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Lower Devonian lithostratigraphy of Belgium

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ABSTRACT

The revision of the lithostratigraphic scale of southern Belgium, based on the revised Geological Map of Wallonia and recent stratigraphic and sedimentological works lead to the re-definition of 79 lithostratigraphic units for the Lower Devonian Series. Most of the units described in the present paper are classical subdivisions of the lithostratigraphic scale but updates on their definition, boundaries and age are provided here. New terms are introduced for remarkable beds and facies. Groups are introduced to gather formations than are rarely separated on geological maps whereas some units previously described as formations are here retrograded to members. The dominant lithologies of the Lower Devonian of Belgium reflect siliciclastic sedimentation in various depositional settings ranging from fluviatile conglomerate to estuarine and deltaic sandstone, tidal siltstone and distal delta-front shale on the southern margin of the London–Brabant Massif and around other Caledonian inliers (e.g. Rocroi, Stavelot–Venn). The vertical succession and lateral correlation of the lithostratigraphic units allow to reconstruct the evolution of the shallow basin from the latest Silurian (Pridoli) to the latest Emsian.

KEYWORDS

Lochkovian,
Pragian,
Emsian,
Gedinnian,
Siegenian,
lithology

Article history

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1. Introduction

Since the pioneer works of Dumont (1832, 1848), Dewalque (1868) and Gosselet (1885, 1888), the Devonian lithostratigraphic scale of Belgium was built up patiently through dating and correlations. The geological mapping program of the national territory in the late 1800s and early 1900s produced a stratigraphic framework characterised by its precision and the continuous updating of the legend of the *Carte géologique de la Belgique à l'échelle du 40 000e* from 1892 to 1929 (e.g. Conseil de Direction de la Carte, 1892; Conseil géologique, 1929). The fundamental monograph by Asselberghs (1946), which represents the culmination of his research on the Lower Devonian of southern Belgium, was the authoritative work for decades, before being adapted by Godefroid (1982) and Godefroid & Stainier (1982). The onset of the revision of the geological maps of Wallonia in the early 1990s, coupled to the works of the National Subcommission on Devonian Stratigraphy, led to the revision by Godefroid et al. (1994) of the Lower Devonian of the Vesdre area, the Theux Window and the Dinant Synclinorium. However, as the latter focused only on the northern part of the basin, the lithostratigraphical scheme of most of the Ardenne was not revised and, consequently, Asselberghs (1946) remained the only comprehensive reference. However, during the mapping of the Ardenne in the frame of the revised Geological Map of Wallonia, the mapping geologists had to introduce several new units to supplement Godefroid et al.'s (1994) lithostratigraphic framework and to update Asselberghs (1946). This has been done through the publication of the explanatory booklets of the geological maps, followed by their ratification by the National Commission for Stratigraphy in Belgium.

Attention is drawn here on the fact that the Lower Devonian lithostratigraphic units are still facing a lot of uncertainties due to 1) the lack of good continuous sections exposing vertical and lateral transition between formations, 2) the monotony of some facies, 3) the thickness of some units, reaching often several hundreds of metres, and 4) the lack of biostratigraphic markers allowing precise correlations between units.

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The present paper aims at updating and supplementing the Lower Devonian lithostratigraphic scale previously published by Godefroid et al. (1994) and summarised by Bultynck & Dejonghe (2002). This update is the result of a review of the tremendous work carried out by the geological cartographers and stratigraphers who have worked on the considered stratigraphic interval.

2. Geological setting

The Lower Devonian covers large parts of southern Belgium and surrounding areas (Rhenish Massif, Eisleck in northern Luxembourg, French Ardennes) where it generally corresponds to densely forested high lands. In the Ardenne Allochthon, which corresponds to a Cambrian–Ordovician basement unconformably overlain by a thick Devonian and Carboniferous succession (Hance et al., 1999), these Lower Devonian formations crop out along the northern, south-eastern and southern limbs of the Dinant Synclinorium, as well as in the Ardenne Anticlinorium and the Neufchâteau–Eifel Synclinorium (Fig. 1). Lateral changes of facies in the lithostratigraphic units occur between the main structural units and are traditionally associated to major faults such as the Xhoris Fault and Midi–Eifel Thrust Fault (Fig. 1). However, as observed by Asselberghs (1946) and confirmed by recent geological mapping, the facies changes are more progressive and 'transitional zones' between facies are frequent. Such a transitional zone occurs along a c. 5 km wide corridor south of the Xhoris Fault. There, the Lower Devonian formations progressively change from the facies known along the southern limb of the Dinant Synclinorium to those known along its northern flank. However, the points where each formation passes to the other vary and can even be repeated. According to Marion & Barchy (in press, a, b), the change from the Mirwart Formation to the Bois d'Ausse Formation is observed c. 1 km south of the Mormont Fault, then, north of this fault, the Mirwart Formation is again recognisable then passes again to the Bois d'Ausse Formation. From there up to the Xhoris Fault, the characteristics of both formations are observed. Hence, to simplify, the Xhoris Fault is here cited as marking the change from one formation to the other.

Some Lower Devonian formations also crop out in the Theux Window (and Bolland drillhole) and in a series of small outliers resting on the Haine–Sambre–Meuse Overturned Thrust sheets (Belanger et al., 2012) (Fig. 1). No Lower Devonian rock is known neither in the Brabant Parautochthon nor in the Campine Basin.

3. Chronostratigraphy of the Lower Devonian

Traditionally, the thick Lower Devonian sequence was divided into Gedinnian, Siegenian and Emsian stages in Belgium and surrounding areas. Theses subdivisions were mostly based on the lithology (shaly versus sandy) and the macrofaunal assemblages, notably those based on brachiopods (Bultynck, 1972). In this respect, the reader is referred to Godefroid et al. (1994, figs 4–6) for the history of the Lower Devonian subdivisions in the Dinant Synclinorium and the Vesdre area. Following the decision of the Subcommission on Devonian Stratigraphy (Bassett, 1985), the Gedinnian and Siegenian,

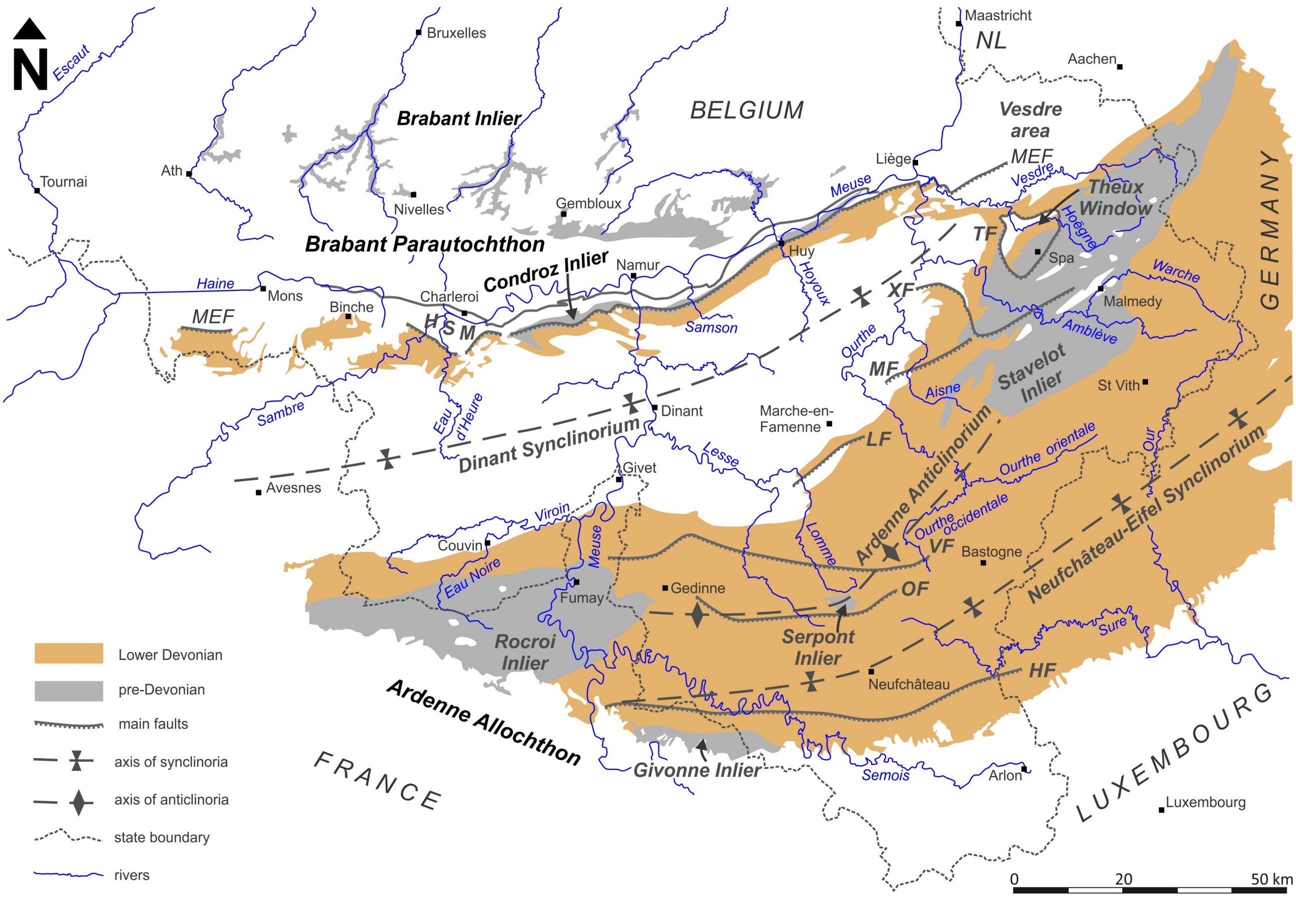

Figure 1. Simplified geological map of the Lower Devonian of southern Belgium and neighbouring countries, with indication of the main structural units, including the Caledonian inliers (adapted from de Béthune, 1954). Abbreviation: HSM, Haine–Sambre–Meuse Overturned Thrust sheets. Major fault abbreviations: HF, Herbeumont Fault; LF, Lamsoul Fault; MF, Mormont Fault; MEF, Midi–Eifel Thrust Fault; OF, Opont Fault; VF, Vencimont Fault; TF, Theux Fault; XF, Xhoris Fault.

which have poorly defined biostratigraphic limits, were abandoned and replaced by the Lochkovian and Pragian stages, whereas the Emsian got a new definition (Fig. 2). The formal definition of these stages is based on the first appearance data of planktic graptolite and conodont taxa. However, planktic graptolites are unknown from the Pridoli–Lower Devonian of Belgium and conodonts are mostly absent from this interval; therefore, it is impossible to precisely recognise the international divisions. The palynostratigraphic succession established by Steemans (1989a) in the Ardenne can be correlated with the Armorican Massif where spores occur together with chitinozoans. Fortunately, the chitinozoan biozones are also known in the Bohemian Massif where the Lochkovian and Pragian stages are defined. The cross-correlation spores/chitinozoans/conodonts allows to localise roughly the boundaries within the Belgian Lower Devonian succession.

The base of the Lochkovian is defined by the first appearance datum (FAD) of the graptolite *Monograptus uniformis uniformis*, very close to the FAD of the conodont *Caudicriodus woschmidti woschmidti* (Martinsson, 1977). Both taxa being absent in the Ardenne, the correlation is made through the spores found in the Fépin Formation that indicate the N zone of the MN Oppel zone (Steemans, 1989a). The latter is close to the Silurian–Devonian boundary. *Caudicriodus woschmidti woschmidti* recovered from the Naux Limestone in the French Semoy River valley (Borremans & Bultynck, 1986) also suggests that the base of the Devonian sequence in the Ardenne is situated in an undifferentiated late Pridoli–early Lochkovian interval (Fig. 3). On the south-eastern flank of the Givonne Inlier (Fig. 1), the Mondrepuis Formation yielded a diverse brachiopod fauna including the athyridide *Dayia shirleyi* that is a typical Pridoli taxon (Godefroid, 1995; Godefroid & Cravatte, 1999). Therefore, the base of the former Gedinnian stage (Dejonghe et al., 2006) and the base of the Devonian sequence in the Ardenne is most probably still in the Silurian System as suggested by Bultynck (1977) and Borremans & Bultynck (1986) (see discussion in Godefroid & Cravatte, 1999).

The base of the Pragian is defined by the FAD of the conodont *Eognathus sulcatus* but, as recent taxonomic revisions showed that typical forms are known below the Global Boundary Stratotype Sections and Point (GSSP) level in the type locality (Slavík & Hladil, 2004), this marker cannot be used anymore to define the base of the stage (Becker et al., 2020). According to Steemans (1989a), the base of the Pragian cannot be properly defined by spores as the current boundary falls within the E interval Zone. This zone is recognised in the uppermost part of the Saint-Hubert Formation in the Pèrnelle pond section, south of Couvin, and within the lower part of the Mirwart Formation in the Arville section, west of Saint-Hubert (Godefroid et al., 1994). In proximal areas, the spores demonstrate the diachronism of the lithological units historically used for the definition of the Gedinnian–Siegenian boundary (Steemans, 1989a; Hance et al., 1992).

The current GSSP for the base of the Emsian is defined by the FAD of the conodont *Polygnathus kitabicus* (*Eocostapolygnathus kitabicus* sensu Bardashev et al., 2002). However, this boundary falls much lower than the base of the Emsian in the classical regions of Germany (Jansen, 2016, 2019) and Bohemia (Slavík et al., 2007). Hence, the base of the Emsian is currently under revision by the Subcommission on Devonian Stratigraphy. The GSSP-defined Pragian–Emsian boundary is not recognised in Belgium as the conodont markers are lacking (Bultynck et al., 2000). The brachiopod *Arduspirifer latestriatus prolatestriatus* (Fig. 3F), which is known from the upper part of the La Roche Formation, also occurs in Spain in beds yielding the conodont *Caudicriodus celtibericus*, a secondary marker of the base of the Emsian (Carls, 1987; Jansen, 2016). Therefore, following this cross-correlation, the Pragian–Emsian boundary lies in the upper part of the La Roche Formation (Figs 2, 3).

In Germany, however, the 'traditional' base of the Emsian (i.e. 'Siegen-Ems' boundary sensu Solle, 1950) is based on the appearance of the brachiopod *Brachyspirifer minatus* (Fig. 3I) (Jansen, 2016) that is coincident with the boundary between the Ulmen and Singhofen groups (Fig. 2). At the same level Riegel & Karathanasopoulos (1982) documented the first occurrence of the miospore *Emphalisporites annulatus*. *Brachyspirifer minatus* occurs in the lower part of the Pesche Member in the Pèrnelle pond section (Godefroid & Stainier, 1982), together with *E. annulatus* (Steemans et al., 2002). The traditional Siegenian–Emsian boundary should consequently be localised near the base of the Pesche Member. It must be noted that the German stratigraphers tend to come back to the historical Siegenian–Emsian boundary in the Rhenish Massif for pragmatic reasons (Jansen, 2016). In parallel, the Subcommission on Devonian Stratigraphy is currently examining the possibility to re-define the base of the Emsian with the FAD of the conodont *Eolinguipolygnathus excavatus* morphotype 114 that is relatively close to the historical Siegenian–Emsian boundary (Carls et al., 2008; Becker et al., 2020).

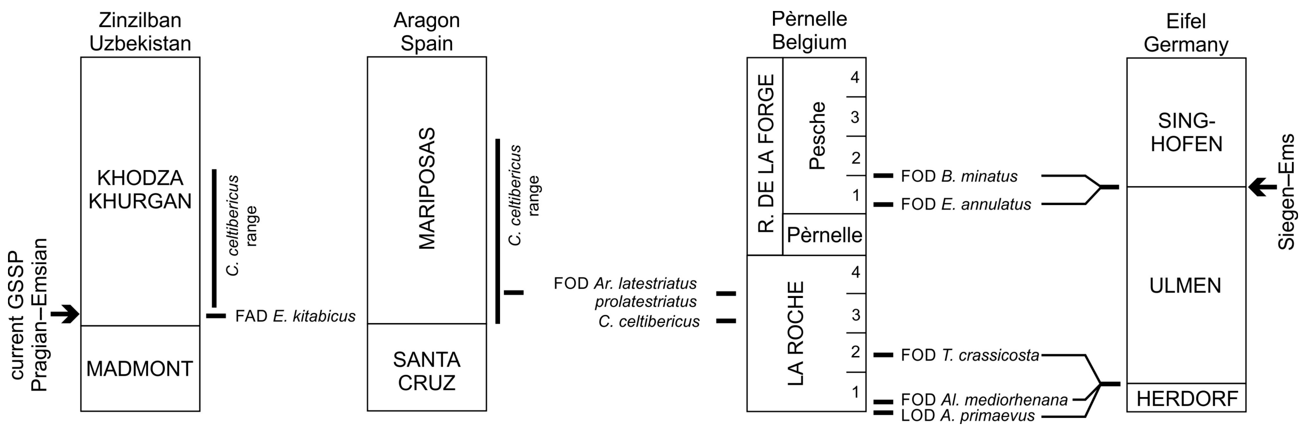

Figure 2. Correlation of the Pragian–Emsian boundary and Siegen–Ems boundary in Uzbekistan (GSSP), Spain, Belgium and Germany. Conodont and brachiopod data after Godefroid (1982), Carls & Valenzuela-Ríos (1993), and Bultynck et al. (2000). Abbreviations: *A.*, *Acrospirifer*; *Al.*, *Alatiformia*; *Ar.*, *Arduspirifer*; *B.*, *Brachyspirifer*; *C.*, *Caudicriodus*; *E.*, *Eocostapolygnathus*; FOD: first occurrence datum; R., Ruisseau; *T.*, *Torosospirifer*.

