Palaeobio Palaeoenv
DOI 10.1007/s12549-016-0236-1

SENCKENBERG CrossMark

ORIGINAL PAPER

Ostracods and rock facies across the Emsian/Eifelian boundary at Couvin (Dinant Synclinorium, Belgium)

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Received: 26 November 2015 / Revised: 31 March 2016 / Accepted: 28 April 2016

Abstract A moderately rich ostracod fauna is reported from the upper part of the St. Joseph Formation (Fm), the Eau Noire Fm and the lower part of the Couvin Fm in the Eau Noire section located nearby Couvin. The section that crosses the Emsian/Eifelian boundary belongs entirely to the Couvinian historical stage. The ostracod fauna observed appertains to the Eifelian Mega-Assemblage and is indicative, in the Eau Noire Fm and in the Couvin Fm, of continuous shallow open-marine environments close to the fair-weather wave-base. The sampling and the number of ostracods extracted from the St. Joseph Fm are not sufficient to make environmental inferences and the study does not demonstrate an abnormal change in the ostracod fauna neither in relation with the Eau Noire Fm/Couvin Fm boundary, nor in relation with the Emsian/Eifelian boundary. The ostracods present near the Emsian/Eifelian boundary are mentioned for the first time in the southern border of the Dinant Synclinorium and they display close relations with the Eifel Mountains (Germany) and the Holy Cross Mountains (Poland).

This article is a contribution to the special issue "Climate change and biodiversity patterns in the mid-Palaeozoic".

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Keywords Ostracods · Emsian · Eifelian · Sedimentology · Palaeoecology · Palaeoclimatology · Ardenne

