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ORIGINAL PAPER

Ostracods across the Frasnian/Famennian boundary (Devonian) in the Hony railway section (southern border of the Dinant Synclinorium, Belgium)—geochemical consequences

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Abstract
Ostracods are extremely rare in the upper part of the Frasnian but sometimes very abundant in the base of the Famennian exposed in the Hony railway section. The associations of ostracods in the base of the Famennian belong to the Eifelian Mega-Assemblage and are indicative of shallow and sometimes semi-restricted marine environments, but this fauna has been mobilised periodically most likely by seismic activity. The abnormally high abundance of particularly well-preserved dissociated valves of adults and instars indicates a depositional environment very close to the shore at Hony, as is the case in some other localities in the southern border of the Dinant Synclinorium. In the fine dark shales straddling the Frasnian/Famennian boundary, ostracods are silicified and are evidence of an intense circulation of ground water during diagenesis. That may explain the increase of chalcophile elements and the absence of a significant iridium anomaly reported in this bed. A new zone based on metacopid ostracods, the *Ovatoquassilites avesnellensis* Zone, is established in the base of the Famennian.

Keywords Ostracods · Palaeoecology · Biostratigraphy · Frasnian/Famennian boundary · Mass extinction

Introduction

The ostracod assemblages present in the base of the Famennian at Sinsin (Casier and Devleeschouwer 1995) and at Senzeille (Casier 2017), in the southern border of the Dinant Synclinorium (Belgium), are indicative of shallow semi-restricted marine environments. These ostracods have been transported a very short distance from the shoreline at Sinsin, as is attested by their abnormally high concentration and the excellent preservation of dissociated valves of adults and instars. At Senzeille, this fauna is in contrast poorly preserved and disseminated indicating a deeper setting at a greater distance from the shore.

The goal of this study is the inventory of the ostracod fauna present close to the Frasnian/Famennian (=F/F) boundary in the Hony section in order to compare with the fauna discovered at the same level at Senzeille and Sinsin. The F/F boundary corresponds to the paroxysmal phase of the Late Devonian mass extinction responsible for the disappearance of about 80% of all ostracod species in the marine realm (Lethiers and Casier 1999; Casier and Lethiers 2001) in relation principally with a period of hypoxy of marine waters followed by and maybe linked to a regression (Casier 2017).

The Hony section (N 50°32′27″; E 5°34′28) is located in the eastern part of the Dinant Synclinorium, along the railway numbered 43 Liège-Remouchamps, and close to the Hony station (Fig. 1). This section is considered as the best reference section for the F/F boundary in the type region for the Frasnian and Famennian stages (Streel et al. 2000).

A lithological description of the Hony section associated with a study of conodonts was published for the first time by Bouckaert and Thorez (1966) and Bouckaert et al. (1972, 1974). They recognised the Upper *gigas* Zone and the Lower *triangularis* conodont Zones in the Hony section but these conodont zones are separated by 1.5 m of shales devoid of conodonts. Later, Sandberg et al. (1988), in the light of a revised conodont zonation, recognised the *linguiformis* Zone in the Hony section. The last conodonts belonging to the *linguiformis* Zone are present in the bed numbered 48t by Sandberg et al. (1988) and the first conodonts belonging to the Lower *triangularis* Zone, in bed numbered 48b (Ibid.), see Fig. 2.

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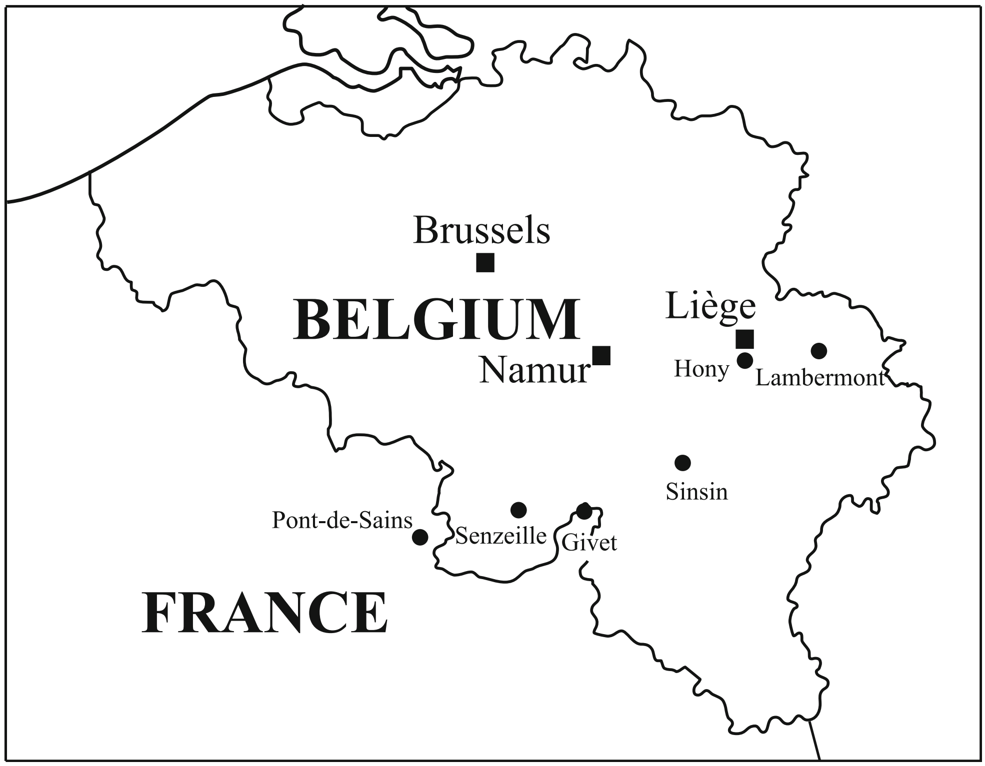