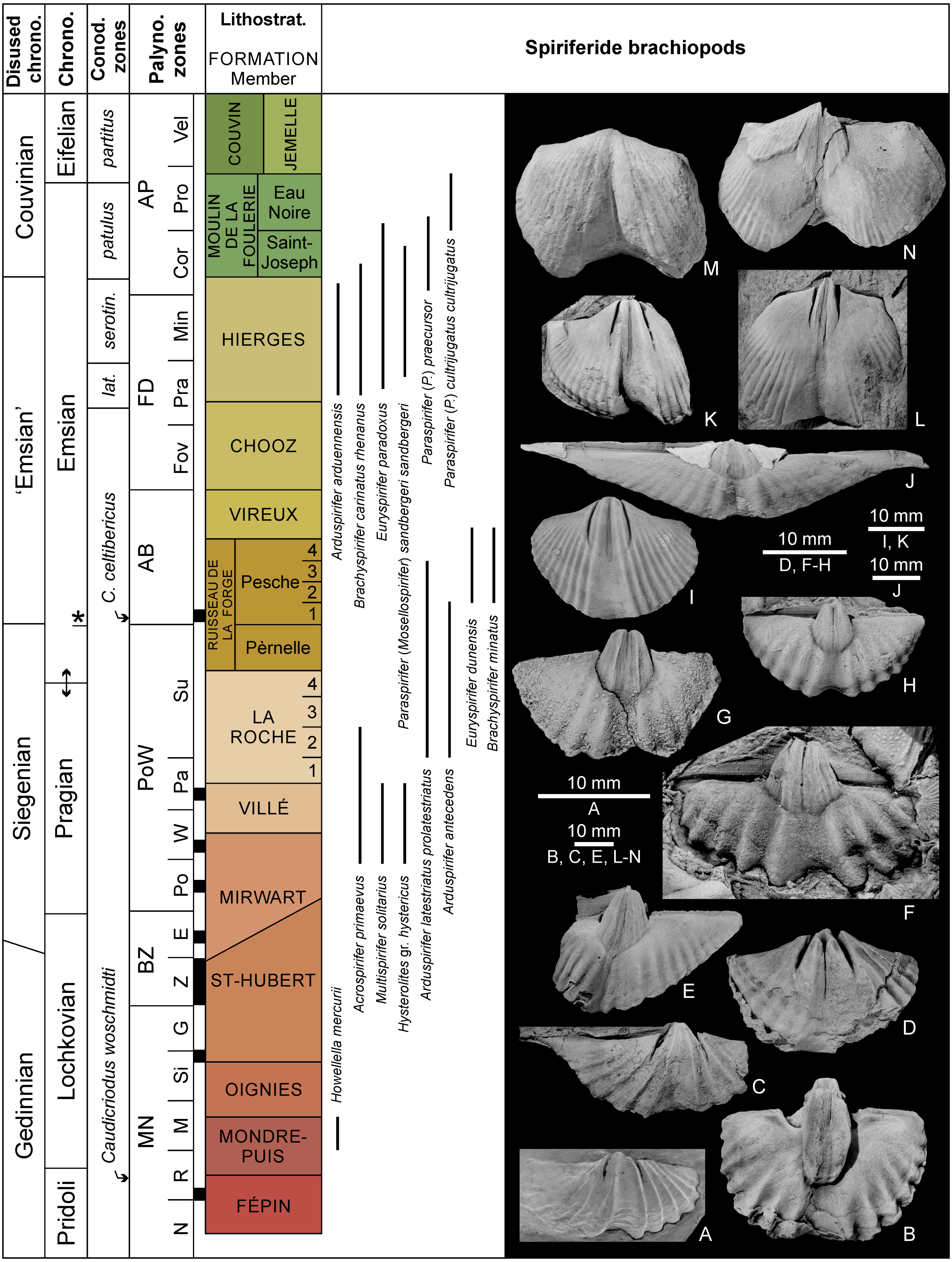

Figure 3. Biostratigraphic zonations (conodonts, miospores) of the Lower Devonian succession on the southern and south-eastern limbs of the Dinant Synclinorium (southern Belgium) and range of selected spiriferides (compilation from Godefroid & Stainier, 1982; Steemans, 1989a; Godefroid et al., 1994; Bultynck et al., 2000; Godefroid, 2001). The asterisk indicates the possible revised base of the Emsian Stage, under discussion among the Subcommission on Devonian Stratigraphy of the International Commission on Stratigraphy (see Becker et al., 2020). Conodont zones: *lat.*, *laticostatus*; *serotin.*, *serotinus*. Other abbreviations: chrono., chronostratigraphy; lithostrat., lithostratigraphy; palyno, palynological. Black boxes represent the palynomorph-yielding samples (see Steemans, 1989a) and insight on the precision of the correlations. Numbers 1 to 4 in La Roche Formation and Pesche Member are the lithological units described by Godefroid (1979). **A–N.** Spiriferide brachiopods from the Lower Devonian of Belgium. All specimens were coated with ammonium chloride (except otherwise stated) and are part of the palaeontological collections of the Royal

(continued on next page)

4. Geochronology of the Early Devonian

The Early Devonian extends from c. 419.0 Ma to c. 394.3 Ma and is subdivided into three ages: Lochkovian (c. 419.2 Ma to c. 412.4 Ma), Pragian (c. 412.4 Ma to c. 410.5 Ma), and Emsian (c. 410.5 Ma to c. 394.3 Ma) (Becker et al., 2020).

5. Biostratigraphy of the Lower Devonian

As exposed earlier, the conodont biostratigraphy has a poor resolution in the Lower Devonian of Belgium, carbonate facies being very rare (Bultynck et al., 2000). A biostratigraphy based on spiriferide brachiopods has been applied in the marine facies but again, the distribution of the taxa along the sedimentary sequence is very scarce and discontinuous, and it does not allow accurate divisions (Godefroid et al., 1982; Godefroid, 1994a, 2001; Godefroid et al., 2002). Moreover, a revision of the representatives of some genera (e.g. *Arduspirifer*) is needed (Mottequin & Jansen, in press). The most stratigraphically significant taxa are given in Figure 3.

The palynostratigraphic scale, which was developed by Steemans (1989a) and Steemans et al. (2002), yielded rather good results in more proximal settings and allows long-distance correlations with the Rhenish, Bohemian and Armorican massifs. However, it has to be noted that the palynological record is scarce as well. As pointed out by Steemans (1989a), a very small fraction of the Lower Devonian lithological succession, over 8 km thick, yielded miospore assemblages. The biostratigraphic correlations presented here (Fig. 3) should therefore be used considering this relative precision.

6. Evolution of the Namur–Dinant Basin during the Early Devonian

The Namur–Dinant Basin belongs to the passive margin of the Laurussian continent during the Early Devonian. Its Cambrian–Silurian basement is visible in the Caledonian massifs (also called inliers) of Belgium, namely the London–Brabant Massif, north of the basin, and the Rocroi, Givonne, Serpont, and Stavelot–Venn inliers in its southern part, whereas the Ordovician–Silurian Condroz Inlier occupies an intermediate position (Figs 1, 4, see also Mottequin & Denayer, 2024). From the Pridoli (latest Silurian) onwards, coarse, immature siliciclastic sediments resulting from the erosion of these massifs accumulated over a large area. The conglomerate marking the base of the transgression consists of superposed debris-flows in an alluvial-lagoonal setting (Meilliez, 1984). It fills palaeo-depressions where the basement was not entirely peneplaned (Michot, 1969). The sediment sources are variable and the transportation seemingly limited judging by the similarity of the elements of the conglomerate and the rocks of the aforementioned massifs (Neumann-Mahlkau, 1970). Sediments directly overlying the conglomerate yield Pridoli marine fauna in the Ardenne (Muno, Waimes), whereas north of the Rocroi and Stavelot–Venn inliers the facies are more proximal, and the microflora suggest a Lochkovian age (Steemans, 1982a, b). Based on these diachronous ages, Steemans (1989b) and Godefroid & Cravatte (1999) reconstructed the transgression northwardly onto the basement from the south-east, south-west, and south.

By the end of the Lochkovian, finer-grained sediments deposited on coastal setting in the northern part of the basin. The more open-marine environments observed in the Ardenne Anticlinorium and Neufchâteau Synclinorium progressed northwards during the Pragian and reached the northern edge of the Stavelot–Venn Inlier and the Condroz Inlier (Fig. 4). The increasing marine nature of the facies, with occasional carbonate, reflects a northwards-southwards deepening (Blieck et al., 1988; Godefroid et al., 1994). In the southern part of the basin, rapid increases in thickness of the deposit suggest the structuration into several sedimentation areas with distinct subsidence rate. The interplay of ENE-WSW-oriented faults defines compartments of a half-graben deepening southwards, in a general extensive tectonic context (Meilliez et al., 1991).

The Emsian records the return of coarse-grained siliciclastic sediments in the northern part of the basin (Fig. 5). The reddish-coloured conglomerates show a resumption of erosion on the continent during a particular lowering of the sea level. In the southern part of the basin and eastwards, towards Luxembourg and Germany, considerably thick shallow-water siliciclastics accumulated (Dejonghe et al., 2017). In the southern area, sedimentation under marine influence continued during the Emsian through the rest of the Devonian but in the northern area, the conglomeratic Burnot Formation marks the end of the Lower Devonian sedimentation (Fig. 5), with probable depositional hiatus and erosional event.

Pridoli–Lower Devonian succession, considered as the post-Caledonian molasse, reaches a total thickness of 1500 m and nearly 5000 m in the northern and southern parts of the basin (Asselberghs, 1946), respectively.

Figure 3 (continued)

Belgian Institute of Natural Sciences (prefixed RBINS). **A.** *Howellella mercurii*, internal mould of a ventral valve (RBINS a556; neotype); Mondrepuis (France), Mondrepuis Formation (SEM; from Mottequin, 2019). **B.** *Acrospirifer primaevus*, ventral view of a flattened articulated internal mould (RBINS a14017); La Roche-en-Ardenne, Villé Formation. **C.** *Multispirifer solitarius*, incomplete internal mould of a ventral valve (RBINS a1946); Dochamps, Villé Formation. **D.** *Hysterolites* gr. *hystericus*, ventral view of an articulated internal mould (RBINS a1991); Harzé, Solières Member. **E.** *Euryspirifer dunensis*, incomplete internal mould of a ventral valve (RBINS a7903); Grupont, Pesche Member. **F.** *Arduspirifer latestriatus prolatestriatus*, internal mould of a ventral valve (RBINS a7913b); Grupont, Pesche Member. **G.** *Arduspirifer antecedens*, internal mould of a ventral valve (RBINS a2912); Couvin, La Roche Formation. **H.** *Arduspirifer arduennensis arduennensis*, internal mould of a ventral valve (RBINS a1317); Rochefort, Hierges Formation. **I.** *Brachyspirifer minatus*, internal mould of a ventral valve (RBINS a2150; holotype); Pèrnelle pond, Pesche Member. **J.** *Euryspirifer paradoxus*, internal mould of a ventral valve with shelly remains (RBINS a7882); Couvin, Hierges Formation. **K.** *Brachyspirifer carinatus rhenanus*, incomplete internal mould of a ventral valve (RBINS a2196); Couvin, Hierges Formation. **L.** *Paraspirifer* (*Mosellospirifer*) *sandbergeri sandbergeri*, internal mould of a ventral valve (RBINS a1357); Couvin, Hierges Formation. **M.** *Paraspirifer* (*Paraspirifer*) *praecursor*, ventral valve (RBINS a1358); Nismes, Saint-Joseph Member. **N.** *Paraspirifer* (*Paraspirifer*) *cultrijugatus cultrijugatus*, internal mould of a ventral valve with shelly remains (RBINS a1324); Couvin, Eau Noire Member.

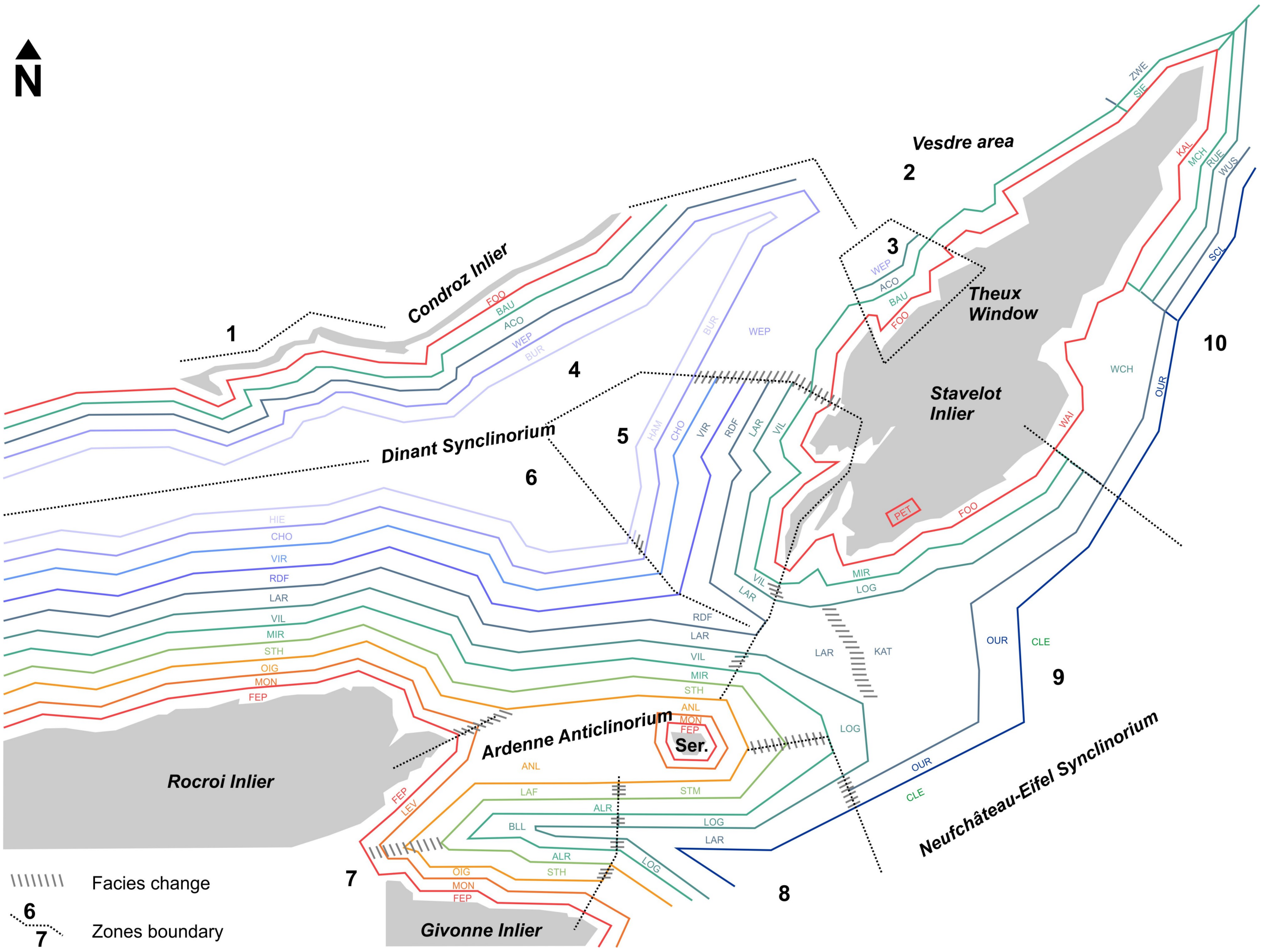

Figure 4. Simplified map (not to scale) showing the distribution of the Caledonian inliers, south of the Brabant Massif, and the main sedimentation areas of the Lower Devonian of southern Belgium and neighbouring countries (modified after Asselberghs, 1946 and updated). 1, Haine–Sambre–Meuse Overturned Thrust sheets; 2, Vesdre area; 3, Theux Window; 4, Northern limb of the Dinant Synclinorium; 5, Eastern limb of the Dinant Synclinorium; 6, Southern limb of the Dinant Synclinorium; 7, Ardenne Anticlinorium; 8, Western part of the Neufchâteau–Eifel Synclinorium; 9, North-eastern part of the Neufchâteau–Eifel Synclinorium; 10, German Venn area. See Fig. 5 for details on the lithostratigraphic succession. Abbreviations of the lithostratigraphic units: ACO, Acoz Formation; ALR, Anlier Facies (Mirwart Formation); ANL, Anloy Formation; BAU, Bois d'Ausse Formation; BLL, Bouillon Facies (Villé Formation); BUR, Burnot Formation; CHO, Chooz Formation; CLE, Clervaux Formation; FEP, Fépin Formation; FOO, Fooz Formation; HAM, Hampteau Facies (Burnot Formation); HIE, Hierges Formation; KAL, *Kaltall-Formation*; KAT, Kautenbach–Troisvierges Formation; LAF, Laforêt Formation; LAR, La Roche Formation; LEV, Levrézy Member (Mondrepuis Formation); LOG, Longlier Formation; MCH, *Monschau-Formation*; MIR, Mirwart Formation; MON, Mondrepuis Formation; MUN, Muno Facies; OIG, Oignies Formation; OUU, Our Formation; RDF, Ruisseau de la Forge Formation; RUE, *Rurberg-Formation*; SCL, *Schleiden-Formation*; SER, Serpont Inlier; SIE, *Siegen-Formation*; STH, Saint-Hubert Formation; STM, Sainte-Marie Formation; PET, Petites Tailles Formation; VIL, Villé Formation; VIR, Vireux Formation; WCH, Warche Group; WAI, Waimes Member (Fooz Formation); WEP, Wépion Formation; WIL, Wiltz Formation; WUS, *Wüstebach-Formation*; ZWE, *Zweifal-Formation*.

7. Lower Devonian lithostratigraphic units

7.1. Preliminary remarks

All the lithostratigraphic units (Fig. 6) are listed alphabetically as a lexicon, notwithstanding their age and geographic distribution. The reader is referred to the Figures 1–6 for further information concerning the latter data.

We have indicated the oldest references, which may explain certain discrepancies between the present work and previous ones (Godefroid et al., 1994; Bultynck & Dejonghe, 2002), as is the case for the Fépin Formation. A history of the subdivisions of the Lower Devonian of the Dinant Synclinorium and the Vesdre area was provided by Godefroid et al. (1994) and complements those published by Asselberghs (1946), Godefroid (1982), and Godefroid & Stainier (1982) that also dealt with the units present outside the aforementioned areas.