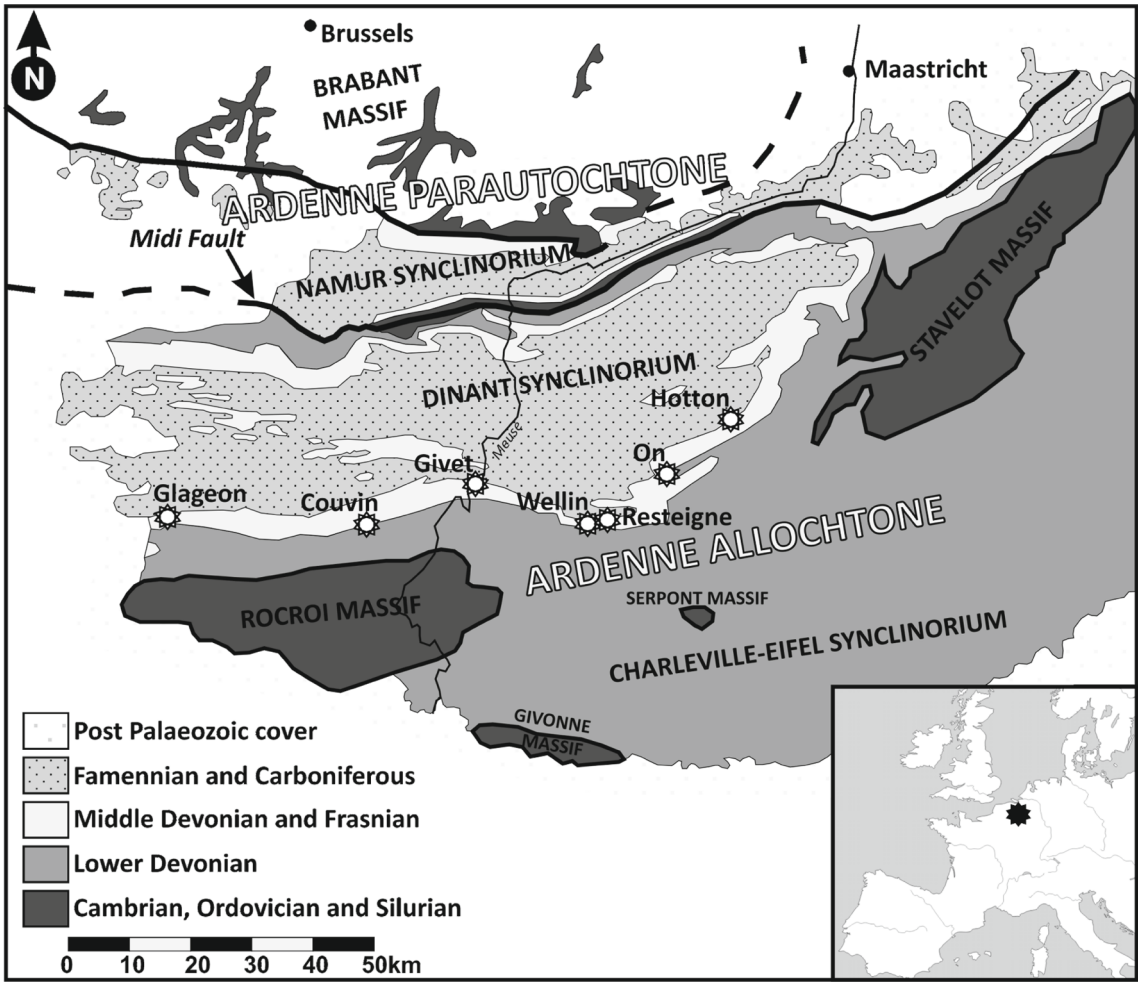
Introduction

Ostracods present close to the Emsian/Eifelian boundary in the Ardenne are studied for the first time. The investigated section is located along the Eau Noire River nearby Couvin, at a place named 'La Foulerie' (N50° 02′ 41″; E4° 29′ 49″, Fig. 1). The Eau Noire section exposes the upper part of the St. Joseph Formation (Fm), the stratotype of the Eau Noire Fm and the stratotype of the La Foulerie Member (Mbr), the lower member of the Couvin Fm (Fig. 2). The Emsian/Eifelian boundary is marked in this section by the entry of conodonts belonging to the *partitus* Zone, 50 m above the base of the Eau Noire Fm (Bultynck et al. 1991; Bultynck and Dejonghe 2001). The Eau Noire section studied by Bultynck (1970), Bultynck and Godefroid (1974), Bultynck et al. (1991) and Mamet and Préat (1994) belongs entirely to the Couvinian historical stage. In the Ardenne, ostracods have been studied in the upper part of the Eifelian at Couvin, Resteigne, Wellin, On-Jemelle and Hotton in Belgium (Casier and Préat 1990; Casier et al. 1992, 1995, 2015), but the exact position of the Eifelian/Givetian boundary in the Ardenne is still in debate (Casier et al. 2015).

Lithological and sedimentological contexts

The St. Joseph Fm is composed of light-greyish shelly crinoidal limestones, occasionally silty, interlayered in a grey-greenish silty shaly succession. The conodonts in the St. Joseph Fm belong to the *patulus* Zone and the stratotype

Published online: 01 June 2016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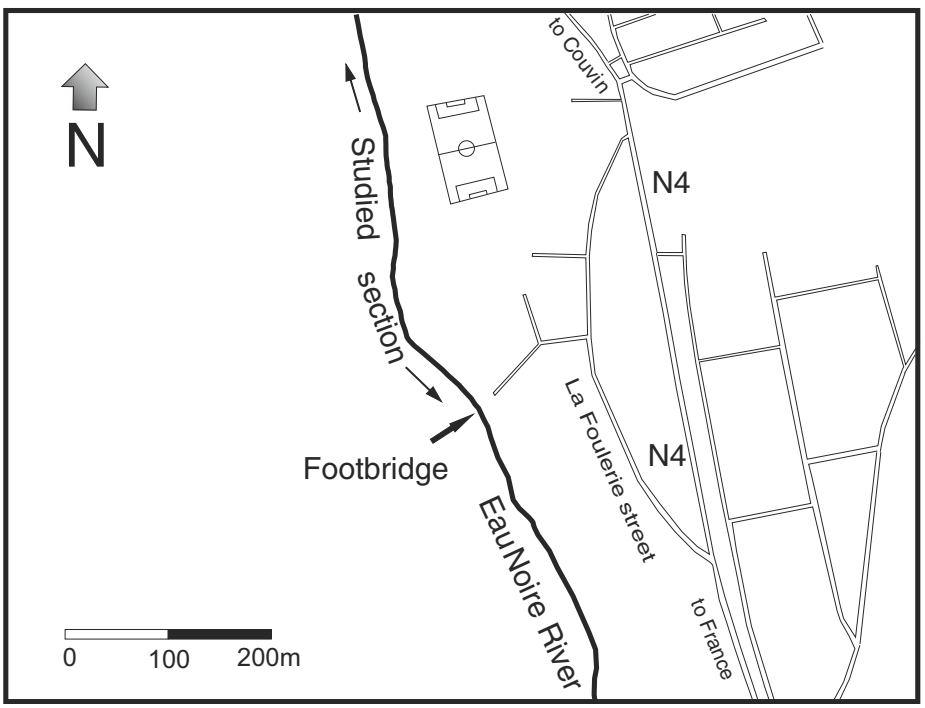
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◀ **Fig. 1** Localisation map of the Eau Noire section, Couvin and other localities cited in the text. Structural setting of Devonian formations of the Ardenne (adapted from Bultynck et al. 1991)

of this formation is located close to Nismes, in the St. Joseph hamlet (Bultynck et al. 1991; Bultynck and Dejonghe 2001).

The lower part of the stratotype of the Eau Noire Fm consists essentially of greyish calcareous shales with bioclasts and a few nodules interlayered in argillaceous nodular limestone beds. The upper part of the Eau Noire Fm alternates between calcareous shales with bioclasts and crinoidal limestone (Bultynck et al. 1991; Bultynck and Dejonghe 2001).

Finally, the base of the stratotype of the La Foulerie Mbr (lower part of the Couvin Fm) exposes well-bedded dark bluish crinoidal limestones with laminar and globular stromatoporoids and rugose corals, overlain by dark bluish argillaceous limestone beds with occasionally thin calcareous nodular shales. The upper part is composed of crinoidal limestones frequently dolomitized, with globular stromatoporoids and branching tabulate corals. The conodonts belong to the *partitus* and *costatus* Zones in the La Foulerie Mbr (Bultynck et al. 1991; Bultynck and Dejonghe 2001).

Ostracods (Figs. 3, 4)

Material and methods

All samples collected in the Eau Noire section were crushed by a hydraulic press and approximately 100 g of each was processed using 99.8 % glacial acetic acid, at nearly 90 °C. This mode of extraction, called hot acetolysis method, is described by Lethiers and Crasquin-Soleau (1988) and Crasquin-Soleau et al. (2005). The residues were sieved on 100, 250 and 1600 μm mesh screens. 1,077 carapaces, valves and fragments of ostracods identifiable at any taxonomic level were thus extracted from 67 samples. They are deposed in the collection of the Earth and History of Life O. D. of the Royal Belgian Institute of Natural Sciences. Collection numbers are detailed in the figure captions.

