this area, it is hardly distinguished from the sandy upper part of the La Roche Formation (Jupille Member). In the vicinity of the Mormont Fault, the Ruisseau de la Forge Formation passes to the Acoz Formation where the reddish colour appears.

Thickness. The formation is 230 m thick in the type section (40 m for the Pèrnelle Member, 190 m for the Pesche Member, Marion & Barchy, 1999) and in the Meuse River valley (60 m for the Pèrnelle Member, Dumoulin & Coen, 2008) and increases to 450 m in the Lesse River and Ourthe River valleys (Blockmans et al., 2019; Dejonghe & Hance, 2008).

Age. Late Pragian to early Emsian at the stratotype (Su Zone). On the base of three species of *Brachyspirifer,* and the occurrence of the conodont *Caudicriodus celtibericus*, the Siegenian (i.e. Pragian)–Emsian boundary was identified in the lower part of the Pesche Member (see 3. Chronostratigraphy of the Lower Devonian).

Sainte-Marie Formation – STM

Origin of name. From the village of Sainte-Marie-Chevigny, *Schistes gris de Sainte-Marie* in Gosselet (1884b, p. 177).

Description. This unit consists of thin-bedded dark grey and bluish siltstone, slate and sandy shale that are usually laminar. The lower part of the formation includes isolated beds or bundles of beds of sandstone and quartzite. The sandstone is light grey and greenish-grey coloured, coarse-grained, micaceous, argillaceous or quartzitic. Oblique laminae and ripple-marks are frequent in the sandstone beds. The fine-grained facies locally include masses of hard silt-sized quartzite with plurimillimetric porphyroblasts of biotite, magnetite, garnet and ilmenite (known as *cornéite* in the old literature, e.g. Stainier, 1907). Carbonate shale and siltstone and shale with decalcified nodules, limonitic or cellular on the outcrop, occur locally. The boundary with the overlying Mirwart Formation is transitional with the progressive disappearance of the biotite and ilmenite and the reappearance of thicker sandstone beds.

Stratotype and sections. There is no continuous section exposing the Sainte-Marie Formation but the typical facies can be observed in the small cliff below the Notre-Dame de Lorette Chapel, north of Remagne. The *cornéite* facies of the Sainte-Marie Formation are well exposed in the La Flèche quarry, northwest of Bertrix.

Area and lateral variations. The Sainte-Marie Formation extends east of the Mogimont Fault near Vivy and north-eastwards up to the Vencimont Fault, south of Saint-Ode. Northwards, it passes to the Saint-Hubert Formation and westwards to the Laforêt Formation.

Thickness. 1400 m in the Haute Lesse River valley (Belanger & Ghysel, 2017a) and c. 2000 m in the Ourthe occidentale River valley (Asselberghs, 1946).

Age. The Sainte-Marie Formation has not yielded any biostratigraphic elements but, by extrapolation with the laterally equivalent Saint-Hubert Formation, it is most probably Lochkovian.

Solières Member – SOL (Acoz Formation)

The Solières Member (*schistes et grès noirs de Solières* in Maillieux & Demanet, 1929, p. 126) is dominated by greyish to bluish shale and siltstone with rare sandstone and quartzitic sandstone interbeds. The reddish colour, though occasional, is not as common as in the other members. Moreover, marine faunas (e.g. brachiopods, bivalves) are locally present (Maillieux, 1931). In the type area, the Solières Member is not intercalated between the Bois d'Ausse and Acoz formations as previously suggested by Hance et al. (1992) but entirely bracketed by the red siliciclastics of the Acoz Formation (Delcambre, 2023). The upper boundary is defined below the first sandstone and quartzitic sandstone of the Wépion Formation.

Staneux Quartzitic Beds (Wépion Formation)

In the Theux Windows, a unit of whitish coarse-grained quartzitic sandstone with thin shaly interbeds develops laterally to the sandstone of the Wépion Formation. It is here named Staneux Quartzitic Beds (*Grès de Staneux* Asselberghs, 1954 p. 106).

Warche Group – WCH

Origin of name. After the Warche River valley upstream of the Robertville dam (Denayer & Mottequin, this paper).

Remark. The Warche Group is introduced to gather lithological units that are very similar, hardly distinguished in the field, and usually regrouped as 'Mirwart–Villé–La Roche' in the geological maps covering the north-eastern limb of the Neufchâteau–Eifel Synclinorium south-east of the Stavelot–Venn Inlier, particularly between Monschau and Gouvy. Note that Anthoine (1940b, p. M43) introduced the term *Quartzite vert poundiguiforme de Warche intraformationnel* as a part of the *Quartzite de Planche*, both being nowadays included in the Cambrian Hour Formation.

Content. From the base to the top, this group includes the Mirwart Formation (particularly the Anlier Facies), the Longlier Formation, the La Roche Formation and its equivalent Kautenbach-Troisvierges Formation. On the German territory, the group would correspond to the Monschau, Rurberg and Wüstebach formations (Ribbert et al., 1992), i.e. the *Siegen-Stufe* of the classical German literature.