Most of the descriptions provided in this chapter are synthetised from previous publications such as the abovementioned lithostratigraphic charts, complemented by more recently published data, notably from the revised Geological Map of Wallonia (*Carte géologique de Wallonie*). To be coherent with the latter, new names are proposed here for units that were previously grouped for mapping purposes. The Pèrnelle and Pesche formations are thus demoted here as members of the newly introduced Ruisseau de la Forge Formation as is the case of the Saint-Joseph and Eau Noire formations that are considered here as members of the newly introduced Moulin de la Foulerie Formation, whereas the Warche Group is introduced in this paper to designate the informal grouping of the Mirwart, Villé and La Roche formations (see details below). However, as some informal groupings used on several sheets of the Geological Map of Wallonia are the result of the lack of outcrops (e.g. *Regroupement Mirwart-Villé* in Marion & Barchy, 1999, or

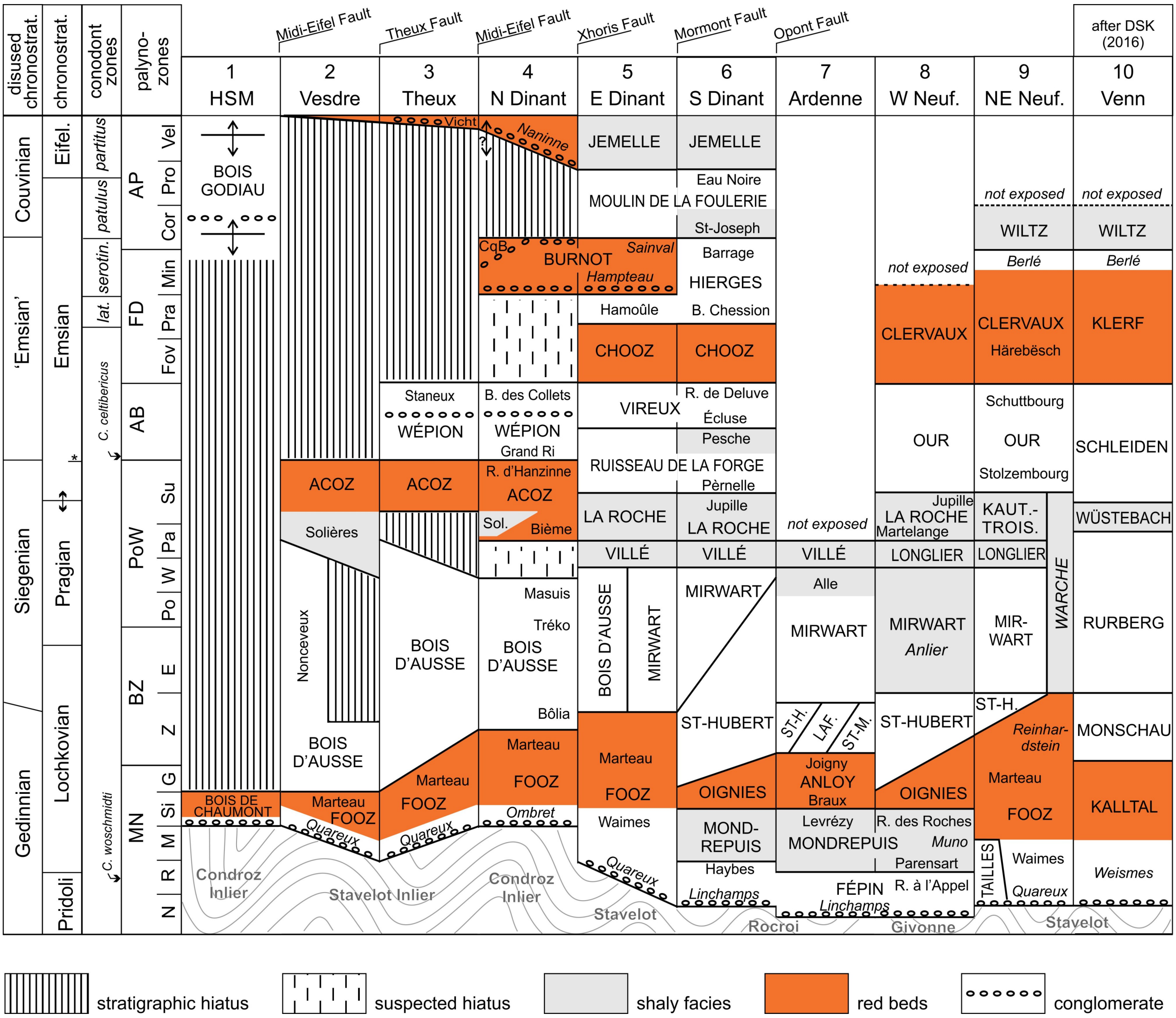

Figure 5. Chronostratigraphic chart of the Lower Devonian strata of Belgium and its correlation with the charts of Germany and central Europe (origin of data: see main text). Formations are indicated in capital letters, members in regular letters whereas remarkable beds and facies are indicated in italics. The asterisk indicates the possible revised base of the Emsian Stage, currently under discussion among the Subcommission on Devonian Stratigraphy of the International Commission on Stratigraphy (see Becker et al., 2020). Conodont biozonation after Slavík (2004) and Carls et al. (2007); palynozones after Streel et al. (1987); German succession (no. 10) after Deutsche Stratigraphische Kommission (DSK, 2016). Abbreviations: B. Chession, Bois Chession Member; B. des Collets, Bois des Collets Member; CqB, Caillou-qui-Bique Member; disused chrono., disused chronostratigraphy; HSM, Haine–Sambre–Meuse Overturned Thrust sheets; KAUT.-TROIS., Kautenbach–Troisvierges Formation; LAF., Laforêt Formation; Neuf., Neufchâteau–Eifel Synclinorium; R. à l'Appel, Roche à l'Appel Member; R. d'Hanzinne, Ruisseau d'Hanzinne; R. de Deluve, Ruisseau de Deluve; R. des Roches, Ruisseau des Roches Member; Sol., Solières Member; ST-M., Sainte-Marie Formation; ST-H., Saint-Hubert Formation; TAILLES, Petites Tailles Formation.

Regroupement Acoz-Wépion-Burnot in Mottequin et al., 2021) rather than natural stratigraphic groups, they have not been formalised.

Units undistinguishable in the field or bearing distinct names in separate areas are also synonymised (e.g. Marteau and Fooz formations, Burnot and Hampteau formations, etc.) after thoughtful discussion and argumentation. Informal members (e.g. *Arkose d'Haybes*, *Arkose de Waismes*, etc.), remarkable beds (e.g. *Poudingue de Quareux*, *Quartzite de Berlé*, etc.) and facies (e.g. Paliseul Facies, Anlier Facies, etc.) are also introduced with formal definitions. As far as possible, existing names were retained unless they were confusing or already in use for other units. For example, the *Arkose de Dave* has not been transformed into a Dave Member as an eponymous formation is already used in the lower Paleozoic lithostratigraphic chart.

7.2. Descriptions

Acoz Formation – ACO

Origin of name. Section on the eastern flank of the Bième valley (also named Ruisseau d'Hanzinne), between Acoz and Bouffioulx, *Cb2 Schistes rouges et grès roses d'Acoz* in Conseil de Direction de la Carte (1892, p. 228). The same year, de Dorlodot (1892, p. 306) introduced the *schistes siliceux et grès d'Acoz*.

Description. The Acoz Formation is dominated by reddish-coloured siliciclastics. Its base is defined by the first occurrence of reddish siltstone and argillaceous sandstone beds overlying the light-coloured quartzite of the Bois d'Ausse Formation. In its type area, the Acoz Formation is divided into two members, from base to top: the **Bième Member – BME** (*Membre de la Bième*, Dejonghe et al., 1994a, p. 121) dominated by dark

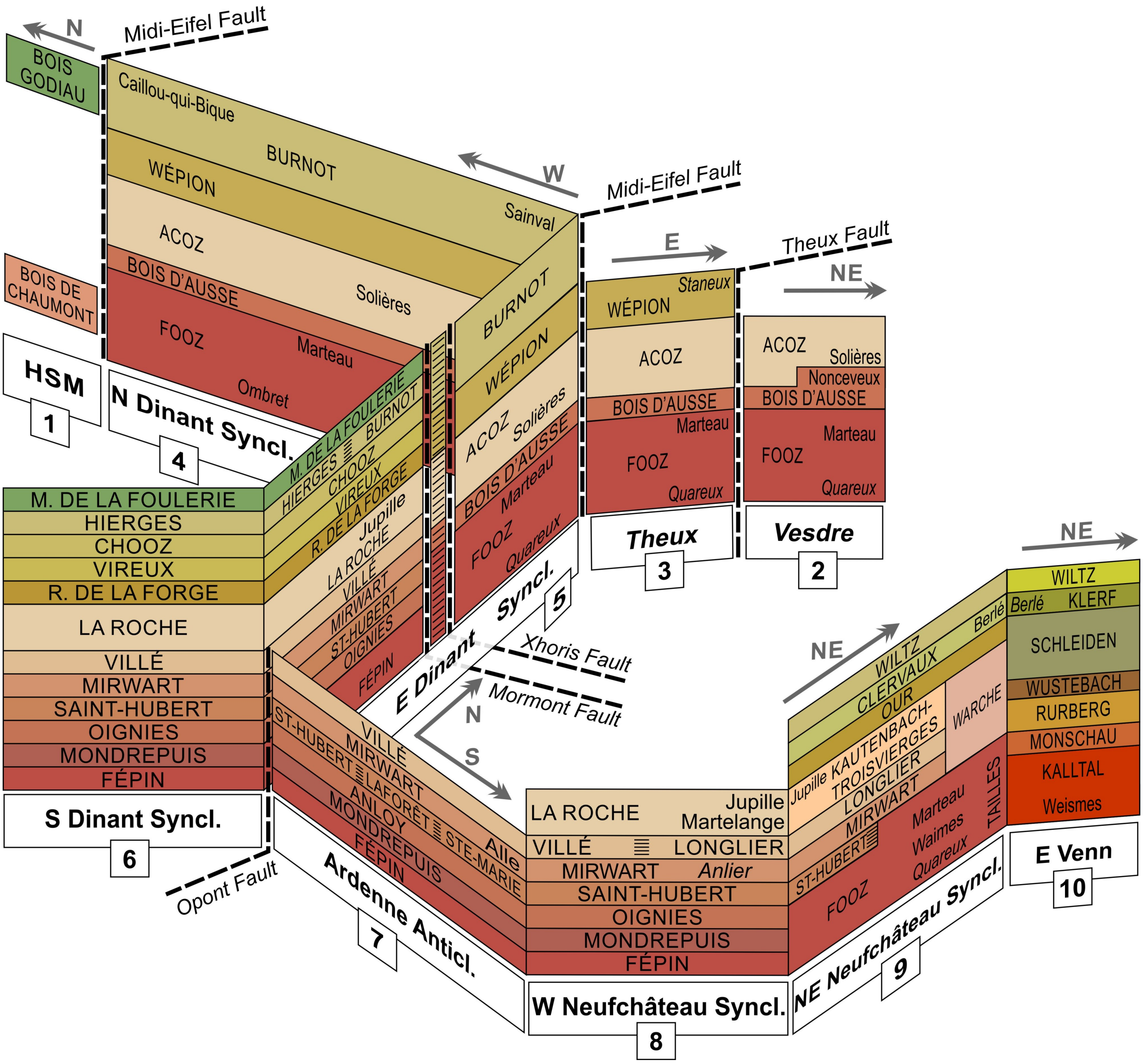

Figure 6. Schematic vertical and lateral relationships of the Lower Devonian units of Belgium. Formations are indicated in capital letters, members in regular letters whereas remarkable beds and facies are indicated in italics. Abbreviations: Anticl., Anticlinorium; HSM, Haine–Sambre–Meuse Overturned Thrust sheets; M. DE LA FOULERIE, Moulin de la Foulerie Formation; R. DE LA FORGE, Ruisseau de la Forge Formation; Syncl., Synclinorium. Numbers 1 to 10 refer to the sedimentation zones defined in Fig. 4. German succession (column 10) after Deutsche Stratigraphische Kommission (2016).

reddish siltstone and shale, and the **Ruisseau d'Hanzinne Member – RHZ** (*Membre du Ruisseau d'Hanzinne*, Dejonghe et al., 1994a, p. 121) enriched upwards in reddish sandstone and metric to plurimetric beds of light-coloured quartzite, and associated with greenish, pinkish or yellowish siltstone and shale (Fig 7A). Quartzite beds contain red shaly pebbles.

Laterally, a shaly unit appears eastwards and was named the Solières Formation (Hance et al., 1992; Dejonghe et al., 1994b). It was mapped as such in the Vesdre area (Laloux et al., 1996) and on the eastern margin of the Dinant Synclinorium by Marion et al. (in press) but, as its development is very limited, it was considered as a member of the Acoz Formation by Delcambre & Pingot (2018). The **Solières Member – SOL** (*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 (Fig. 7B). 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; Mottequin & Jansen, in press). 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.

Stratotype and sections. The Acoz Formation, and the Bième and Ruisseau d'Hanzinne members are exposed on the eastern side of the Hanzinne River (also named Bième River), between the disused quarries of the Bois de Châtelet and the Bois d'Acoz. The Solières Member was defined in a small quarry situated north of the eponymous village (Fourmarier, 1912) but a parastratotype was proposed by Monseur (1959) on the right bank of the Amblève River valley, north of Nonceveux.

Area and lateral variations. The Formation is present along the northern and north-eastern limbs of the Dinant Synclinorium and in the Vesdre area but, in the latter region, the Bième and

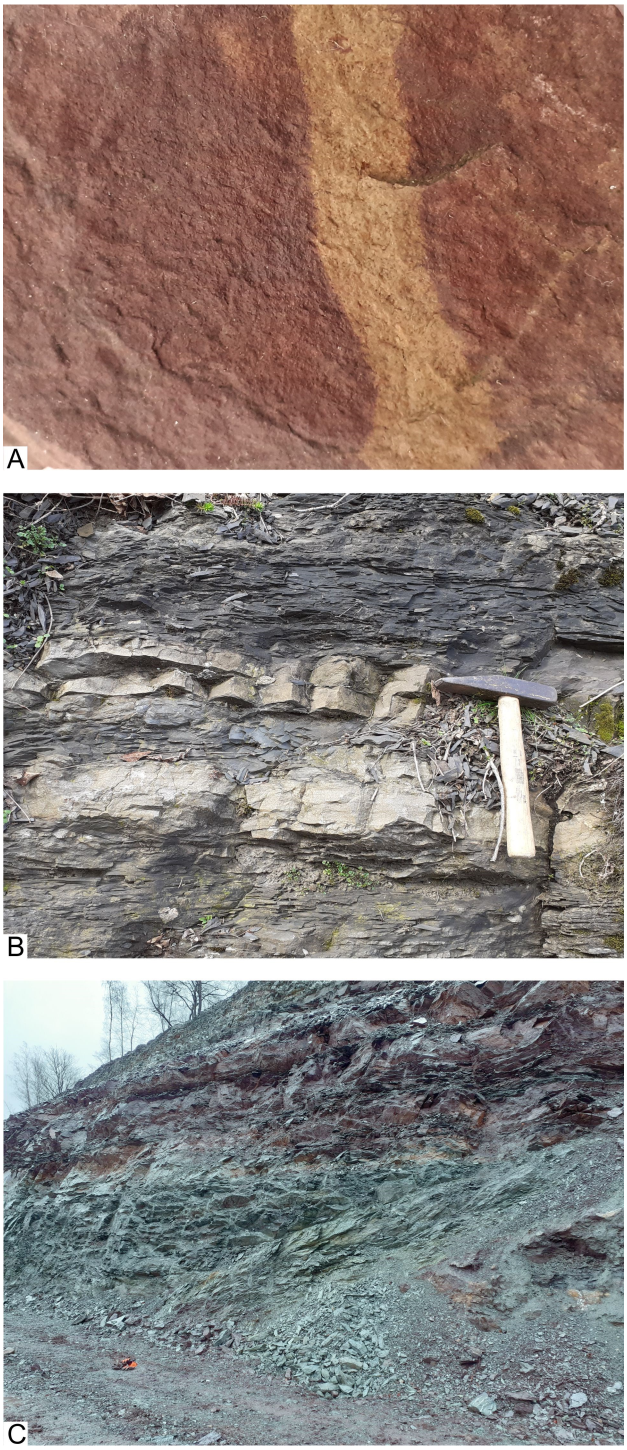

Figure 7. Illustration of some Lochkovian units. **A.** Reddish silty sandstone with yellowish stains (dolomitic material) of the Acoz Formation. Hand sample from the Hoyoux River valley (width of the picture c. 5 cm). **B.** Black shale and siltstone of the Solières Member of the Acoz Formation. Section along the Amblève River at Nonceveux. **C.** Transition from the green shale of the Saint-Hubert Formation to the purple siltstone of the Anloy Formation. Section along the railway south of Poix-Saint-Hubert station.

Ruisseau d'Hanzinne members are not recognised, as light-coloured quartzite beds already occur in the lower part of the Formation. The Solières Member is known east of the Samson River valley, and only individualised from place to place on the northern flank of the Dinant Synclinorium. The Acoz Formation is also recorded in the Bolland borehole (Graulich, 1975).

Thickness. The Formation is 300 m thick west of the Meuse River valley (140 m and 160 m for the Bième and Ruisseau d'Hanzinne members, respectively) and up to 400 m thick east of this valley (Delcambre & Pingot, 2000a, 2017). In the Vesdre area, the thickness depends on the reworking induced by the overlying Eifelian conglomerate (Vicht Formation, see Denayer et al., 2024) and varies from 250 m in Eupen, 50 m in Pepinster and 0 m in Heusy (Dejonghe et al., 1994a). The Solières Member is 125 m thick in the Amblève River valley, 130 m in the Hoyoux River valley (where it was merged with the Bois d'Ausse Formation by Mottequin et al., 2021) and less than 50 m at Solières (Dejonghe et al., 1994b; Delcambre, 2023).

Age. Pragian. Steemans (1989a) attributed the Acoz Formation to the Pa to Su zones in the Dinant Synclinorium and to the E to Su zones in the Vesdre area, suggesting a younger age eastwards.

Use. The quartzitic sandstones were locally used for building purposes.

Main contributions. Asselberghs (1946), Monseur (1959), Steemans (1989a), Hance et al. (1992), Dejonghe et al. (1994a, 1994b).

Alle Member – ALL

See Mirwart Formation.

Anlier Facies

See Mirwart Formation.

Anloy Formation – ANL

Origin of name. After 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 (Fig. 7C).

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, becoming 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 (Fig. 8A). 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

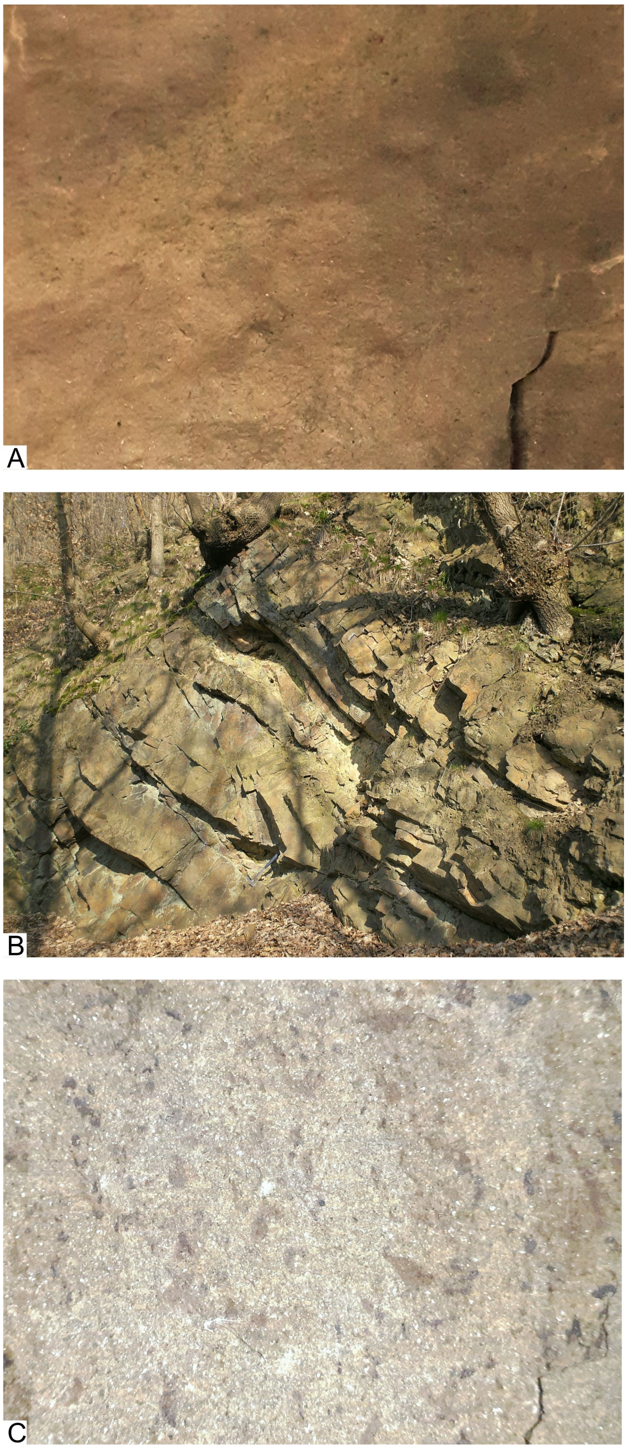

Figure 8. Illustration of some Lower Devonian units. **A.** Variegated siltstone of the Joigny Member of the Anloy Formation, section along the Meuse River at Joigny (France). Hand sample (width of the picture c. 5 cm). **B.** Massive sandstone beds with oblique stratification typical of the Bois d'Ausse Formation. Faubourg Sainte-Catherine, Huy in the Hoyoux River valley (courtesy of Jean-Marc Marion). **C.** Arkosic sandstone with fragments of fossil plants, Massuis Member of the Bois d'Ausse Formation. Hand sample from the Meuse River valley (width of the picture c. 8 cm).