Two ostracods were extracted from one sample numbered EN6 collected in the top of the St. Joseph Fm. One hundred and one ostracods were extracted from nine samples numbered EN7 to EN44 collected in the Eau Noire Fm. Finally, 974 ostracods were extracted from 27 samples numbered EN 51 to EN 168, and ENO2 to ENO104 in the Couvin Fm (see Fig. 2 for the stratigraphical position of these samples).

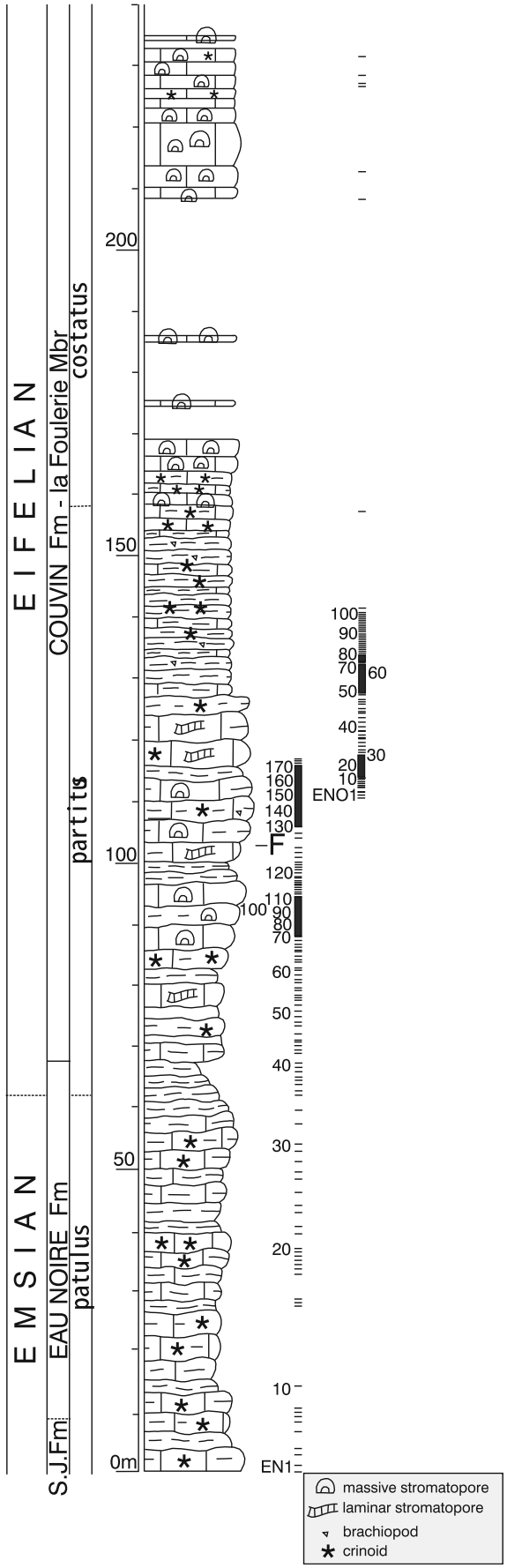
Ostracods are present in almost all the samples collected except in the upper part of the La Foulerie Mbr where samples numbered ENO9, 12, 15, 21, 27, 38, 43, 47, 48, 58, 80, 84, 91, 105, 106 and 108 were barren. The sampling is also sparse in the upper part of the section due to the abundance of stromatoporoids. In the following samples, ostracods were undeterminable: EN13, 34, 56, 112 and 160 and ENO58, 71, 79 and 84.

Palaeoecological results

More than 42 ostracod taxa have been identified in the Eau Noire section, a low diversity compared to the thickness (230 m) of the series. Fourteen belong to the Palaeocopina, one to the Paraparchiticopina, two to the Platycopina, seven to the Metacopina and 18 to the Podocopina (Appendix 1). All species are benthic and pertain to the Eifelian Mega-Assemblage which corresponds to the incorrect term 'Eifeler Ökotyp' of Becker (in Bandel and Becker 1975; see Casier 2004). Several neritic assemblages are recognised within this mega-assemblage (Casier 1987; Casier 2008, Fig. 1; Casier and Préat 2003, Fig. 3); they are indicative of lagoonal (assemblage 0), of semi-restricted (assemblage I) or of open-marine environments from shallow waters above fair-weather wave base (assemblage II) to deeper waters below fair-weather wave base and sometimes below storm-wave base (assemblage III). In this last assemblage, the relative proportion of metacopines and podocopines is related to the oxygen content of the bottom waters and consequently to the water depth (*Ibid.*). In deep neritic settings, only metacopines and palaeocopines ostracods are present, and in such a case the last assemblage is equivalent to the Malvinokaffric 'ecotype' of Lethiers et al. (2001) as demonstrated by the recent study of ostracods from the Belen Fm at Pisacavina, in Bolivia (Casier in Racheboeuf et al. 2012).

Only two species, *Microcheilinella affinis* and another belonging to the genus *Parakozlowskiella*, were extracted from the single sample collected in the St. Joseph Fm. The environment was open-marine as indicated also by the abundance of crinoids in these levels (Fig. 2).