Fig. 1 Locality map of the Hony section and other Belgian localities cited in the text

The presence of glassy spherules believed to be of impact origin has been reported close to the F/F boundary in the Hony section (Claeys and Casier 1994), but this occurrence is not associated with a significant positive Ir anomaly (Claeys et al. 1996). The F/F boundary was also analysed at Hony for trace elements and major elements (Ibid.).

Streel and Vanguestaine (1989) and Streel et al. (2000) have studied spiny acritarchs and miospores in the Hony section and they recognised a transgressive-regressive marine sequence in the shaly interval straddling the F/F boundary. However, a recent study of brachiopods and corals by Mottequin and Poty (2015) did not recognise the presence of a sea-level fall near the F/F boundary.

Previous study of ostracods at Hony

Becker and Bless in Becker et al. (1974) sampled the Frasnian and Famennian in the Hony railway section for ostracods. They did not find ostracods in the last 80 m belonging to the late Frasnian, but they did find several species in six samples collected in the base of the Famennian and below the fault observable in the section (Fig. 2). The species mentioned by Becker and Bless are the following: beyrichacean ostracode sp. 100, cf. sp. 100, sp. 103 and sp. 104, *Cryptophyllus* sp. indet., cf. sp. 17 and cf. sp. 18 Becker and Bless, 1974, *Ochescapha? beckeri* Groos, 1969 and sp. 100, *Glezeria belgica* (Matern, 1929), *Hypotetragona?* sp. indet., *Bythocyproidea* sp. indet, "*Cytherellina*" sp. 131, *Knoxiella* sp. 108, *Knoxiella?* sp. 132 and sp. indet., quasillitid ostracode sp. 112, and podocopid ostracode sp. 106. Above the fault, they indicate the presence of beyrichiacean ostracode sp. 104, beyrichiacean? ostracode sp. indet., *Moorites* sp. 130, quasillitid ostracode sp. 112 and *Cryptophyllus* sp. indet. The majority of these taxa have not been described nor figured.

The Hony section close to the F/F boundary

The studied part of the Hony section exposes olive green to grey and dark grey shales containing some beds or lens of limestone, sometimes rich in apparently poorly diversified brachiopods (Fig. 2). The carbonates are a few centimetres thick with the exception of a 30-cm-thick bed (bed 48t of Sandberg et al. 1988) appertaining to the *linguiformis* conodont Zone and consequently Frasnian in age. The 1.4-m-thick bed located between the beds numbered 48t and 48b of Sandberg et al. (1988), the latter of which marks the base of the Early *triangularis* conodont Zone, is devoid of conodonts and is for the lower 2/3 composed of grey shales containing some bioclastic elements and for the upper 1/3 composed of dark grey shales. Streel et al. (2000) noticed the presence of extremely rare and poorly diversified miospores in this level compared to the rest of the section. The boundary between these shales corresponds to the present sample Ho27 from which microtektite-like glass has been extracted (Claeys and Casier 1994) and where Sandberg et al. (1988) placed the F/F boundary. Below the bed numbered 48t by Sandberg et al. (1988) and above the bed numbered 48b (Ibid.), shales are olive green.