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).

Stratotype and sections. The historical outcrops along the disused vicinal railway along the Lesse River, north of Anloy, can be completed by the railway section, immediately south of the Poix-Saint-Hubert station. The type sections of the *Quartzophyllades de Braux* and *Schistes de Joigny* are situated on the western bank of the Meuse River valley between Joigny and Braux (France). In Belgium, the Braux Member is exposed in the disused quarries along the road N973, north-west of Bohan. The Joigny Member crops out along the road parallel to the Semois River north of Membre.

Area and lateral variations. 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 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 south-west of Petit-Fays and up to Arreux (France) where it disappears below the Jurassic cover. The Joigny Member is only developed between Bohan and Carlsbourg. Eastwards, it cannot be distinguished from the rest of the Anloy Formation.

Thickness. The Anloy Formation reaches 1100 m in thickness in the Semois River valley (Belanger & Ghysel, 2017a) and decreases eastwards to c. 900 m near the Serpont Inlier (Beugnies, 1983). In their type area, the Braux and Joigny members are respectively 80 m and 400 m thick (Belanger & Ghysel, 2017a, b).

Age. The Anloy Formation has not yielded any biostratigraphic elements, so its Lochkovian age is extrapolated from the lateral equivalent Oignies Formation.

Use. The sandstone beds were locally used for building purposes.

Main contributions. Gosselet (1888), Asselberghs (1940, 1946), Beugnies (1983), Hatrival & Beugnies (1973).

Barrage Member – BAG

See Hierges Formation.

Berlé Quartzite

See Clervaux Formation.

Bième Member – BME

See Acoz Formation.

Bois Chestion Member – BCS

See Hierges Formation.

Bois d'Ausse Formation – BAU

Origin of name. Section along the Namur–Arlon railway line through the crossing of the Bois d'Ausse close to Sart-

Figure 9. Illustration of some Lower Devonian units. **A.** Siltstone-sandstone alternations typical of the Nonceveux Member of the Bois d'Ausse Formation. Section along the Amblève River at Nonceveux. **B.** Typical facies of the Burnot Formation. Section along the Hoyoux River at Régissa (Marchin). **C.** Sequential deposits of red sandstone, siltstone and dolomitic shale in the Sainval Facies of the Burnot Formation. Sainval section in the Ourthe River valley north of Tilff.

Bernard, *Grès du bois d'Ause* in Gosselet (1873, p. 19). D'Omalius d'Halloy (1868, p. 514) mentioned the *Bois d'Ose* south of Namur where the sandstones of the *Système du Grès de Montigny* are particularly well developed.

Description. The Bois d'Ausse Formation starts with the first grey, blue-grey or light-coloured quartzitic sandstone beds that overlie the green or variegated sandstone and siltstone of the Fooz Formation (Fig. 8B). The contact with the red facies of the overlying Acoz Formation is also clear-cut. Three members were defined in the Tréko River valley by Dejonghe et al. (1994c, p. 107), but their lateral extension seems to be limited, and their distinction is not possible eastwards in the Hoyoux River valley. These are, from base to top: the Bôlia, Tréko and Masuis members (*Membre de Bôlia*, *Membre du Tréko*, *Membre des Masuis* in Dejonghe et al., 1994c, p. 107). The **Bôlia Member – BOL** is characterised by thick beds of grey to grey-green quartzitic sandstone, usually arkosic, rich in cross-stratifications that are separated by thin beds of green to green-blue siltstone and shale. Its top includes a plurimetric unit of olive-green sandstone. The **Tréko Member – TRK**, consists of alternating thin beds of green sandstone and siltstone, reminiscent of the Fooz Formation (Delcambre & Pingot, 2014). The **Masuis Member – MAS** comprises lenticular beds of light grey to grey-beige quartzitic sandstone and arkosic sandstone that are separated by centimetric to decametric beds of grey shale. Some of the quartzite beds include shaly pebbles and plant fragments (Fig. 8C).

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, and an upper, grey, beige or reddish, silty and shaly one, but with no clear boundary (Fig. 9A). The base of the sequences is well marked, sometimes erosive and recurrences 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 **Nonceveux Member – NON** of the Bois d'Ausse Formation.

Stratotype and sections. As the historical Sart-Bernard section is incomplete and poorly exposed nowadays, Dejonghe et al. (1994c) proposed the Tréko River valley section at Vitrival as the stratotype that can be complemented by that of the Chevreuils River valley at Dave where the lowermost part of the Formation is better exposed. The type section of the Nonceveux Member is located on the right bank of the Amblève River valley, north of the eponymous village.

Area and lateral variations. The Bois d'Ausse Formation is recognised on the northern and eastern flanks of the Dinant Synclinorium and in the Vesdre area, from Wiheries to Eupen. It is also recorded in the Bolland borehole (Graulich, 1975). The Nonceveux Member exists along the eastern limb of the Dinant Synclinorium (north of the Xhoris Fault), and in the Vesdre area. The Nonceveux Member is also recorded in the Bolland borehole (Graulich, 1975).

Thickness. It is highly variable: 200–300 m south of Binche (Hennebert & Delaby, 2017), 150–170 m in the Bième River valley at Acoz (Delcambre & Pingot, 2000b), 100 m at the stratotype (Dejonghe et al., 1994c), more than 300 m in the Meuse River valley (Delcambre & Pingot, 2017), c. 300 m in the Hoyoux River valley (Mottequin et al., 2021), and 35 m in the Vesdre area (Hance et al., 1992). The Nonceveux Member is 110 m thick at the stratotype (Hance et al., 1992; Dejonghe et al., 1994d), 100–120 m thick at Pepinster (Laloux et al., 1996) and thins out westwards.

Age. Based on palynology, Steemans (1989a) suggested a Lochkovian to late Pragian age for the Bois d'Ausse Formation, which spans the interval of the Siβ Zone to the Su Zone. In Huy, the shale of the Nonceveux Member yielded an assemblage indicative of the Paα Zone (Dejonghe et al., 1994d) whereas in Pepinster, the upper Lochkovian Z Zone is recorded. Hence the Nonceveux Member displays a diachronic age and becomes younger westwards (Steemans, 1989a).

Use. This unit has been intensively quarried for granulate and building stone production.

Main contributions. Bataille (1924), Asselberghs (1946), Michot (1953, 1969), Monseur (1959), Steemans (1981, 1989a), Hance et al. (1992), Dejonghe et al. (1994c, 1994d), Goemaere et al. (2012).

Bois de Chaumont Formation – BCH

Origin of name. Section located in the Bois de Chaumont south-east of the village of Presles, *Formation du Bois de Chaumont* in Delcambre & Pingot (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 & Pingot (2014). In the meantime, the latter author 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 variations. 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 is 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.

Use. Very locally quarried as a building stone (Delcambre & Pingot, 2014).

Main contributions. Lassine (1914), Fourmarier (1919), Michot (1928), Steemans (1994), Delcambre & Pingot (2014).

Bois des Collets Member – BCO

See Wépion Formation.

Bois Godiau Formation – BGD

Origin of name. Section at the Bois Godiau (or Godeau) locality, south of Bouffioulx, *Formation de Bois Godiau* in Delcambre & Pingot (2000b, p. 17).

Description. The Bois Godiau Formation is a thick conglomerate with centimetre- to decimetre-sized pebbles of quartz, quartzite and dark slate embedded in a reddish sandstone or argillaceous sandstone matrix. This conglomerate rests unconformably on the Silurian basement.

Stratotype and sections. Western bank of the Bième River valley, south of Bouffioulx near the Bois Godiau locality.

Area and lateral variations. The Formation is only known from the type locality situated in the Haine–Sambre–Meuse Overturned Thrust sheets, i.e. north of the Midi–Eifel Fault. It could be an isolated outlier of the Rivière Formation (Middle Devonian).

Thickness. Unknown with accuracy as only a couple of metres crop out in the type locality.

Age. Late Emsian or Eifelian. Up to now, no dating element has been found in the conglomerate. Based on the facies, de Dorlodot (1890, 1893) correlated it with the Naninne Conglomerate of the Middle Devonian Rivière Formation (see Denayer et al., 2024).

Use. Nil.

Main contribution. Delcambre & Pingot (2000b).

Bôlia Member – BOL

See Bois d'Ausse Formation.

Bouillon Facies

See Villé Formation.

Braux Member – BRO

See Anloy Formation.

Bure formation

Disused unit, see Moulin de la Foulerie Formation.

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 in the literature) conglomerate bed overlying the greenish sandstone of the Wépion Formation (Fig. 9B).

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-

Figure 10. Illustration of some Lower Devonian units. **A.** Conglomerate with greenish-grey matrix of the Hampteau Facies of the Burnot Formation. Neolithic megaliths at Wéris. **B.** Caillou-qui-Bique Rock in the Honnelle River valley, Caillou-qui-Bique Member of the Burnot Formation. **C.** Red siltstone of the Chooz Formation. Section along the Viroin River at Vireux (width of the picture c. 4 cm).

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 (Fig. 9C). 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., 1991, p. 87) that is here considered as a local member (**Vicht Member – VIC**, see Figs 9–10 in Denayer et al., 2024). 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., 1991). The Vicht 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 (Fig. 10A).

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** (Fig. 10B) 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 Pepinster 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 north-eastern part of the Dinant Synclinorium. As a consequence of this age getting younger north-eastwards, 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 Member 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 (N92) 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 south-east 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 variations. 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 then 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 is 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 Pepinster, 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, 1996). 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., 1996).

Use. The coarse-grained sandstone was used during the Neolithic for the millstone production (Picavet, 2015). Massive blocks of conglomerate have been used in the Neolithic for the erection of the famous megaliths around Wéris. In more recent times, the rocks were used for building purposes and for the roadbeds.

Main contributions. Gosselet (1873), Bayet (1894), Anthoine (1919), Van Tuijn (1927), Asselberghs (1946), Asselberghs (1955), Liégeois (1955), Foucher (1966), Kasig & Neumann-Mahlkau (1969), D'Heurs (1970), Breil-Schollmayer (1989), Hance et al. (1989, 1992, 1996), Dejonghe et al. (1991), Stainier (1994a, b), Laloux et al. (1996), Neumann-Mahlkau & Ribbert (1998), Corteel et al. (2004).

Caillou-qui-Bique Member – CQB

See Burnot Formation.

Chaieneu member

Disused member of the former Hampteau formation, now integrated into the Burnot Formation.

Chooz Formation – CHO

Origin of name. After the village of Chooz, located in a meander of the Meuse River (France), d^{2c} *Schistes rouges de Chooz* in Gosselet (1882, unpaginated explanatory booklet).

Description. The Chooz Formation, initially called *roches rouges de Vireux* by Gosselet (1868) (more or less equivalent to the *Grès, et schistes rouges de Winenne* introduced by the Conseil de Direction de la Carte, 1892, p. 228), is essentially made of red and green shale (enclosing centimetre- to decimetre-thick beds of similarly coloured quartzite) that alternate with red and green sandy units that can reach several metres in thickness.

In the Meuse River valley, Godefroid & Stainier (1994a) distinguished two subunits. The lower one (c. 50 m thick) comprises argillaceous or quartzitic sandstone occurring as thick masses separated by red and green, rarely grey, shale and siltstone (Fig. 10C). The lower sandstone includes some thin carbonate horizons and yielded some terebratulide brachiopods, bryozoans and bivalves. The upper subunit is much thicker (270–280 m) and consists of red and green shale and siltstone that incorporate beds or lenses of similarly coloured sandstone up to 10–14 m thick.

Stratotype and sections. Disused Mont Vireux quarry on the left bank of the Meuse River at Vireux-Molhain (France) for the contact with the underlying Vireux Formation; Vireux-Molhain–Mazée road (D47), west of the crossroads with the Givet road (RN51), for the contact with the overlying Hierges Formation (Godefroid & Stainier, 1988; Godefroid & Stainier, 1994a).

Area and lateral variations. South and south-eastern flanks of the Dinant Synclinorium up to the Xhoris Fault. In the Ourthe River valley and eastwards, the Chooz Formation is overlain by the conglomerate of the Hampteau Facies of the Burnot Formation. In this area, the first conglomeratic bed, rather than the last red-coloured bed, is used to define its top.

Thickness. It ranges between 320 and 330 m in the Meuse River valley (Godefroid & Stainier, 1988) and to the west

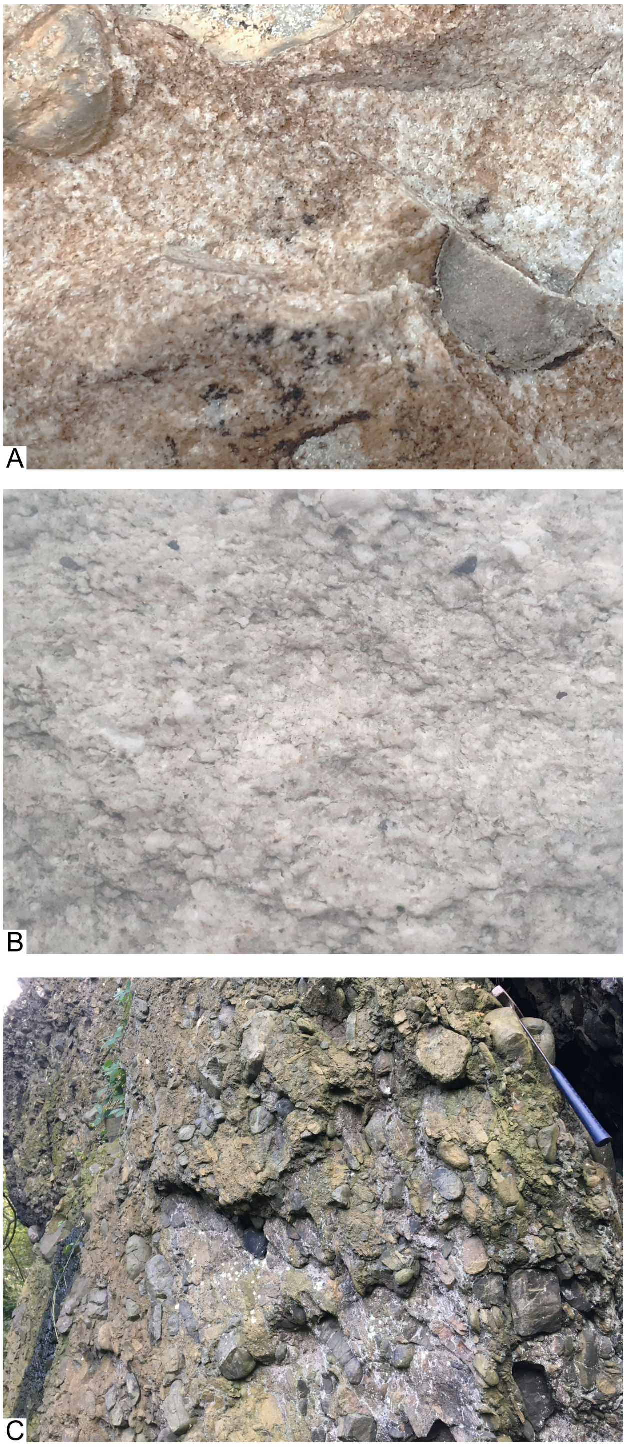

Figure 11. Illustration of some Lower Devonian units. **A.** Coarse-grained quartzitic sandstone with mud chips of the Berlé Quartzite. Hand sample from Berlé (width of the picture c. 5 cm). **B.** Microconglomeratic sandstone with lithic clasts, 'arkose' of the Haybes Member. Hand sample from Lahonry quarry (width of the picture c. 10 cm). **C.** Ombret Conglomerate at the base of the Fooz Formation. Pierre Falhotte, Ombret in the Meuse River Valley.

(Marion & Barchy, 1999), and reaches 300 m to the east (Barchy & Marion, 2014).

Age. Traditionally considered as corresponding to the middle part of the Emsian following the tripartite subdivision of this stage (e.g. de Dorlodot, 1901; Conseil géologique, 1929) but elements for a precise dating are lacking. The Vireux and Chooz formations constitute a thick mass of rocks almost devoid of fossils (Godefroid & Stainier, 1988) that is comprised between the fossiliferous and well-dated Ruisseau de la Forge (Pesche Member) and Hierges formations.

Use. In the past, the sandstone beds were used locally for roadbed.

Main contributions. Gosselet (1868, 1871), Godefroid & Stainier (1988, 1994a).

Clervaux Formation – CLE

Origin of name. After the 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). 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 **Härebësch Member – HAR**, *Membre de Härebësch* in Dejonghe, 2021, p. 23), and are better individualised in Luxembourg (Dejonghe, 2021). 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). The **Berlé Quartzite** (called *Q1* in Asselberghs, 1946) is made of lenticular beds of argillaceous and quartzitic sandstone with planar and oblique stratifications, mud chips, dissolved coquinas and bioturbations (Michel et al., 2010) (Fig. 11A). The quartzitic horizon is laterally very discontinuous and, where not developed, the overlying Wiltz Formation rests directly on the Clervaux Formation. Similar 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, south-west 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 Quartzite is 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 quartzite was 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 Quartzite is 2–5 m thick in Belgium (Ghysel, 2023) and its 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 Quartzite yielded an upper Emsian macrofauna and therefore is equivalent to the upper part of the Clervaux Formation (Asselberghs, 1941).

Remark. 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., 2023). Note also that the German Stratigraphic Commission considers the Berlé Quartzite as a formation (Jansen, 2016).

Use. The quartzite was intensively quarried both in Belgium and Luxembourg for building purposes. The sandstones were also quarried for aggregate production.

Main contributions. Asselberghs (1913, 1946), Lucius (1951), Godefroid & Stainier (1982), Franke (2006), Ribbert (2007), Michel et al. (2010).

Dave member

Disused term equivalent of the Waimes Member, see Fooz Formation.

Eau Noire Member – ENR

See Moulin de la Foulerie Formation.

Écluse Member – ECL

See Vireux Formation.