Thirteen species are recognised in the Eau Noire Fm. Five belong to the Palaeocopina (*Kozlowskiella* sp. A, *Parakozlowskiella* sp. indet., *Ochescapha ornatissima*, *Ochescapha mobilis delicata* and *Guerichiella* sp. A, aff. *meridiensis*) and 6 to the Podocopina (*Tubulibairdia* aff. *cognata*, *Micronewsomites* sp. A, aff. *notabilis*, *Bairdiocypris* sp. indet., *Bairdia cultrijugati*, *Bairdia dispar*, *Bairdiacypris antiqua*). The Metacopina are represented by *Ropolonellus robustus* in a single sample (EN31) and the Paraparchiticopina, also in a single sample (EN19) by *Coeloenellina* cf. *cuertenensis*. The environment was open-marine, well-oxygenated and shallow as indicated by the abundance of podocopines and rarity of metacopines. In the Eau Noire Fm, *Bairdia cultrijugati*, 1950 is notably present in



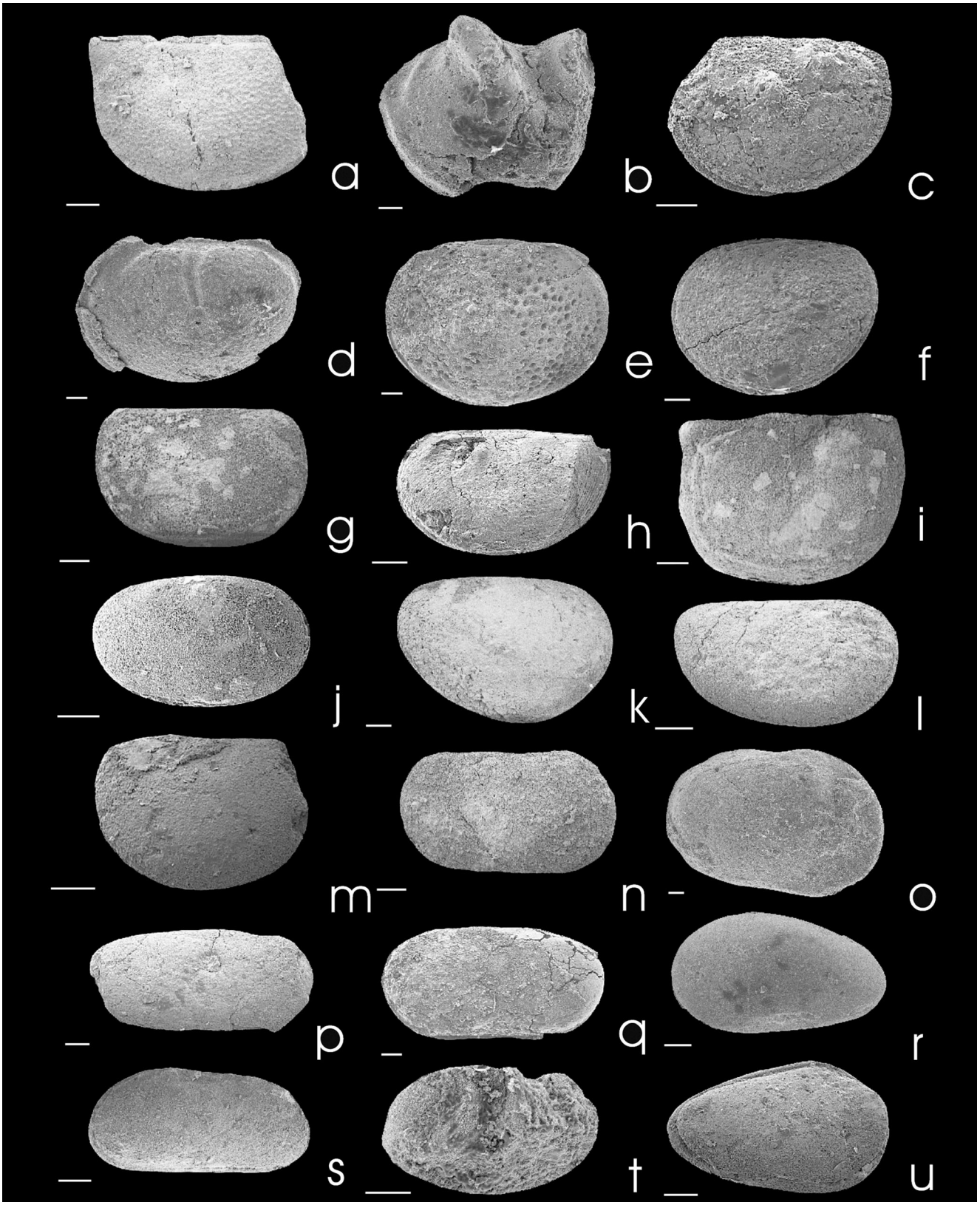
◀ **Fig. 2** Lithological column of the Eau Noire section, conodont zones recognised by Bultynck in Bultynck et al. (1991) and position of samples

almost all the samples and *Bairdiacypris antiqua* appears in the upper part of the formation.