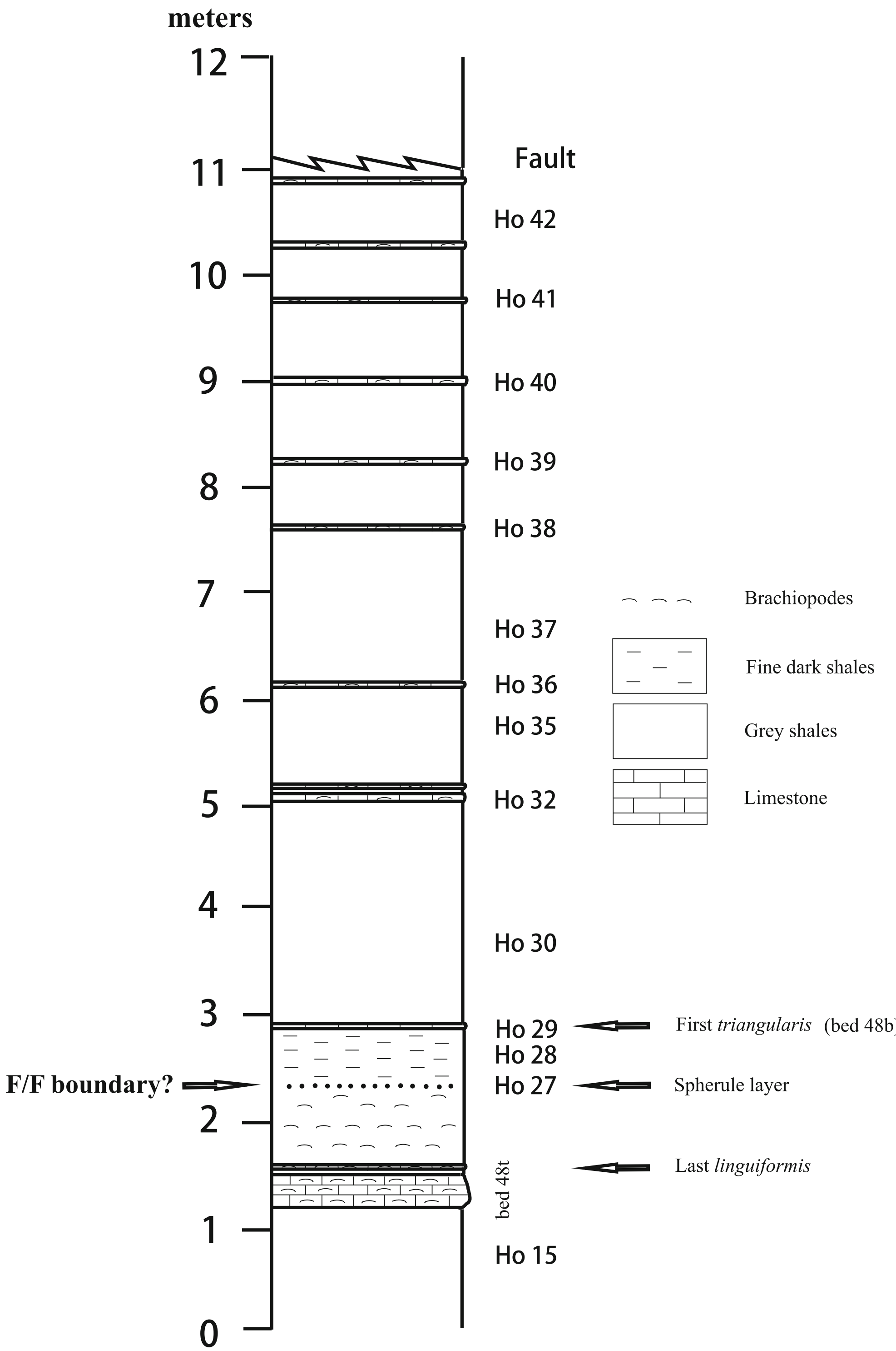

Fig. 2 Lithological column of the Hony railway section. Position of samples and of beds 48b and 48 t of Sandberg et al. (1988)

Ostracods collected close to the F/F boundary in the Hony section

Ostracods were extracted from limestones by hot acetolysis (Lethiers and Crasquin-Soleau 1988; Crasquin-Soleau et al. 2005) and from shales after crushing and sieving only (Appendix 1, Figs. 2, 3, and 4). A total of 2140 ostracodes were thus extracted and they are stored in the collection of the OD Earth and Life History of the Royal Belgian Institute of natural Sciences. Field works have been carried out during the nineties.

Sample numbered Ho15 collected in the 5 m of olive green shales below bed numbered 48t of Sandberg et al. (1988) yielded rare fragments of ostracods. They belong to *Svantovites lethiersi* Casier 1979, *Knoxiella* sp. A and *Cryptophyllus* sp. indet.