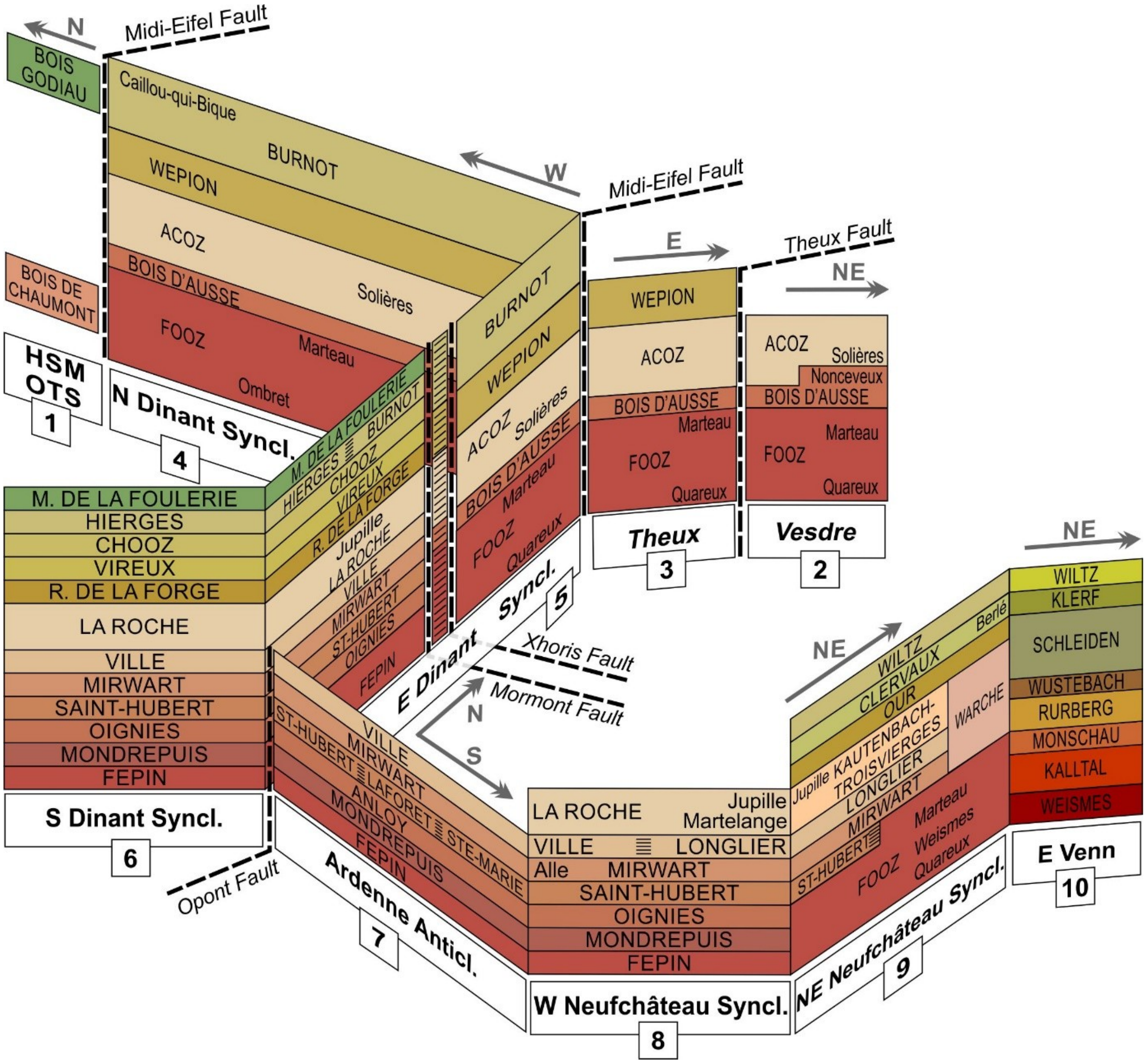

Figure 1. Schematic vertical and lateral relationships of the Lower Devonian units of Belgium. Abbreviations: Anticl.: Anticlinorium, Syncl.: Synclinorium, CQB: Caillou-qui-Bique Member, KAT: Kautenbach-Troisvierges Formation, LAF: Laforêt Formation, PTT: Petites Tailles Formation, SOL: Solières Member, STH: Saint-Hubert Formation, STM: Sainte-Marie Formation. 1: Haine-Sambre-Meuse overturned thrust sheets, 2: Vesdre area, 3: Theux Window, 4: northern limb of the Dinant Synclinorium, 5: eastern limb of the Dinant Synclinoirum, 6: southern limb of the Dinant Synclinorium, 7: Ardenne Anticlinorium, 8: western part of the Neufchâteau Synclinorium, 9: northeastern part of the Neufchâteau Synclinorium, 10: eastern side of the Stavelot-Venn Inlier.

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