Fépin Formation – FEP

Origin of name. After 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 Conglomerate**, 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 Caledonian unconformity. The conglomerate displays finning-upwards sequences with erosive base. Coarse-grained sandstone, with occasional planar or oblique stratifications, forms metre-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 (Fig. 11B). 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 Conglomerate is 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 variations. The Fépin Formation covers the Cambrian and Ordovician rocks of the Rocroi, Givonne and Serpont Inliers. It was mapped along the south-western digitation of the Stavelot–Venn Inlier but the facies corresponds to the Waimes 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 Conglomerate passes to the Quareux Conglomerate whereas the Haybes Member passes to the lighter-coloured Waimes 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 south-western 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 m 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).

Use. The conglomerate is still locally used (Lahonry, Fépin) for aggregates and for building purposes. The coarse-grained sandstone has been used since the Neolithic to produce millstones (Picavet et al., 2017).

Main contributions. Gosselet & Malaise (1868), Gosselet (1884a), Renard (1884), Bailly (1936), Anthoine (1940a), Asselberghs (1946), Godefroid (1982), Steemans (1982a), Meilliez (1984, 1989, 2006), Meilliez & Mansy (1990), Meilliez & Blieck (1994a).

Fooz Formation – FOO

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

Remarks. In the northern parts 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

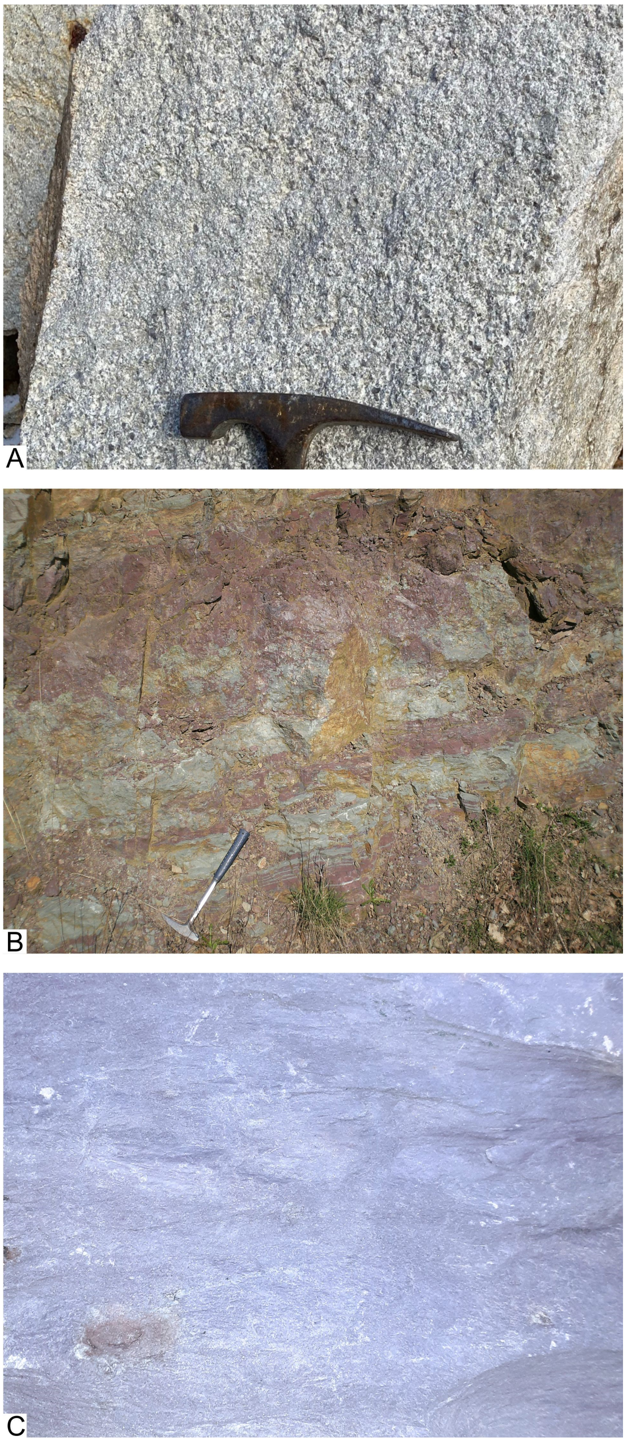

Figure 12. Illustration of some Lower Devonian units. **A.** Typical 'arkosic' facies (lithic greywacke) of the Waimes Member of the Fooz Formation in the Warchenne quarry near Malmedy. **B.** Greenish and reddish siltstone of the Marteau Member of the Fooz Formation. Tihange-Strée road section in the Meuse River valley (courtesy of Jean-Marc Marion). **C.** Purple shale typical of the Rheinhardstein Facies of the Marteau Member of the Fooz Formation. Hand sample from the Warchenne Quarry near Malmedy (width of the picture c. 5 cm).

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 Conglomerate** (*Poudingue d'Ombret* in Gosselet, 1873, p. 19; Mourlon, 1876, p. 327) in western areas and **Quareux Conglomerate** (*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 (Fig. 11C). 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 **Waimes Member – WAI** is composed of kaolinitic coarse-grained sandstone with few micro-conglomeratic recurrences and siltstone intercalations (Fig. 12A). 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* in 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) (Fig. 12B). Silcretes and ferricretes are also developed (Goemaere et al., 2012). The 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 south-eastern edge of the Stavelot–Venn Inlier, the Marteau Member displays blueish to purple colour, due to slight metamorphism here named as the **Reinhardstein Facies** (Fig. 12C).

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, Fig. 11C) 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., 1994e) because the historical section in Spa (Marteau locality) is too discontinuous and strongly tectonised. The Waimes quarry and nearby section along the former railway acts as a composite type section for the Waimes Member. The Reinhardstein Facies is exposed in the Warche River valley near the medieval Reinhardstein castle.

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

Thickness. The Quareux Conglomerate varies in thickness from 0 to c. 10 m in the Amblève River valley (Marion et al., in press), whereas the Ombret Conglomerate can attain several metres in thickness. The Waimes Member reaches 150 m in thickness in the type area (Lamberty et al., in press) and falls to c. 12 m in the Meuse River valley. The Marteau Member is c. 150 m thick in Eupen and Spa (Dejonghe et al., 1994e) and increases westwards to 170 m in Dave (Delcambre & Pingot, 2017).

Age. The base of the Formation is diachronous, becoming younger from the south-east to the north-west. South-east of the Stavelot–Venn Inlier, the Waimes Member, overlying the basal conglomerate yielded brachiopods (e.g. *Quadrifarius dumontianus*, *Shaleria rigida*) indicative of the Pridoli (Boucot, 1960). In the Theux 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).

Use. The conglomerate and sandstone have been used very locally as building stones. The coarse-grained sandstone of the Waimes Member is used as a building and ornamental stone (*Arkose de Waimes*) and for aggregate.

Main contributions. Asselberghs (1930, 1943), Boucot (1960), Michot (1969), Hance et al. (1991, 1992), Dejonghe et al. (1994e, 1994f), Goemaere et al. (1997, 2012).

Grand Ri Member – GRI

See Wépion Formation.

Hamoûle Member – HML

See Hierges Formation.

Hampteau Facies

See Burnot Formation.

Härebësch Member – HAR

See Clervaux Formation.

Haybes Member – HAY

See Fépin Formation.

Hierges Formation – HIE

Origin of name. After the village of Hierges (France), S*chistes calcaires de Hierges* in Sauvage & Buvignier (1842, p. 13).

Description. In the Meuse River valley, the Hierges Formation begins at the first bed of sandstone that overlies the last red-coloured bed of the Chooz Formation. It was divided into two members by Godefroid & Stainier (1994b, p. 80). The lower member, the **Bois Chestion Member – BCS** (*Membre du Bois Chestion*; c. 20 m thick), is essentially made of quartzitic or argillaceous, locally fossiliferous, sandstone that forms two or three bundles separated by grey or grey-greenish, fossiliferous shale. The lowermost part (2–2.5 m thick) of this member usually consists of thin beds of argillaceous sandstone alternating with shale. The upper member, the **Barrage Member – BAG** (*Membre du Barrage*; 308 m thick south of Couvin), consists of shale and siltstone, locally carbonated, in which many beds of fossiliferous calcareous sandstone and non-carbonate sandstone with or without fossils are incorporated. The fossils are usually dissolved on the outcrops and preserved as steinkerns (*Grauwacke de*/*d'Hierges* in the literature) (Fig. 13A).

The top of the Hierges Formation is defined below the first massive shelly limestone bed of the overlying Saint-Joseph Member of the Moulin de la Foulerie Formation.

Between the Ourthe River and the Aisne River valleys, the Hierges Formation is only represented by a the **Hamoûle Member – HML** (*Membre de Hamoûle* in Stainier, 1994a, p. 91) that is comprised between the Chooz and the Burnot formations. The Hamoûle Member starts with the occurrence of gravelly or conglomeratic sandstone overlying the red, green and mottled detrital rocks of the Chooz Formation (Fig. 13B). The sandstone is coarse-grained, quite often contain crinoids, brachiopods and ostracods.

Stratotype and sections. No section presents the entire unit in the eponymous locality. The stratotype for the lower limit, with the underlying Chooz Formation, is along the Vireux–Mazée road, west of the crossroads with the Givet road whereas that for the upper limit, established by Godefroid & Stainier (1994b) at Saint-Joseph near Nismes, has entirely disappeared nowadays. A new stratotype for this limit is proposed along the Eau Noire south of Couvin (also stratotype of the Moulin de la Foulerie Formation). The Hamoûle Member is exposed along the Ourthe River south of Hampteau.

Area and lateral variations. South and south-eastern flank of the Dinant Synclinorium. The Hierges Formation stricto sensu is recognised until the meridian of Chanly (Dumoulin & Blockmans, 2013a). Eastwards, this unit becomes sandier and, at Tellin, a gravely sandstone level is present at its top (Blockmans et al., 2019). This transitional facies of the Hierges Formation was named *facies mixte* or *facies de Jemelle* by Asselberghs (1946, p. 281). In the Ourthe River valley near the Hampteau meridian, the lower part of the Hierges Formation (Hamoûle Member) tends to entirely fade away whereas its upper part passes to the conglomerate of the Hampteau Facies of the Burnot Formation (see Burnot Formation).

Thickness. The Formation is 320–330 m thick at Hierges (Godefroid & Stainier, 1994b) and 300–350 m thick in the

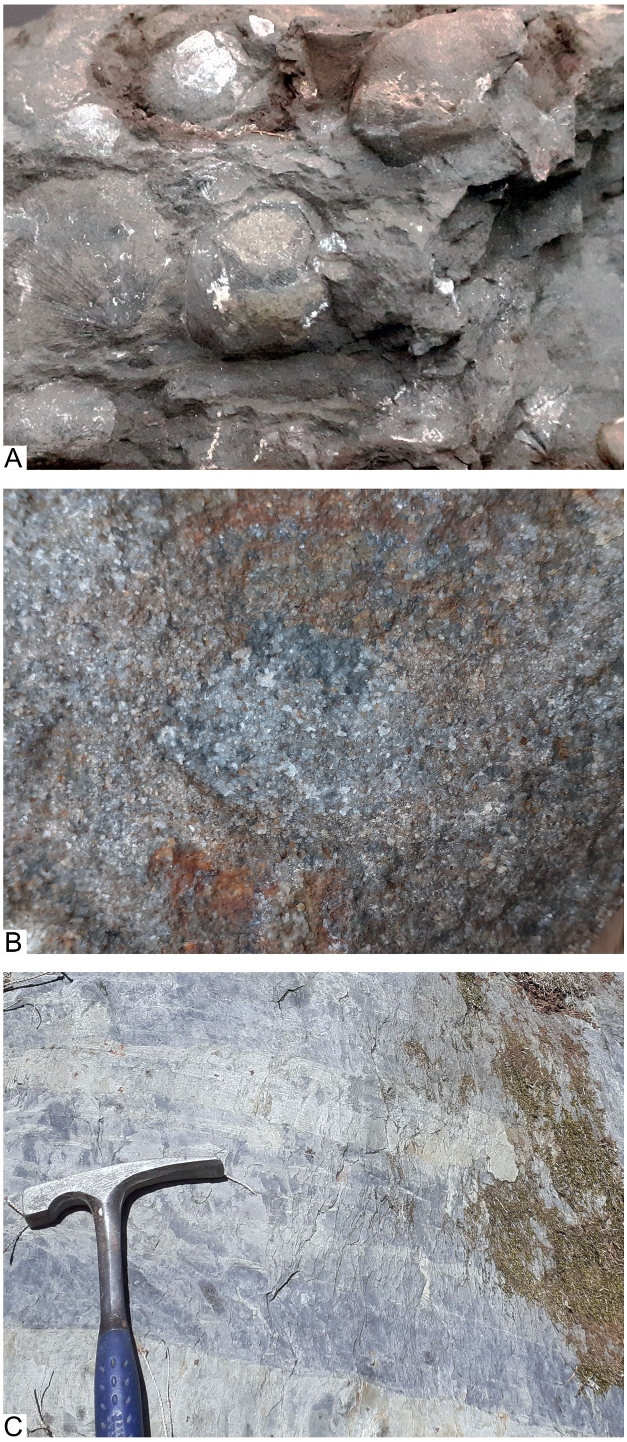

Figure 13. Illustration of some Lower Devonian units. **A.** Fine-grained sandstone with partly dissolved coquina beds typical of the Hierges Formation (*grauwacke de Hierges*). Hand sample from the section along Viroin River at Vireux (width of the picture c. 12 cm). **B.** Coarse-grained sandstone of the Hamoûle Member of the Hierges Formation. Hand sample from the section along the Ourthe River at Hampteau (width of the picture c. 10 cm). **C.** Typical *quartzophyllade* alternation of slate and silty sandstone in the Kautenbach–Troisvierges Formation. Steinbach quarry in the Ourthe orientale River valley.

Lesse River valley (Dumoulin & Blockmans, 2013a), the Hamoûle Member is c. 140 m thick in the Ourthe River valley at Hampteau (Dejonghe, 2008).

Age. Late Emsian. Until 1985, the top of the Hierges Formation was traditionally considered as the top of the Emsian in Belgium and northern France, but the conodont *Polygnathus costatus partitus*, which was chosen for defining the base of the Eifelian (Werner & Ziegler, 1982; Bassett, 1985), is found higher stratigraphically, i.e. in the upper part of the Eau Noire Member of the Moulin de la Foulerie Formation (Bultynck, 1991b; Bultynck et al., 1991, 2000). In matter of conodont zonation, the lower part of the Barrage Member spans the interval of the *laticostatus* to the *serotinus* zones (Bultynck, 1970; Bultynck & Godefroid, 1974; Godefroid & Stainier, 1994b). Among the very rich brachiopod fauna of the Hierges Formation (e.g. Maillieux, 1941; Godefroid, 1994a; Mottequin, 2019; Mottequin & Jansen, in press), spiriferides are important for correlation with the nearby Rhenish Massif. *Arduspirifer arduennensis arduennensis* (Fig. 3H), *Brachyspirifer carinatus rhenanus* (Fig. 3K) and *Paraspirifer* (*Mosellospirifer*) *sandbergeri sandbergeri* (Fig. 3L) appears few metres above the base of the unit (Godefroid, 1977, 1982, 1994a, 2001; Godefroid & Stainier, 1994b).

Use. The sandstones were used essentially for roadbeds and cobblestone production and, locally, as building stone.

Main contributions. De Dorlodot (1901), Maillieux (1941), Asselberghs (1946), Bultynck (1970), Godefroid & Stainier (1988, 1994b).

Joigny Member – JOI

See Anloy Formation.

Jupille Member – JUP

See La Roche Formation.

Kautenbach–Troisvierges Formation – KAT

Origin of name. After 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 (Fig. 13C). 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 Ourthe occidentale River valley, upstream Houffalize, allow to see these facies.

Area and lateral variations. North-eastern 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 *Herdorf-Schichten* in the Eifel Hills

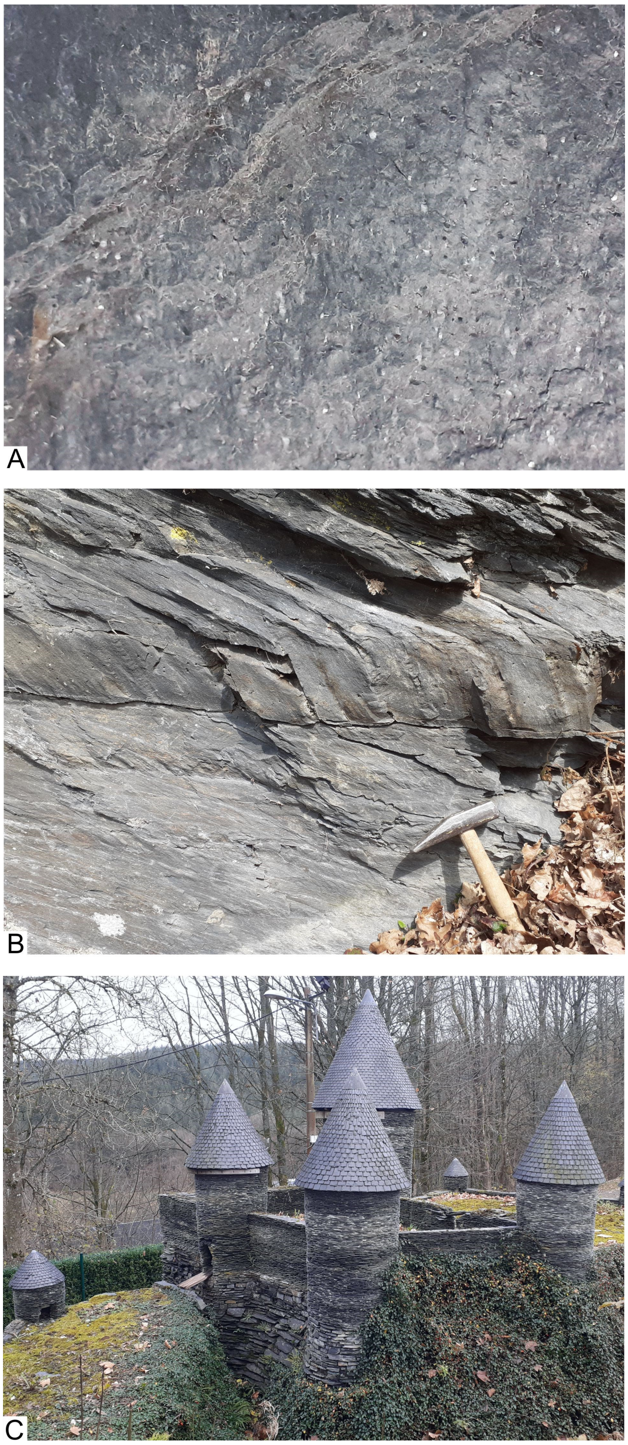

Figure 14. Illustration of some Lower Devonian units. **A.** Grey slate with millimetric magnetite crystals of the Laforêt Formation. Hand sample from the section along the Semois River at Chairière (width of the picture c. 4 cm). **B.** Dark slate and silty sandstone of the La Roche Formation. Note the refraction of the cleavage through the sandstone bed. Section near the motorway bridge near Houffalize in the Ourthe River valley. **C.** Model of the Neufchâteau old castle, made of slate from the Martelange Member of the La Roche Formation.

(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.

Use. Both the slates and quartzitic sandstones were quarried for building purpose.