In the Couvin Fm, the ostracod assemblages are composed of 10 Palaeocopina (*Obotritia eifeliensis*; *Kozlowskiella kozlowskii*; *Kozlowskiella* sp. A; *Kielciella fastigans*; *Guerichiella septentrionensis*; *Guerichiella* sp. A, aff. *meridiensis*; *Aparchites?* sp. A; *Aparchites?* sp. indet.; *Fellerites* sp. indet. and *Amphissella calceolae*), of two Platycopina (*Uchtovia kloedenellides* and *Uchtovia testis*), of seven Metacopina (*Cytherellina* sp. A?; *Cytherellina* sp. B, aff. *perlonga*; *Polyzygia?* sp. indet.; *Bufina granulata*; *Ropolonellus robustus*; *Jenningsina catenulata* and *Amphicostella* sp. indet.) and finally of 16 Podocopina (*Ampuloides* sp. indet.; *Pachydomella?* cf. *reticulata*; *Tubulibairdia* aff. *cognata*; *Microcheilinella affinis*; *Micronewsomites* sp. A, aff. *notabilis*; *Praepilatina* sp. A; *Praepilatina* sp. indet.; *Bairdiocypris soetenica*; *Bairdiocypris* sp., aff. *lamellaris*; *Bairdiocypris* sp. A; *Condracypris ? circumvallata*; *Bairdia cultrijugati*; *Bairdia* sp. A; *Acratia?* sp. indet.; *Bairdiacypris antiqua*; *Bairdiacypris* sp. indet.). The open-marine, well-oxygenated and shallow environmental conditions prevailed also in the Couvin Fm.

The study does not demonstrate an abnormal change in the ostracod fauna neither in relation with the Eau Noire Fm/

Fig. 3 Ostracods recognised in the Eau Noire section. *EA Fm* Eau Noire Fm, *C Fm* Couvin Fm, *LV* left valve, *RV* right valve, *LC* left lateral view of a carapace, *RC* right lateral view of a carapace, *DV* dorsal view. IRScNB n. b… indicates the number in the collection of the 'D.O. Terre et Histoire de la Vie' of the Royal Belgian Institute of Natural Sciences. Scale bar = 100 μm. **a** *Obotritia eifeliensis* Adamczak, 1968. RC fragment. C Fm. ENO65. IRScNB n° b6764. **b** *Kozlowskiella kozlowskii* (Přibyl, 1953). RC fragment. C Fm. ENO5. IRScNB n° b6765. **c** *Kozlowskiella* sp. A. LC. EA Fm. EN44. IRScNB n° b6766. **d** *Parakozlowskiella* sp. indet. RV. EA Fm. EN35. IRScNB n° b6767. **e** *Ochescapha ornatissima* (Gürich, 1896). RC. EA Fm. EN31. IRScNB n° b6768. **f** *Ochescapha mobilis delicata* Adamczak, 1968. RC. EA Fm. EN35. IRScNB n° b6769. **g** *Kielciella fastigans* (Becker, 1964). RC. C Fm. ENO65. IRScNB n° b6770. **h** *Guerichiella septentrionensis* Adamczak, 1968. LC. EA Fm. EN31. IRScNB n° b6771. **i** *Guerichiella* sp. A, aff. *meridiensis* Adamczak, 1968. RV. C Fm. ENO62. IRScNB n° b6772. **j** *Aparchites?* sp. A. LC. C Fm. EN55. IRScNB n° b6773. **k** *Aparchites* sp. indet. LC. C Fm. ENO62. IRScNB n° b6774. **l** *Aparchites?* sp. indet. LC. C Fm. ENO69. IRScNB n° b6775. **m** *Fellerites* sp. indet. RC. C Fm. EN57. IRScNB n° b6776. **n** *Amphissella calceolae* (Gürich, 1896). LC. C Fm. ENO74. IRScNB n° b6777. **o** *Coeloenellina* cf. *cuertenensis* Becker, 1964. LV. EA Fm. EN19. IRScNB n° b6778. **p** *Uchtovia kloedenellides* (Adamczak, 1968). RC. C Fm. EN55. IRScNB n° b6779. **q** *Uchtovia testis* (Adamczak, 1968). LC. C Fm. EN139. IRScNB n° b6780. **r** *Cytherellina* sp. A Becker 1965? RC. C Fm. EN91. IRScNB n° b6781. **s** *Cytherellina* sp. B, aff. *perlonga* (Kummerow, 1953). RC. C Fm. ENO65. IRScNB n° b6782. **t** *Polyzygia?* sp. indet. V Fragment. C Fm. ENO30. IRScNB n° b6783. **u** *Ropolonellus robustus* Adamczak, 1976. RC Fm. EN150. IRScNB n° b6784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Couvin Fm boundary (7/12 species recognised here and there), nor in relation with the Emsian/Eifelian boundary (7/13 species recognised here and there).

Geographic distribution of species recognised in the Ardenne Massif

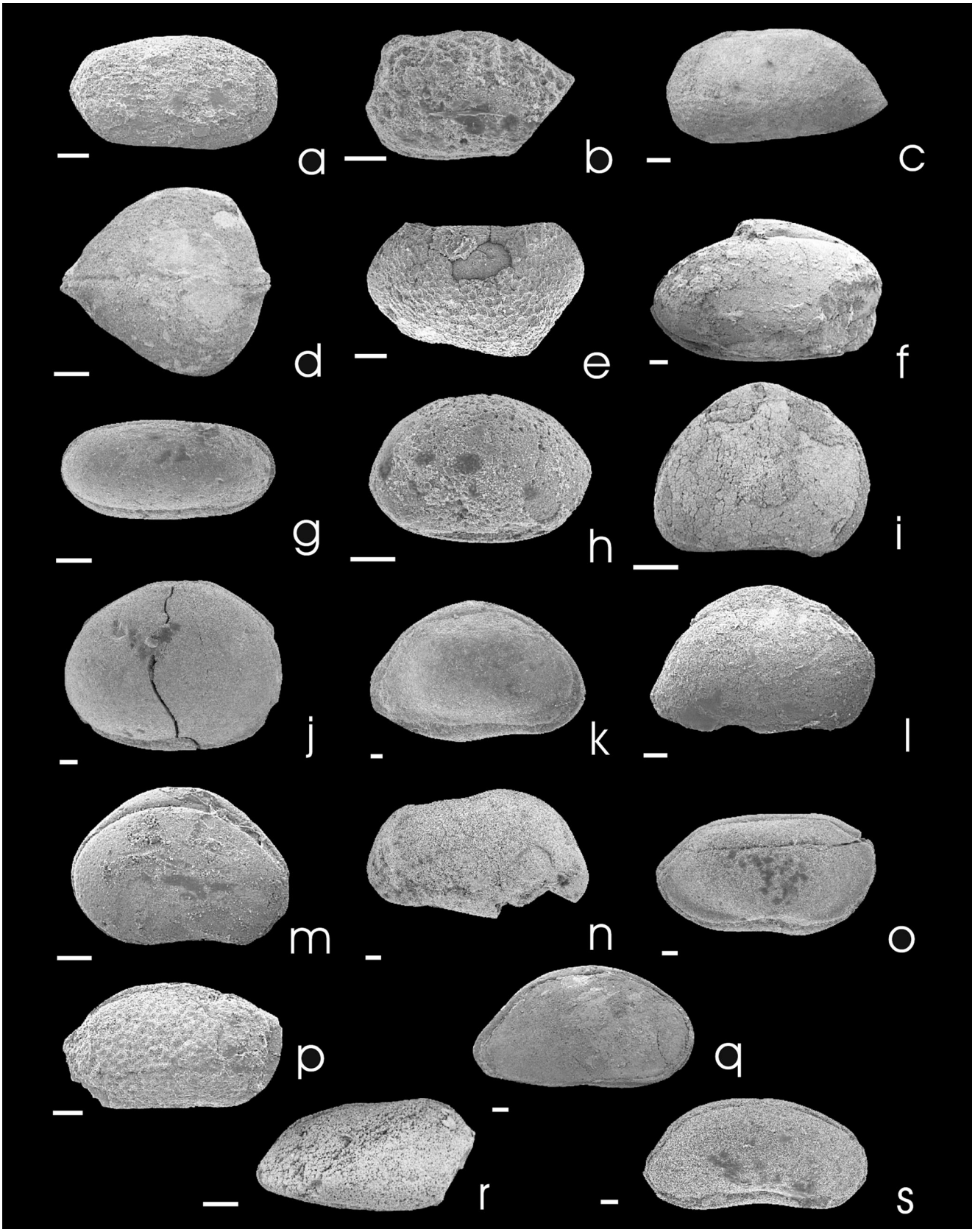
The closest faunal relations exist with Poland and Germany. Fourteen (16?) species are known from the Grzegorzowice Fm and one of those also from the Skaly Fm in the Holy Cross Mountains of Poland (Gürich 1896; Přibyl 1953; Adamczak 1968, 1976). Nine (12?) are known from the Heisdorf Schichten to the Rodert Schichten in Eifel, and two of those also from the Hobräck Schichten in the Bergisches Land (Krömmelbein 1950; Becker 1964, 1965; Becker and Bless 1974; Groos 1969; Becker and Groos-Uffenorde 1982). *Microcheilinella affinis* Polenova, 1955 was described for the first time from Southern Oural in Russia and *Jenningsina catenulata* (Van Pelt, 1933) is also known from the Givetian of the Boulonnais (France), the Huergas and Candás Fms in North-western Spain, from the Bell Shales (late Eifelian-early Givetian) in Michigan and from the Windom Shales (middle Givetian) in the New York State (Polenova 1955; Van Pelt 1933; Stover 1956; Becker 1988; Milhau 1988; Maillet et al. 2016).

The important development of the reef activity over a long distance and therefore their association with shallow deposits during the Middle Devonian explains the close faunal relationships between the Ardenne, the Eifel and the Holy Cross Mountains (Rhenohercynian ostracod province of Maillet et al. 2013a, b). Only one species, *Jenningsina catenulata* (Van Pelt, 1933), shows a much larger geographic distribution. In reality, this last species belongs to the metacopines, the majority of which are cosmopolite. Beside the cosmopolitan-swimming entomozoidean ostracods, characterised by their particular fingerprint ornamentation, and the deep-water spiny ostracods of the Thuringian Mega-Assemblage, only the metacopines possess a biostratigraphic value beyond the regional scale during a large part of the Devonian (Casier 2008).