Main contributions. Brichant (1928), Asselberghs (1946), Brühl (1966), Dejonghe et al. (2017).

Laforêt Formation – LAF

Origin of name. After 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 (Fig. 14A). 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 variations. 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.

Use. Very locally used for building purposes.

Main contributions. Gosselet (1884b, 1884c), Asselberghs (1946), Hatrival & Beugnies (1973), Belanger & Ghysel (2017a).

La Roche Formation – LAR

Origin of name. After the town of La Roche-en-Ardenne in the Ourthe valley, *facies de Laroche* in Asselberghs (1946, p. 180).

Description. The La Roche Formation is dominated by slate, slaty siltstone (*phyllade*) and shale, typically dark grey or bluish, with few bluish sandstone intercalations (Fig. 14B). The cleavage is usually very good in the fine-grained beds and the rock can easily be split into thin sheets. Where sandstone and siltstone beds are intercalated, the cleavage is poorer, and the rock is cut in thick slabs. Pseudonodules, occasionally up to 50 cm in diameter, occur in the lower and upper parts of the Formation. In the Neufchâteau–Eifel Synclinorium, a basal unit of monotonous fine-grained dark slates is known as the **Martelange Member – MTL** (*Phyllades de Martelange* in Asselberghs, 1912a, p. M58; 1912b, p. B201). It differs from the rest of the formation by the virtual absence of sandstone laminae and beds that allowed the production of fine slates (Fig. 14C) (Ghysel, 2022a, 2022b, 2023; Belanger, in press). Locally, small carbonate or limonitic nodules occur, together with scarce decarbonated coquina (*Grauwacke de Petigny* in the old literature, Asselberghs & Maillieux, 1938). 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

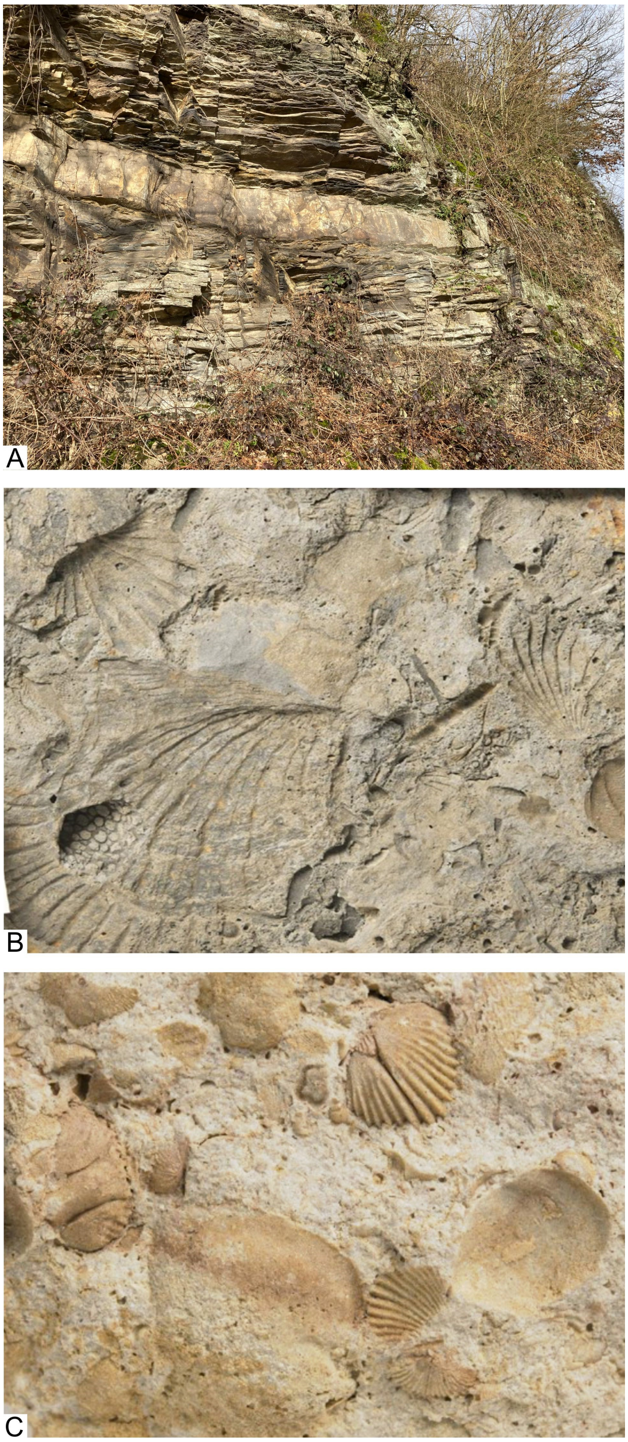

Figure 15. Illustration of some Lower Devonian units. **A.** Sandstone beds scattered within the siltstone sequence typical of the Jupille Member of the Laroche Formation. Jupille road section in the Ourthe River valley. **B.** Decalcified coquina beds with bivalves and bryozoans typical of the Longlier Formation. Hand sample (RBINS a14018) from the Longlier railway section (width of the picture c. 4 cm). **C.** Decalcified coquina beds with brachiopod in white quartzitic sandstone typical of *faciès anoreux* of the Mirwart Formation. Hand sample (RBINS a14019) from Petigny (Moulin-des-bois Quarry) (width of the picture c. 5 cm).

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 – JUP** 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 (Fig. 15A). 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. Sections along the road N833 from La Roche-en-Ardenne to Hotton (Stainier, 1994c). The base of the La Roche Formation is exposed at the northern exit of La Roche-en-Ardenne along this road, whereas its top and the Jupille Member can be observed along the same road, c. 600 m south of Jupille (Dejonghe et al., 2008). The Martelange Member is exposed along the road from Arlon to Martelange (N4) (Belanger, in press).

Area and lateral variations. Southern and south-eastern 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. Highly variable: 215 m south of Couvin (Marion & Barchy, 1999), 420 m south of Grupont (Blockmans et al., 2019), about 400 m at Amonines, 400 m on the northern flank of the La Roche Syncline increasing to 800 m on its opposite flank (Dejonghe & Hance, 2001). The Martelange Member is 100–150 m thick in its type area but tends to disappear northwards (Ghysel, 2023). 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).

Age. Mostly late Pragian. In the Pèrnelle pond section, south of Couvin, the La Roche Formation (units 2–4 in Godefroid, 1979) yielded the brachiopod *Arduspirifer latestriatus prolatestriatus* (Fig. 3F) suggesting that this part is Emsian (Bultynck et al., 2000). In Belgium, however, the 'traditional' base of the Emsian is based on the appearance of the brachiopod *Brachyspirifer minatus* (Fig. 3I) and located above the La Roche Formation (Godefroid & Stainier, 1982).

Use. The slate of the Martelange Member was intensively quarried for the production of roof tiles (Ghysel 2022a, 2022b, 2023; Belanger, in press). Many underground quarries are still visible between the Semois River valley and in several localities in the Grand Duchy of Luxembourg. Nowadays, some open-pit quarries extract the slate as an ornamental stone whereas the slag heaps of the former exploitations are used to produce slate mulch.

Main contributions. Gosselet (1884b, 1884c), Brichant (1928), Asselberghs (1946), Brühl (1966), Godefroid & Stainier

(1982), Stainier (1994c), Dejonghe & Hance (2001), Godefroid (2001), Dejonghe et al. (2008).

Levrézy Member – LEV

See Mondrepuis Formation.

Linchamps Conglomerate

See Fépin Formation.

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, Fig. 15B) but they are concentrated in lenticular beds; bivalves and brachiopods can reach a large size. 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, 2024).

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 south-east 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 (see below). 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 bear a precise biostratigraphic signal and the Longlier Formation is traditionally considered to be equivalent in age with the Villé Formation. Based on the presence of *Euryspirifer dunensis* (Fig. 3E) 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). However, this is disputed by Jansen (2016) who considers that the specimens from the La Roche Formation attributed to *E. dunensis* by Godedroid (1994b) should be assigned to *E. assimilis* spp. (see Mottequin & Jansen, in press).

Use. Locally used as a building stone in the past.

Main contributions. Asselberghs (1912a, 1912b, 1913, 1946), Brichant (1928), Maillieux (1936), Godefroid (1994b), Ghysel (2023).

Marteau Member – MAR

See Fooz Formation.

Martelange Member– MTL

See La Roche Formation.

Masuis Member – MAS

See Bois d'Ausse Formation.

Mirwart Formation – MIR

Origin of name. After the village of Mirwart in the Lomme River valley, *Schistes, grauwacke et grès de Mirwart* in Forir (1900).

Remark. The Mirwart Formation corresponds to the former *Grès d'Anor* formation introduced by Hébert (1855, p. 1172). However, the lack of a proper section in the Anor area and the duplication of the whitish quartzitic beds (*faciès anoreux* in the literature related to the Lower Devonian formations, Fig. 15C) have justified the abandon of this denomination (Stainier, 1994d). This unit passes westwards to the *Schistes et Quartzites de Nouzon* (Beugnies & Waterlot, 1965) in France and eastwards to the *Monschau-Schichten* (Ribbert et al., 1992) in Germany.

Description. The Mirwart Formation is an assemblage of quartzite, quartzitic sandstone, siltstone and shale of various colours. The sandstone and quartzite are greenish, bluish or beige in colour and occur in metre- to plurimetre-thick beds, commonly lenticular and limited by undulating surfaces. They usually display parallel, oblique or cross stratifications, wavy lenticular bedding, flaser bedding, shale chips, basal erosion and other sedimentary structures (Goemaere & Dejonghe, 2005). The shale and siltstone are darker in colour, bluish grey to black. In the Ardenne Anticlinorium, the sandstone facies dominates over the shaly one but eastwards (La Roche Syncline and eastwards), the sandstone beds tend to appear in metre- to plurimetre-thick bundles separated by thicker packages of shale, siltstone and slate, often laminar (*quartzophyllade*). Rare carbonate sandstone intercalations occur sporadically. Similarly, southwards, the slaty and shaly facies dominate and the sandstone beds form scarce isolated bars. Along the southern limb of the Neufchâteau–Eifel Synclinorium, the Formation is represented by homogenous *quartzophyllades* with few metre-thick intercalations of greenish-grey sandstone with oblique stratifications (mostly restricted to the lower part of the Formation). Along the northern limb of the Neufchâteau–Eifel Synclinorium, the Formation is made of two units dominated by slaty facies, separated by a third unit richer in sandstones and quartzitic sandstone. The first two units were named *formations de Morhet et de Verlaine* by Beugnies (1985) but the impossibility to distinguish them in most places make these two terms obsolete.

In the upper part of the Formation, the **Alle Member – ALL** (*phyllades d'Alle* in Gosselet, 1888, p. 288) can be individualised. It consists of a unit of dark slate with a tight cleavage and thin quartzitic laminae capped by a horizon with

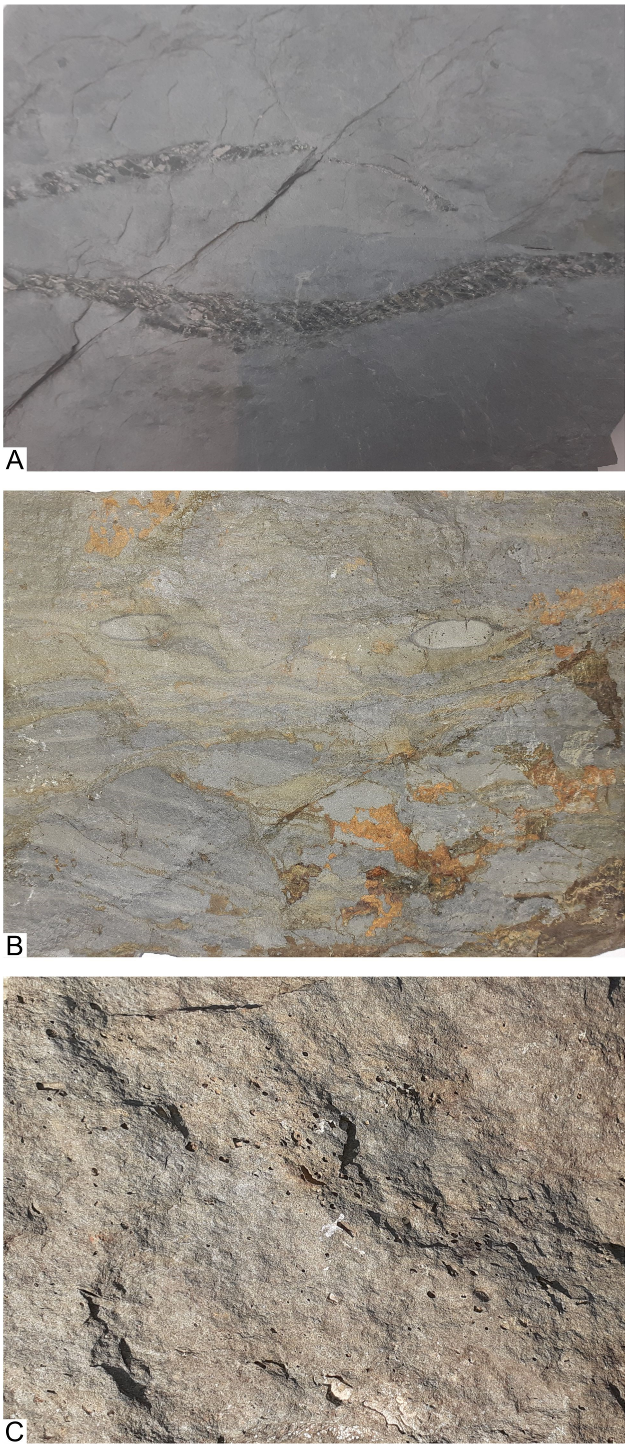

Figure 16. Illustration of some Lower Devonian units. **A.** Bluish slate with chloritised plant remains (*Taeniocrada decheniana*) from the Alle Member of the Mirwart Formation. Hand sample from the Semois River valley (width of the picture c. 6 cm). **B.** Laminated slaty siltstone typical of the Muno Facies of the Mondrepuis Formation, hand sample from the section along the disused railway at Muno (width of the picture c. 10 cm). **C.** Brown sandy siltstone with small, decalcified crinoids, typical of the Saint-Joseph Member of the Moulin de la Foulerie Formation. Hand sample from the section along the Viroin River at Treignes (width of the picture c. 10 cm).

chloritised plant debris (dominantly *Taeniocrada decheniana,* Fig. 16A). This unit has been quarried for roof tiles in the Semois River valley (Laforêt, 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).

Although the Mirwart Formation has been mapped throughout the Ardenne, it is clear that there are two distinct facies: a northern one corresponding to the classical definition of the Mirwart Formation and a southern, where the fine-grained lithology largely dominates upon the sandstones. This last facies is referred as 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) 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).

Stratotype and sections. Sections along the Namur–Arlon railway near Mirwart. The Formation is well exposed in the Lambert (Flamierge) and the Collignon (Bastogne) quarries where the sandstone beds display the typical *boudinage* as firstly defined by Lohest (1909).

Area and lateral variations. The northern facies dominated by the sandstones occur along the southern and south-eastern margin of the Dinant Synclinorium up to the Mormont Fault, where it passes to the Bois d'Ausse Formation. This facies is also recognised within the Ardenne Anticlinorium up to La Roche-en-Ardenne where it passes progressively eastwards to a more shaly and slaty facies that is difficult to distinguish from the overlying Longlier and Kautenbach–Troisvierges formations and is included in the Warche Group. In the Neufchâteau Synclinorium, the southern fine-grained slaty 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.

Thickness. It is particularly variable: 300 m south of Couvin (Marion & Barchy, 1999), 600 m between Mirwart and La Roche-en-Ardenne (Blockmans et al., 2019), 1000 m west of Dochamps (Dejonghe & Hance, 2001), up to 2000 m in Bertrix and Bouillon (Belanger & Ghysel, 2017b). The Alle Member is 100–150 m thick in most areas. The Alle Member is c. 85 m thick in the Semois River valley (Belanger & Ghysel, 2017b).

Age. A diachronous Lochkovian to Pragian age is proposed by Steemans (1989a) from the east and south (Mirwart and Chiny: Lochkovian Z to Pragian W zones) to the west (Couvin: Pragian Paα Zone).

Use. The sandstone and quartzitic sandstone have been quarried for building purpose and are now used for the aggregate production. The Alle slate was intensively mined to produce roof tiles in the Semois River valley (Asselberghs, 1924). The slaty beds in the lower part of the Formation were also quarried as roof tiles in the Laval River valley (Beugnies, 1985).

Main contributions. Asselberghs (1913, 1946), Brühl (1966), Stainier (1994d), Goemaere & Dejonghe (2005).

Mondrepuis Formation – MON

Origin of name. After the village of Mondrepuis (France), *Schistes verts de Mondrepuis* in Thorent (1839, p. 245).

Description. The Formation is essentially shaly with dark grey and bluish-grey shale with light grey or greenish-grey siltstone laminae. Heterogeneous sandy laminae and thin beds of yellowish, greenish and brownish micaceous quartzitic sandstone occur locally. Fossils are frequent and occur as lens-like accumulations of shells (brachiopods, bivalves, crinoids, trilobites, tentaculites, etc.), decalcified and limonitic on the outcrop. On the north-eastern margin of the Rocroi Inlier, these carbonate facies were named *Siltites et Grès du Pont Collin* by Meilliez (1989). In the lower part, coarse-grained sandstone beds are locally developed. South of the Rocroi Inlier, the facies are slightly metamorphic and the Mondrepuis shale passes to the bluish-grey slate with thin sandy laminae of the **Levrézy Member – LEV** (*schistes de Levrezy* in Gosselet, 1880, p. 62, 67). The slates are finely micaceous, occasionally graphitic and locally reddish-brown in colour due to the disseminated oxidised pyrite. In the French part of the Semois River valley, this member includes 2–6 m thick lenses of sandy crinoidal limestone (*Calcaire de Naux, Calcaire de la Havetière, Calcaire de Montcy-Notre-Dame*; Clerc, 1830; Bultynck, 1982) that correspond to some calcareous sandstone beds observed on the Belgian side.

On the eastern flank of the Givonne Inlier, two members have been distinguished (Belanger & Ghysel, 2017b). The lower one, situated 30–100 m above the base of the Formation is the **Ruisseau des Roches Member – RDR** (*Horizon du Ruisseau des Roches* in Beugnies, 1976, p. 484). It consists of bioclastic carbonate shales rich in macrofossils. The upper one, the **Parensart Member – PRS** (*Horizon de Parensart* in Godefroid & Cravatte, 1999, p. 7), a term proposed to replace Beugnies' (1976) *Horizon de Muno*, is dominated by shales with thin beds of carbonate siltstone, decalcified and limonitic on the outcrop. The Parensart Member is c. 75 m thick and situated 100 m above the Ruisseau des Roches Member. These last two members were integrated into a distinct unit by Godefroid (1982), i.e. the *formation de Muno* (*Grès et schistes de Muno* in Maillieux & Demanet, 1929, table 2) here referred as the **Muno Facies** (Fig. 16B).

Stratotype and sections. The historical stratotype at Mondrepuis (France) is discontinuous and the Bois de Ridoux section at Haybes (France) is very degraded nowadays. The best section, although difficult to access, is situated along the N5 motorway south of Couvin but the upper part is faulted. The Parensart and Ruisseau des Roches members are exposed along the disused railway between Muno and Sainte-Cécile (Godefroid & Cravatte, 1999), though in this locality the facies is more fine-grained than in the Dinant Synclinorium. The Levrézy Member is exposed along the western bank of the Meuse River between Bogny and Braux (France) and along the eastern bank of the Semois (Semoy) River between Navaux and Thilay (France).

Area and lateral variations. The Mondrepuis Formation can be traced on the southern limb of the Dinant Synclinorium between Macquenoise and Gedinne then it passes to the Levrézy Member south of the Rocroi Inlier. In the Ardenne Anticlinorium, the classical facies of the Mondrepuis Formation is developed on the northern flank of the Serpont Inlier. On the southern limb of the Neufchâteau–Eifel Synclinorium, the Formation and its fossiliferous members (Ruisseau des Roches and Parensart) are developed on the margin of the Givonne Inlier.

Thickness. In the type locality (Meilliez & Blieck, 1994b) and along the northern margins of the Rocroi and Serpont inliers, the Formation is up to 150 m thick and rapidly increasing in thickness southwards to 500 m near Willerzie (Blockmans, in press) and 300–800 m on the northern margin of the Givonne Inlier (Belanger & Ghysel, 2017b). The Levrézy Member reaches 1000 m on the southern margin of the Rocroi Inlier.

Age. The Formation is diachronous. Near the Givonne Inlier, the Ruisseau des Roches Member yielded a Pridoli brachiopod fauna (e.g. *Quadrifarius dumontianus, Dayia shirleyi*, see Godefroid & Cravatte, 1999) whereas the Parensart Member contains a diverse Lochkovian brachiopod fauna (e.g. *Howellella mercurii*, Fig. 3A) indicating an early Lochkovian age (Boucot, 1960; Godefroid & Cravatte, 1999; Mottequin & Jansen, in press). In the Dinant Synclinorium, the Mondrepuis Formation yielded only Lockhovian fauna and microflora (R Zone at Willerzie and Lahonry, Steemans, 1989a).

Use. In the French part of the Semois River valley, the slates of the Levrézy Member were locally quarried as roof tiles.

Main contributions. Beugnies (1960, 1976), Milhau et al. (1987), Meilliez (1989), Meilliez & Blieck (1994b), Godefroid (1995), Godefroid & Cravatte (1999).

Moulin de la Foulerie Formation – MFL

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

Remark. 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 (unformal 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 (Marion & Barchy, 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 Bed, 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, 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, 2013b) and Pondrôme–Wellin (Dumoulin & Blockmans, 2013a), 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 Bed. 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) (Fig. 16C). 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 (Fig. 17A). The macrofauna is abundant and diverse (rugose and tabulate corals, brachiopods, trilobites, crinoids).

Figure 17. Illustration of some Lower Devonian units. **A.** Typical alternation of argillaceous bioclastic limestone and calcshale of the Eau Noire Member of the Moulin de la Foulerie Formation. Section in Halma near Wellin. **B.** Red siltstone of the Oignies Formation. Section south of the Ry de Rome dam. **C.** Load-cast structures in the sandstone beds of the Our Formation. Section along the Our River south of Stoubach.

The carbonate content increases upwards, announcing the calcareous Couvin Formation. East of Nismes, the Villers-la-Tour Member of the Eifelian Couvin Formation disappears but a 10–20 m thick basal carbonate unit remains between the Eau Noire Member and the overlying Vieux Moulin Member (see Denayer et al., 2024). This unit of argillaceous crinoidal limestone can be traced up to the Jemelle area. The term **Sohier Limestone** 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; Marion & Barchy, 1999).

Area and lateral variations. Southern and south-eastern limbs of the Dinant Synclinorium up to the Ourthe River valley. East of the Lomme River valley, the carbonate character of the Eau Noire 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 valley, 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' in 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).

Use. The haematitic layer at the base of the Saint-Joseph Member was very locally mined as iron ore in the Lomme River valley (Denayer et al., 2011).

Main contributions. Godefroid (1968, 1977), Tsien (1969, 1974), Bultynck (1970, 1991b, 1991c), Denayer (2024).

Muno Facies

See Mondrepuis Formation.

Nonceveux Member – NON

See Bois d'Ausse Formation.

Oignies Formation – OIG

Origin of name. After the village of Oignies-en-Thiérarche, *Schistes bigarrés d'Oignies* in Gosselet & Malaise (1868, p. 68).

Description. The rocks encountered within the Oignies Formation are reddish, a characteristic colour not found in the underlying and overlying units. The dominant lithology is red, purple-red, green or variegated shale and siltstone, often finely micaceous (Fig. 17B). Quartzitic or arkosic sandstone form lenticular beds up to several decimetres in thickness in the lower and upper parts of the Formation. Horizons with decalcified nodules, probably of paedogenetic origin, occur in the upper half of the unit. The various lithologies are arranged in several metre-thick, fining-upwards sequences. Each of them starts with coarse-grained arkosic sandstone on an erosive base, passes to fine-grained sandstone and siltstone, and ends with red shale. Fossil remains are extremely rare (Godefroid, 1982).

Stratotype and sections. The historical section along the Ruisseau de Nouée at Oignies-en-Thiérache offers a very poor exposure. The sections along the Ry de Rome dam and along the road N964, between the Fonds de l'Eau south of Couvin and la Forestière near Brûly-de-Pesche, expose the main lithologies. The Moulin de Frétogne section along the Meuse River, north of Fépin, exposes almost entirely the Formation and its boundaries with the overlying and underlying units (Meilliez & Blieck, 1994c).

Area and lateral variations. Besides the development of the sandstone lenses, the Oignies Formation is rather homogenous along the southern limb of the Dinant Synclinorium. Eastwards, it passes to the upper part of the Marteau Member of the Fooz Formation near Manhay. In the Ardenne Anticlinorium, the Oignies Formation is replaced by the slightly metamorphic Anloy Formation south of the Vencimont Fault (Asselberghs, 1946). On the northern flank of the Givonne Anticlinorium, the Oignies Formation is richer in sandstone beds and dominantly greenish in colour. It was therefore mapped with the overlying Saint-Hubert Formation (Belanger & Ghysel, 2017b).

Thickness. In the Moulin de Frétogne section in the Meuse River valley, the Formation is c. 200 m thick, and a thickness of 400 m is commonly attributed to it in the Couvin area (Meilliez & Blieck, 1994c).

Age. In the Couvin area, the upper part of the Oignies Formation yielded a palyno-assemblage indicating the BZ Zone and therefore is late Lochkovian. In the Saint-Hubert section, the top of the formation belongs to the Siβ Zone, i.e. the middle part of the Lochkovian. Hence, the Oignies Formation is older eastwards (Meilliez & Blieck, 1994c).

Use. Locally the sandstone beds have been used as building stones.

Main contributions. Asselberghs (1946), Godefroid (1982), Meilliez & Blieck (1994c).

Ombret Conglomerate

See Fooz Formation.

Our Formation – OUU

Origin of name. After 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 (Fig. 17C). 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) overcome this drawback. However, none of these sections fully exposes the formation. Its base can be observed in the Reelerfurtbach River valley at Stoubach, a hamlet of Burg-Reuland, 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 Stolzembourg Member and 1100 m for the Schuttbourg 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* (Fig. 3G), *Euryspirifer* cf. *latissimus*, and *Meganteris ovata* indicating the middle to upper part of the Lower Emsian (De Baets et al., 2013).

Use. Locally used as building stone.

Main contributions. Furtak (1965), Vandenven (1991), Dejonghe et al. (2017), Dejonghe (2019).

Paliseul Facies

See Anloy Formation.

Parensart Member – PRS

See Mondrepuis Formation.

Pèrnelle Member – PRN

See Ruisseau de la Forge Formation.

Pesche Member – PES

See Ruisseau de la Forge Formation.

Petites Tailles Formation – PET

Origin of name. After the village of Petites-Tailles (Houffalize), *Quartzites des Petites-Tailles* in Geukens (1966, p. 216).

Description. The lower part of the Formation includes massive greenish to whitish quartzitic sandstone, conglomeratic and coarse-grained sandstone with small white quartz pebbles and greenish slaty shale beds. The quartzitic sandstone commonly displays a brecciated facies due to the abundance of tectonic quartz veins. In the upper part, the greenish to dark grey slaty shale and quartzophyllade are proportionally more abundant than the quartzitic sandstone, though the latter is still present. Shaly sandstone with clasts of dark shale occur in the

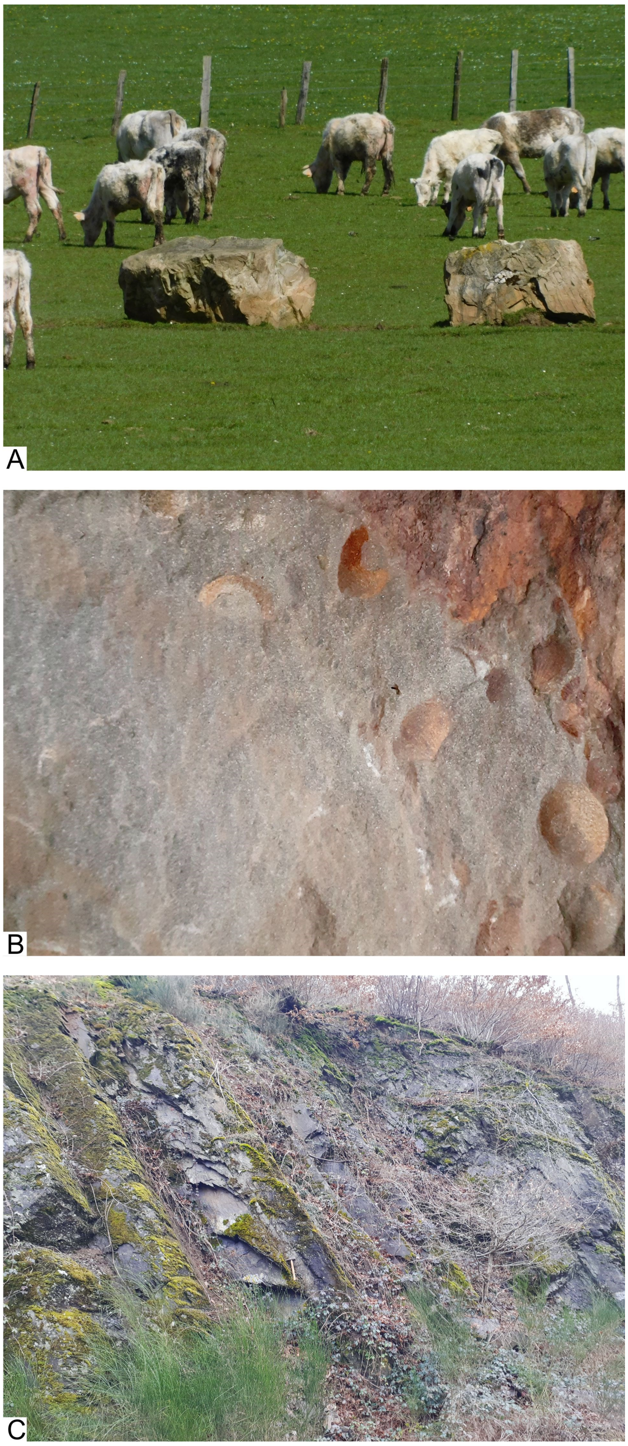

Figure 18. Illustration of some Lower Devonian units. **A.** Erratic blocks of the quartzitic sandstone, representative of the Petites Tailles Formation. Meadow west of the Petites Tailles village (courtesy of Jean-Marc Marion). **B.** Brownish sandstone with decalcified shells of the Pèrnelle Member of the Ruisseau de la Forge Formation. Hand sample from the Pèrnelle section south of Couvin (width of the picture c. 8 cm). **C.** Shale beds of the Pesche Member of the Ruisseau de la Forge Formation along the Pèrnelle section south of Couvin.

upper part.

Stratotype and sections. No continuous section exposes the Formation and the composition is mostly known from spot outcrops and isolated blocks scattered in the area situated between Tailles, Fraiture, Bihain and les Petites Tailles (Fig. 18A).

Area and lateral variations. South of les Petites Tailles, the Formation seems to pass to the Waimes Member of the Fooz Formation, either laterally or vertically, even if the lack of outcrops does not allow to demonstrate the transition.

Thickness. Unknown, probably a few tens of metres.

Age. The Petites Tailles Formation yielded no dating on element other than reworked Cambrian and Ordovician acritarchs and its age is supposedly post-Ordovician and 'pre-Gedinnian' after Geukens (1984). However, the occurrence of the basal conglomerate and the similarity of the quartzitic sandstone and slaty shale with some facies of the Waimes Member suggest an age similar or equivalent to the base of the Fooz Formation, i.e. late Pridoli to earliest Lochkovian.

Use. Nil.

Main contributions. Geukens (1966, 1984); Verniers et al. (2002).

Quareux Conglomerate

See Fooz Formation.

Roche à l'Appel Member – RAA

See Fépin Formation.

Reinhardstein Facies

See Fooz Formation.

Ruisseau de Deluve Member – RDL

See Vireux Formation.

Ruisseau d'Hanzinne Member – RHZ

See Acoz Formation.

Ruisseau de la Forge Formation – RDF

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

Remark. 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 occur within the sandstone (Fig. 18B). 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 (Fig. 18C). Many of these sandstone beds are slightly carbonated and contain 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 variations. 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 (Dejonghe & Hance, 2008; Blockmans et al., 2019).

Age. Late Pragian to early Emsian at the stratotype (Su Zone). On the basis of three species of *Brachyspirifer* (Godefroid, 1980; Godefroid & Stainier, 1982) and the occurrence of the conodont *Caudicriodus celtibericus* (Bultynck, 1976; Godefroid, 1994d), the Siegenian (i.e. Pragian)–Emsian boundary can be approximately positioned in the lower part of the Pesche Member (see 3. Chronostratigraphy of the Lower Devonian).

Use. The sandstone of the Pèrnelle Member was very locally exploited for building stone production.

Main contributions. Godefroid (1979, 1994c, 1994d).

Ruisseau des Roches Member – RDR

See Mondrepuis Formation.

Saint-Hubert Formation – STH

Origin of name. After the town of Saint-Hubert, *Schistes et quartzites de Saint-Hubert* in Gosselet (1880, p. 63).

Description. The Saint-Hubert Formation mostly consists of micaceous sandy shales with quartzitic sandstone intercalations, all of light to dark bottle-green colour. In the lower part, reddish and variegated shale and sandstone, similar to those of the underlying Oignies Formation, still occur but in a smaller proportion than in the former. The boundary between both formations is therefore difficult to establish but is more conveniently defined above the last thick occurrence of red shale (Fig. 7C). Bundles, 10–12 m thick, of grey and bluish-grey sandstone beds, are scattered within the succession. They are continuous or lenticular and display commonly oblique stratifications and ripple-marks. Dissolved calcareous nodules filled up with pulverulent limonite commonly give a cellular aspect to the green shale. Upwards, the proportion of sandstone and quartzitic sandstone beds and lenses tends to increase, announcing the overlying, sandier Mirwart Formation. The top of the Formation is defined below the first bed of greyish coarse-grained sandstone. Where weathered, the sandstones are either rubified or whitened.

Stratotype and sections. The composite type section is located both along the Namur–Arlon railway at the Poix-Saint-Hubert station and along the Lomme River south of Mirwart (Stainier, 1994e).

Area and lateral variations. The Formation is recognised along the southern limb of the Dinant Synclinorium, north of the Vencimont Fault. South of this fault, it passes in the Ardenne Anticlinorium to the Laforêt Formation (in the Semois River valley) and to the Sainte-Marie Formation (east of Paliseul) in which a metamorphic facies enriched in ilmenite, magnetite, biotite and amphibole is locally developed. North-eastwards, along the southern margin of the Stavelot–Venn Inlier, the Saint-Hubert Formation progressively passes to the sandstone of the upper part of the Fooz Formation. Lenticular beds of green sandstone still exist between Bihain and Salmchâteau.

Thickness. The Formation displays a relatively constant thickness varying from c. 400 m in the Couvin area (Marion & Barchy, 1999) to c. 600 m in the Lomme River and Ourthe River valleys (Dejonghe, 2012; Blockmans et al., 2019).

Age. The green shale of the lower part of the Formation yielded an assemblage of miospores typical of the upper Lochkovian Siβ Zone in the Lomme River valley (Godefroid et al., 1982). In the Eau Noire River valley, the base is dated of the Z Zone whereas the upper part of the Formation yielded an assemblage indicating the upper Lochkovian to lower Pragian E Zone. The base of the Saint-Hubert Formation is therefore diachronous, being younger towards the north and the west (Steemans, 1989a).

Use. Locally the sandstone beds were quarried for building purposes.

Main contributions. Maillieux (1932), Asselberghs (1946), Godefroid (1982), Stainier (1994e), Boulvain & Ludet (2024).

Saint-Joseph Member – STJ

See Moulin de la Foulerie Formation.

Sainte-Marie Formation – STM

Origin of name. After 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) (Fig. 19A). 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, north-west 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

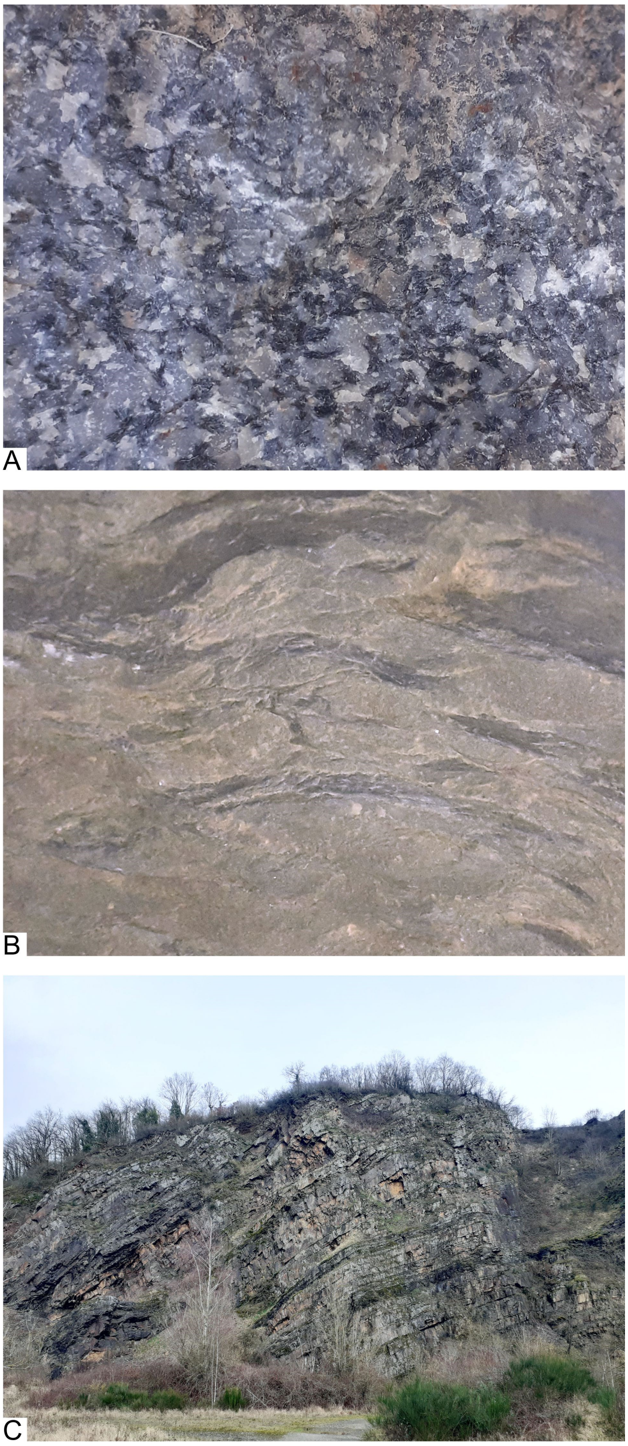

Figure 19. Illustration of some Lower Devonian units. **A.** Fine-grained quartzitic sandstone with biotite porphyroblasts (black dots) typical of the metamorphic rock known as *cornéite* in the old literature. Sainte-Marie Formation. Hand sample from the railway section north of Libramont (width of the picture c. 3 cm). **B.** Calcareous slaty siltstone with irregular cleavage (*calcareophyllades* in Asselberghs, 1946) typical of the Bouillon Facies of the Villé Formation. Hand sample from the Semois River valley (width of the picture c. 10 cm). **C.** Sandstone beds of the Vireux Formation at the Mont de Vireux quarry.

biostratigraphic elements but, by extrapolation with the laterally equivalent Saint-Hubert Formation, it is most probably Lochkovian.