Conclusions

Ostracods belong exclusively to the Eifelian Mega-Assemblage in the Eau Noire section. In the St. Joseph Fm, the sampling is insufficient to precise the environment. In the Eau Noire Fm and in the Couvin Fm, the great abundance of podocopines, the rarity of palaeocopines and the quasi absence of metacopines indicate continuous shallow open-marine environments close to the fair-weather wave-base. Ostracods with thick carapaces and belonging to the genera *Bairdia*, *Bairdiocypris*, *Tubulibairdia* and *Microcheilinella* prevailed in agitated environments. *Bairdia cultrijugati* Krömmelbein, 1950 is the most abundant species and is present in almost all the samples. No assemblage indicative of semi-restricted or of lagoonal water conditions has been observed. The sedimentation conditions and the climate were certainly relatively stable during the deposition of the studied formations. Such environmental stability differs strongly from the Givetian, during which the reefal activity increased with the extension of semi-restricted and lagoonal environments behind the reefal barrier (e.g. Maillet et al. 2013a, b; Casier et al. 2013, 2015). For ostracods, close relations existed with the Eifel (Germany) and the Holy Cross Mountains (Poland) during the late Emsian and early Eifelian.

Fig. 4 Ostracods recognised in the Eau Noire section. *EA Fm* Eau Noire Fm, *C Fm* Couvin Fm, *LV* left valve, *RV* right valve, *LC* left lateral view of a carapace, *RC* right lateral view of a carapace, *DV* dorsal view. IRScNB n. b… indicates the number in the collection of the 'D.O. Terre et Histoire de la Vie' of the Royal Belgian Institute of Natural Sciences. Scale bar = 100 μm. **a** *Jenningsina catenulata* (Van Pelt, 1933). RV. C Fm. EN104. IRScNB n° b6785. **b** *Amphicostella* sp. indet. C Fm. RC? ENO32. IRScNB n° b6786. **c** *Ampuloides* sp. indet. C Fm. DV. ENO65. IRScNB n° b6787. **d** *Ampuloides* sp. indet. DV. C Fm. ENO65. IRScNB n° b6788. **e** *Pachydomella?* cf. *reticulata* Adamczak, 1976. LV. C Fm. ENO99. IRScNB n° b6789. **f** *Tubulibairdia* aff. *cognata* (Krömmelbein, 1955). RC. C Fm. EN55. IRScNB n° b6790. **g** *Microcheilinella affinis* Polenova, 1955. RC. C Fm. EN91. IRScNB n° b6791. **h** *Micronewsomites* sp. A, aff. *notabilis* (Polenova, 1955). RC. C Fm. ENO66. IRScNB n° b6792. **i** *Praepilatina* sp. A. RC. C Fm. ENO74. IRScNB n° b6793. **j** *Praepilatina* sp. indet. RC. C Fm. EN91. IRScNB n° b6794. **k** *Bairdiocypris soetenica* Becker, 1965. RC. C Fm. EN91. IRScNB n° b6795. **l** *Bairdiocypris* sp., aff. *lamellaris* Adamczak, 1976. RC. C Fm. EN64. IRScNB n° b6796. **m** *Bairdiocypris* sp. A. RC. C Fm. EN139. IRScNB n° b6797. **n** *Condracypris? circumvallata* (Kummerow, 1953). LV. C Fm. ENO69. IRScNB n° b6798. **o** *Bairdia cultrijugati* Krömmelbein, 1950. RC. C Fm. ENO69. IRScNB n° b6799. **p** *Bairdia dispar* Adamczak, 1976. RC. EA Fm. C Fm. EN35. IRScNB n° b6800. **q** *Bairdia* sp. A. C Fm. RC. EN139. IRScNB n° b6801. **r** *Acratia?* sp. indet. RC. C Fm. ENO62. IRScNB n° b6802. **s** *Bairdiacypris antiqua* (Pokorńy, 1951). RC. C Fm. EN57. IRScNB n° b6803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Acknowledgements This paper is a contribution to IGCP project n. 596 'Climate change and biodiversity patterns in Mid-Paleozoic (Early Devonian to Lower Carboniferous)'. We appreciate the helpful reviews of our manuscript by Claudia Dojen (Landesmuseum Kärnten, Austria) and Bruno Milhau (Université catholique de Lille).

Appendix 1: Taxonomic and stratigraphical positions of ostracod taxa in the Eau Noire section