Use. Nil.

Main contributions. Gosselet (1884b, 1884c), Asselberghs (1946), Belanger & Ghysel (2017a), Michel (2024).

Sainval Facies

See Burnot Formation.

Schuttbourg Member – SCH

See Our Formation.

Sohier Limestone

See Moulin de la Foulerie Formation.

Solières Member – SOL

See Acoz Formation.

Staneux Member – STN

See Wépion Formation.

Stolzembourg Member – STO

See Our Formation.

Tréko Member – TRK

See Bois d'Ausse Formation.

Villé Formation – VIL

Origin of name. After Villé, a locality of the town of La Roche-en-Ardenne, *Formation de Villé* in Godefroid & Stainier (1982, p. 151).

Description. The Villé Formation includes dark blue shale, siltstone and slate with thin limonitic sandstone laminae, dark blue siltstone and quartzitic sandstone in pluridecimetre-thick beds. Sandstone and siltstone show parallel lamination, flaser bedding and occasional ripple marks. The lithologies are commonly slightly carbonated and contain coquina beds, though usually dissolved, and impure crinoidal limestone beds and lenses. Brachiopods, bivalves, corals and crinoids are frequent. Through the weathering, all lithologies present commonly a 'rusty' patina and limonite-filled cells corresponding to decarbonated material. Besides the fossils, the carbonate is present as cement in the sandstones and siltstones. The Formation also includes sets of greyish, greenish or even white quartzitic sandstone beds (grès à *faciès anoreux* and *Grès Blanc de Cielle* sensu Asselberghs, 1946).

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 plurimetric sequences (*calcareophyllades*, Fig. 19B) and abundant crinoidal beds and lenses. These lithologies form the **Bouillon Facies** (*facies de Bouillon* in Asselberghs, 1927, p. 210; 1946, p. 143). In the Dinant Synclinorium, the typical facies of the Villé Formation, as known in its type locality, still contains a carbonate unit. This is the *facies des Amonines* sensu Asselberghs (1946, p. 145), in which the rock is superficially decarbonated (*Grauwacke du bois de Saint-Michel* and *Grauwacke de St.-Michel* in the old literature, e.g. Maillieux & Demanet, 1929; Asselberghs & Maillieux, 1938; Maillieux, 1941). In the Neufchâteau–Eifel Synclinorium, east of the Vierre River valley, the carbonate content rapidly decreases, and the quartzite and slate beds become dominant, hence passing to the Longlier Formation.

Stratotype and sections. Villé near La Roche-en-Ardenne along the La Roche-en-Ardenne–Houffalize road (N860).

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

Area and lateral variations. The Villé Formation is present along the southern and south-eastern limb of the Dinant Synclinorium, from Anor to the La Roche-en-Ardenne Fault, then northwards up to the Xhoris Fault. It passes to the Longlier Formation on the eastern margin of the Halleux Anticline. 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).

Thickness. The Formation is c. 30 m thick south of Couvin (Marion & Barchy, 1999), 500 m at Amonines (Marion & Barchy, in press, a), 250–300 m along the northern flank of the La Roche-en-Ardenne Syncline (Dejonghe & Hance, 2001) and up to 600 m in the Semois River valley near Bouillon (Belanger & Ghysel, 2017a).

Age. Despite its richness in fossils, the Villé Formation yielded few guide markers. A Pragian ('middle Siegenian') age is supported by the occurrence of the brachiopod *Multispirifer solitarius* (Fig. 3C) (Godefroid & Stainier, 1982) and the first *Euryspirifer* (Godefroid, 1994b).

Use. The carbonate facies were quarried in the Bouillon area to produce lime. Elsewhere, the slaty facies were locally used for construction.

Main contributions. Asselberghs & Leblanc (1934), Maillieux (1940), Asselberghs (1946), Godefroid & Stainier (1982), Stainier (1994f).

Vireux Formation – VIR

Origin of name. After the village of Vireux in the Meuse River valley (France), *Grès noir de Vireux* in Gosselet (1864, p. 306).

Description. The base of the Vireux Formation corresponds to the first bluish-grey quartzitic sandstone overlying the shale and siltstone of the Ruisseau de la Forge Formation. The Vireux Formation consists of thick masses of bluish-grey or greenish, more or less argillaceous sandstone and quartzitic sandstone that are separated from each other by dark grey or greenish shale and siltstone beds (Fig. 19C). The upper limit of this lithostratigraphic unit is placed at the bottom of the first red shale bed of the Chooz Formation.

At the stratotype, Godefroid & Stainier (1988, 1994c) subdivided the Vireux Formation into two members, from base to top: the Écluse and Ruisseau de Deluve members. The **Écluse Member – ECL** (*Membre de l'Écluse* in Godefroid & Stainier, 1988, p. 99) is made of thick masses of frequently lenticular beds of grey, bluish-grey or locally greenish quartzitic sandstone that are separated by thick beds of dark grey shale. The vertical arrangement of the lithologies suggests sequential shallowing-upwards deposits (Cibaj, 1992). Sedimentary structures (cross-beds, ripple marks, load and groove casts, ball-and-pillows) are frequent. Discontinuous and thin fossiliferous horizons (brachiopods, bivalves, crinoids, tabulate corals, trilobites) are observed in the sandstone beds. The **Ruisseau de Deluve Member – RDL** (*Membre du Ruisseau de Deluve* in Godefroid & Stainier, 1988, p. 99) comprises thick masses of quartzitic or argillaceous, bluish-grey or more frequently greenish sandstone alternating with greenish or, more rarely, dark grey shale. It only yielded plant remains. The boundary between the two members is defined at the top of the last bed containing macrofossils and sedimentary structures. It is not clear-cut from the lithological viewpoint; therefore, Godefroid & Stainier (1988, 1994c) placed it at the top of the last bed yielding macrofauna, but again, this criterion cannot be easily applied on isolated outcrops. Hence, both members are not distinguished on the geological maps of Wallonia (e.g. Dumoulin & Coen, 2008).

Stratotype and sections. Disused Montigny quarries, on the left bank of the Meuse River, between Vireux-Molhain and Montigy-sur-Meuse (France). The stratotype can be complemented with the section of the abandoned Mont de Vireux quarry at Vireux-Molhain (Fig. 19C) although the contact with the underlying Ruisseau de la Forge Formation is not exposed.

Area and lateral variations. The Vireux Formation is recognised on the southern and south-eastern flanks of the Dinant Synclinorium up to the Aisne River valley, where it passes laterally to the Wépion Formation (Marion & Barchy, in press, a).

Thickness. It considerably varies, from the west to the east: c. 100 m south of Couvin (Marion & Barchy, 1999), c. 130 m in the Meuse River valley (Montigny-sur-Meuse: 66 m for the Ruisseau Deluve Member and 54 m for the Écluse Member, Dumoulin & Coen, 2008), and 350 m in the Lesse River valley (Blockmans et al., 2019).

Remark. The definition of the upper limit of the Vireux Formation varies on both sides of the Belgian–French border as pointed out by Godefroid & Stainier (1994c) and Dumoulin & Coen (2008). Belgian geologists use the first appearance of the red colour to place the base of the overlying Chooz Formation in contrast with their French counterparts who use a lithological change. Consequently, on the last version of the geological map of Givet (Lacquement et al., 2006a, 2006b), the Vireux Formation is 200 m thick in the Meuse River valley, covering therefore the sandy basal part of the overlying Chooz Formation.

Age. Traditionally ascribed to the lower part of the Emsian following the tripartite subdivision of this stage (e.g. de Dorlodot, 1901; Conseil géologique, 1929) but elements for a precise dating are lacking (see also Chooz Formation).

Use. The sandstone was intensively exploited for the production of cobblestones and building stone, essentially in the Meuse River valley.

Main contributions. Godefroid & Stainier (1988, 1994c), Cibaj (1992).

Waimes Member – WAI

See Fooz Formation.

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 poudinguiforme de Warche intraformationnel* as a part of the *Quartzites 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 lateral equivalent, namely the Kautenbach–Troisvierges Formation. In Germany, the group would correspond to the Monschau, Rurberg and Wüstebach formations (Ribbert et al., 1992), i.e. the *Siegen-*

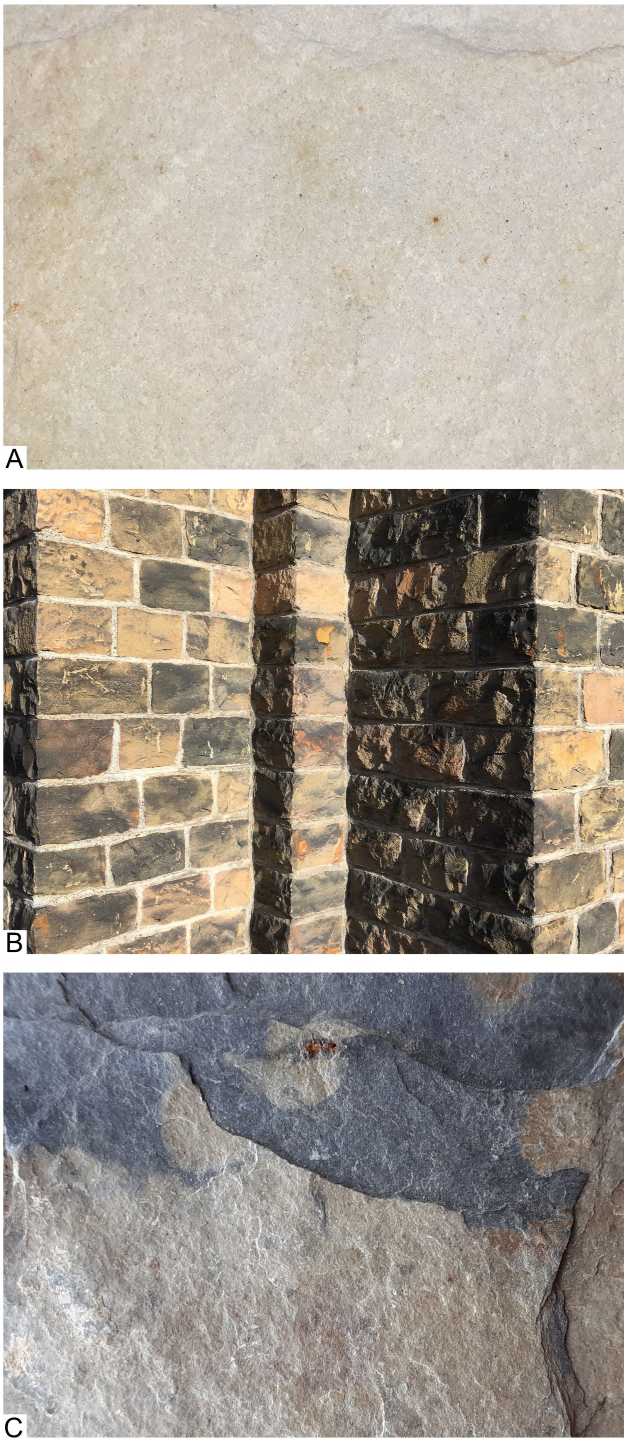

Figure 20. Illustration of some Lower Devonian units. **A.** White quartzitic sandstone of the Staneux Member of the Wépion Formation. Hand sample from the Staneux quarry (width of the picture c. 5 cm). **B.** Typical look of the brownish and orange Wépion sandstone used as building stone. Church at Les Forges, Marchin, in the Hoyoux River valley. **C.** Dark grey shale with typical brownish-beige weathering colour of the Wiltz Formation. Hand sample from Volaiville (width of the picture c. 4 cm).

Stufe of the classical German literature.

Type area. Discontinuous outcrops along the Warche valley between Bullange (Büllingen) and the Robertville lake.

Wépion Formation – WEP

Origin of name. After Les Collets locality in Wépion, in the Meuse River valley, *Grès de Wépion* in Gosselet (1888, p. 355).

Description. The Wépion Formation was divided into two members by Stainier (1994g), namely the Grand Ri and Bois des Collets members. The **Grand Ri Member – GRI** (*Membre du Grand Ri* in Stainier, 1994g, p. 128) begins with a thick bed of green quartzite with a conglomeratic base (white quartz, green or red sandstone and tourmalinite pebbles). It then passes to thick units of blue-grey, greenish or reddish sandstone and quartzite that alternate with thickly bedded, grey, green or red shale and siltstone beds that include some thin sandstone beds. Then come quartzites and blue or greenish argillaceous sandstones of which beds are frequently lenticular. They form thick bundles that are separated by thick units of grey, black or mottled shales and siltstones. These finer lithologies comprises decimetre- to pluridecimetre-thick beds of green and red sandstone beds, generally well-stratified. Desiccation cracks and raindrop impressions occur in the pelitic horizons, which often contain plant debris (e.g. Gerrienne, 1994).

The **Bois des Collets Member – BCO** (*Poudingue du Bois des Collets* in Stainier, 1891, p. M44) consists of very coarse-grained to conglomeratic sandstones that are separated by shales. The siliciclastic rocks of this member are all ferruginous, cellular and green. The coarse-grained and conglomeratic beds are more and more frequent upsection, marking the coarsening-upward trend that culminates in the overlying Burnot Formation.

In the Theux Window, a unit of whitish coarse-grained quartzitic sandstone with thin shaly interbeds develops laterally to the sandstone. It is here named **Staneux Member – STN** (*Grès de Staneux* in Asselberghs, 1954, p. 106) (Fig. 20A).

Stratotype and sections. On both sides of the Meuse River valley, at Dave and Wépion. The disused Dave quarry exposes the contact between the Acoz and Wépion formations whereas the abandoned Bois des Collets quarry at Wépion displays the upper part of the Formation. The contact with the overlying Burnot Formation is observed south of the southernmost quarry located at Wépion, near the ruins of an old masonry building (Delcambre & Pingot, 2017). The Staneux Member is exposed in the eponymous quarry, south of Theux (Marion et al., in press).

Area and lateral variations. North and eastern margins of the Dinant Synclinorium, up to the Mormont Fault (van Tuijn, 1927), where it passes to the Vireux Formation (Marion & Barchy, in press, b). According to Asselberghs (1946), the Bois des Collets Member is observed from Binche to the Fond d'Oxhe, south-east of Ombret. The Staneux Member is only known from the Theux Window.

Thickness. The Formation is 200 m thick in the Sambre River valley (Hennebert, 2008), 280 m at Acoz (Stainier, 1994g), 300–400 m thick in the Meuse River valley (Delcambre & Pingot, 2017), 400–450 m thick in the Hoyoux valley (Mottequin et al., 2021), 200–300 m thick in the Ourthe River valley (Delcambre, in press) and thins out to 0 m in the Theux Window.

Age. Emsian AB Zone (Steemans, 1989a). The Staneux Member yielded an assemblage indicative of the Su to AB zones, i.e. an age slightly older than the Wépion Formation in the Meuse River valley (Steemans, 1987).

Use. The sandstones were extensively quarried for building purposes (building and facing stones, Fig. 20B) and aggregates. The white sandstone of the Staneux Member are still quarried in the eponymous quarry.

Main contributions. Stainier (1891), Asselberghs (1946), Michot & Pirlet (1987), Steemans (1987, 1989a), Stainier (1994g), Delcambre & Pingot (2017).

Wiltz Formation – WIL

Origin of name. After the town of Wiltz (Grand Duchy of Luxembourg), *Schistes de Wiltz* in Gosselet (1885, p. 262).

Description. The Wiltz Formation consists of dark grey to greenish-grey shale and siltstone displaying a fine cleavage (Fig. 20C) and overlying top of the Berlé Quartzite or the variegated shale of the Clervaux Formation. It includes some rare thin sandstone beds and more frequent, more or less decalcified carbonate nodules, which are usually transformed in limonite. The lower part of the Formation yields an abundant fauna (crinoids, brachiopods, bivalves, corals, trilobites, see Franke, 2010) preserved as steinkerns. In the upper part, centimetre- to decimetre-thick beds of greenish-grey sandstone occur in metre-thick bundles. They are lenticular and display oblique stratifications and basal erosional surfaces.

Stratotype and sections. The stratotype is located along the disused railway between Wiltz and Schleif (Grand Duchy of Luxembourg). In Belgium, the basal part of the Formation is exposed between Traimont and Witry (Ghysel, 2023).

Area and lateral variations. Neufchâteau–Eifel Synclinorium, east of Ebly.

Thickness. The Formation is up to 300 m thick in the Belgian part of the Neufchâteau–Eifel Synclinorium (Ghysel, 2023), and up to 700 m thick near Clervaux in the Grand Duchy of Luxembourg (Dejonghe, 2021). The top of the Formation is not exposed in Belgium and Luxembourg. In the German part of the Neufchâteau–Eifel Synclinorium, the Wiltz Formation is overlain by the sandstone-dominated *Wetteldorf-Schichten* (Werner, 1969).

Age. Late Emsian (middle and upper parts) based on the diverse brachiopod fauna (Jansen, 2016). Steemans et al. (2000) recognised a spore assemblage indicative of the Late Emsian AP Zone.

Use. Nil.

Main contributions. Asselberghs (1913, 1946), Franke (2010), Michel et al. (2010), Dejonghe (2021), Ghysel (2023).

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Author contribution

JD and BM participated equally to the research, writing and illustration of the paper.

Data availability

The fossils and rock samples figured here are part of the collections of the Royal Belgian Institute of Natural Sciences, Service géologique de Wallonie and University of Liège.

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