Order Palaeocopida Henningsmoen, 1953
Suborder Palaeocopina Henningsmoen, 1953
Superfamily Kirkbyoidea Ulrich and Bassler, 1906
Family Arcyzonidae Kesling, 1961
Obotritia eifeliensis Adamczak, 1968 (Fig. 3a). ENO65.
Superfamily Hollinoidea Swartz, 1936
Superfamily Beyrichioidea Matthew, 1886
Family Beyrichidae Matthew, 1886
Kozlowskiella kozlowskii (Přibyl, 1953) (Fig. 3b). EN64; ENO5, 139.
Kozlowskiella sp. A (Fig. 3c). EN32, 44, 57, 139?; ENO95.
Parakozlowskiella sp. indet. (Fig. 3d). EN6, 35.
Ochescapha ornatissima (Gürich, 1896) (Fig. 3e). EN31, 35, 40.
Ochescapha mobilis delicata Adamczak, 1968 (Fig. 3f). EN35.
Superfamily Primitiopsoidea Swartz, 1936
Family Primitiopsidae Swartz, 1936
Kielciella fastigans (Becker, 1964) (Fig. 3g). ENO62, 65, 69.
Guerichiella septentrionensis Adamczak, 1968 (Fig. 3h). EN31, 35, 64.
Guerichiella sp. A, aff. *meridiensis* Adamczak, 1968 (Fig. 3i). ENO62.
Superfamily Aparchitoidea Jones, 1901
Family Aparchitidae Jones, 1901
Aparchites? sp. A (Fig. 3j). EN55, 57, 66, 109, 129; ENO30?, 66, 69, 95.
Aparchites sp. indet. (Fig. 3k). ENO62.
Aparchites? sp. indet. (Fig. 3l). ENO35, 69.
Family Rohzdestvenskayitidae Mc Gill, 1966
Fellerites sp. indet. (Fig. 3m). EN57.
Superfamily unknown
Family Scrobiculidae Posner, 1951
Amphissella calceolae (Gürich, 1896) (Fig. 3n). EN51; ENO66?, 74.
Suborder Paraparchiticopina Gramm in Gramm and Ivanov (1975)
Superfamily Paraparchitoidea Scott, 1959
Family Paraparchitidae Scott, 1959
Coeloenellina cf. *cuertenensis* Becker, 1964 (Fig. 3o). EN19.
Suborder Platycopina Sars, 1866
Superfamily Kloedenelloidea Ulrich and Bassler, 1908
Family Kloedenellidae Ulrich and Bassler, 1908
Uchtovia kloedenellides (Adamczak, 1968) (Fig. 3p). EN55.
Uchtovia testis (Adamczak, 1968) (Fig. 3q). EN64?, 139; ENO7, 62, 65?
Order Podocopida Sars, 1866
Suborder Metacopina Sylvester-Bradley, 1961
Superfamily Healdioidea Harlton, 1933
Family Healdiidae Harlton, 1933
? *Cytherellina* sp. A Becker 1965 (Fig. 3r). EN91; ENO95.
Cytherellina sp. B, aff. *perlonga* (Kummerow, 1953) (Fig. 3s). ENO65.
Superfamily Thlipsuroidea Ulrich, 1894
Family Thlipsuridae Ulrich, 1894
Polyzygia? sp. indet. (Fig. 3t). ENO30.
Family Bufinidae Sohn and Stover, 1961
? *Bufina granulata* Adamczak, 1976*e* ENO33.
Superfamily Quasillitoidea Coryell and Malkin, 1936
Family Ropolonellidae Coryell and Malkin, 1936
Ropolonellus robustus Adamczak, 1976 (Fig. 3u). EN31, 150, 162; ENO66?, 74.
Family Quasillitidae Coryell and Malkin, 1936
Jenningsina catenulata (Van Pelt, 1933) (Fig. 4a). EN162?, EN104.
Amphicostella sp. indet. (Fig. 4b). ENO32.
Suborder Podocopina Sars, 1866
Superfamily Bairdiocypridoidea Shaver, 1961
Family Pachydomellidae Berdan and Sohn, 1961
Ampuloides sp. indet. (Figs. 4c, d). EN64; ENO35?, 64, 104?
Pachydomella? cf. *reticulata* Adamczak, 1976 (Fig. 4e). ENO99.
Tubulibairdia aff. *cognata* (Krömmelbein, 1955) (Fig. 4f). EN7?, 31, 35, 38, 55, 57, 62, 64, 91, 92, 126, 129, 139, 150; ENO92?
Microcheilinella affinis Polenova, 1955 (Fig. 4g). EN6, 62, 64, 91, 117; ENO7, 32?, 49, 52, 55, 57, 65, 69, 74.
Micronewsomites sp. A, aff. *notabilis* (Polenova, 1955) (Fig. 4h). EN35?, 66, 77?; ENO32, 57, 66, 99?
Family Bairdiocyprididae Shaver, 1961
Praepilatina sp. A (Fig. 4i). EN57; ENO32?, 74, 93?
Praepilatina sp. indet. (Fig. 4j). EN91.
Bairdiocypris soetenica Becker, 1965 (Fig. 4k). EN55, 57, 64, 91, 126, 150; ENO55?, 62, 64, 69, 74?
Bairdiocypris sp., aff. *lamellaris* Adamczak, 1976 (Fig. 4l). EN64, 153; ENO62.
Bairdiocypris sp. A (Fig. 4m). EN139; ENO92.
Bairdiocypris sp. indet. EN44, 55, 57, 60, 62, 64, 66, 126, 131, 150, 162; ENO2, 5, 7, 52, 53, 62, 65, 69, 74, 88, 93.
Condracypris? circumvallata (Kummerow, 1953) (Fig. 4n). ENO33, 52?, 55?, 69.
Family Bairdiidae Sars, 1988
Bairdia cultrijugati Krömmelbein, 1950 (Fig. 4o). EN7, 18, 31, 35, 38, 40, 44, 51?, 52?, 54, 55, 57, 60, 62, 64, 66,

73, 82, 84, 91, 92, 102, 109, 117, 125, 126, 129, 131, 139, 149, 150, 153; ENO2?, 49, 52, 53, 55, 57, 62, 64, 65, 66, 69, 74, 76, 92, 93, 95, 99, 104.

Bairdia dispar Adamczak, 1976 (Fig. 4p). EN31.

Bairdia sp. A (Fig. 4q). EN77, 139.

Acratia? sp. indet (Fig. 4r). EN66; ENO53, 62,

Bairdiacypris antiqua (Pokorńy, 1951) (Fig. 4s). EN40, 44, 52?, 55, 57, 60, 62, 64, 66, 77, 92; ENO32, 52, 57, 62, 64, 66, 69, 92, 93, 99.

Bairdiacypris sp. indet. EN92; ENO44, 49, 92.

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