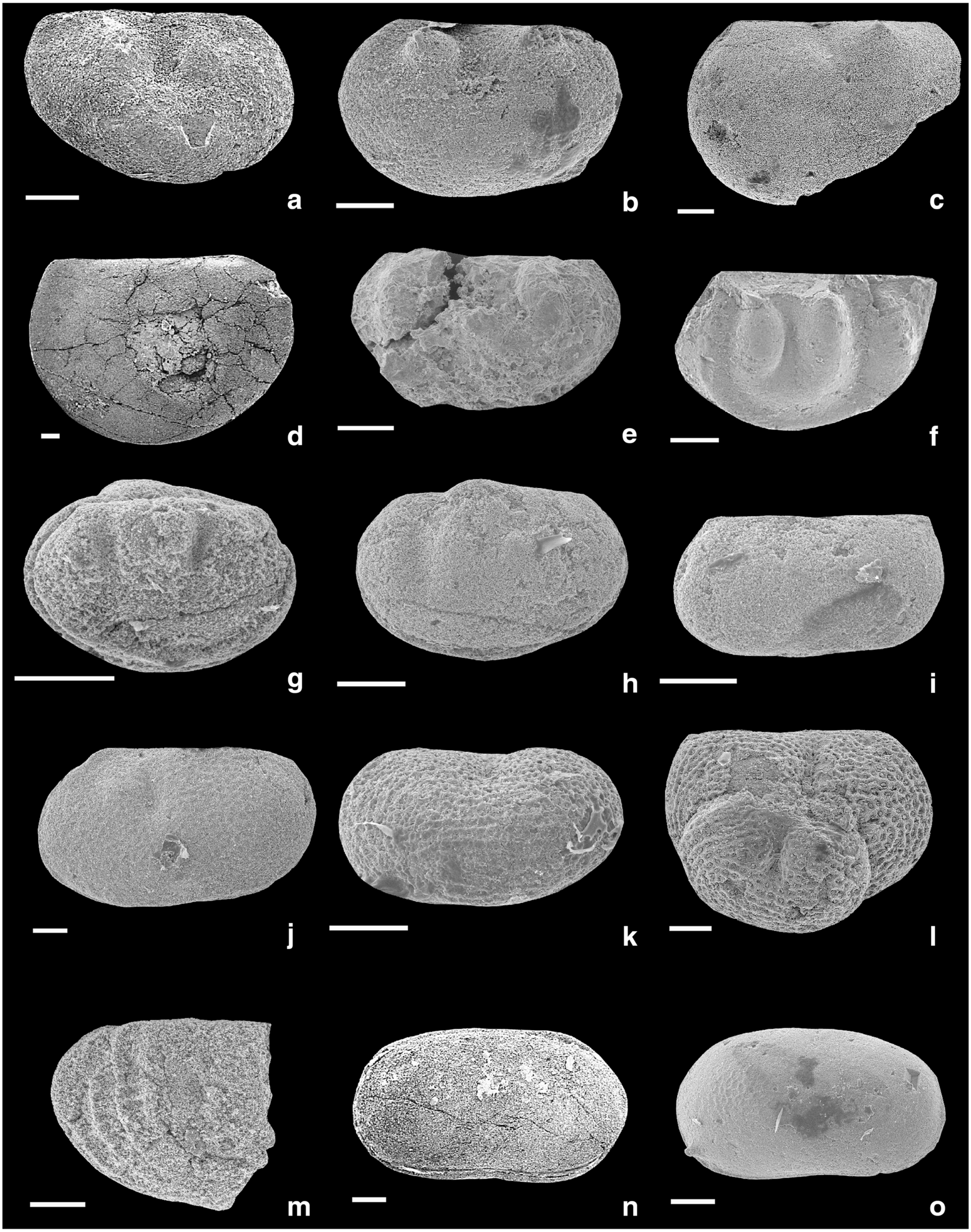
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Fig. 3 Ostracods recognised in the Hony section with the exception of the specimen of Fig. 3f extracted in the Lambermont section. *Lv* left valve view, *Rv* right valve, *Lc* left lateral view of a carapace, *Rc* right lateral view of a carapace, *Dv* dorsal view. IRScNB no followed by the number 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** *Adelphobolbina* sp. A, aff. *europaea* Becker and Bless, 1971. Rc. Ho41. IRScNB n° b6809. **b** *Kozlowskiella?* sp. A. Lv. Ho56. IRScNB n° b6810. **c** *Ochescapha?* sp. 110 Becker and Bless, 1974. Lv fragment. Ho56. IRScNB n° b6811. **d** *Ochescapha beckeri* Groos, 1969 sensu Becker and Bless, (1974). Lc. Ho39. IRScNB n° b6812. **e** *Glezeria minuta* Casier and Devleeschouwer, 1995. Rv poorly preserved. Ho27. IRScNB n° b6813. **f** *Glezeria minuta* Casier and Devleeschouwer, 1995. Lc. La20. IRScNB n° b6814. **g** *Balantoides* sp. A Casier and Devleeschouwer, 1995 (Fig. 3g,h). Rc. Ho48. IRScNB n° b6815. **h** *Balantoides* sp. A Casier and Devleeschouwer, 1995. Rc. Ho38. IRScNB n° b6816. **i** *Youngiella mica* Rozhdestvenskaja, 1972. Rc. Ho38. IRScNB n° b6817. **j** *Knoxiella* sp. B, aff. *domanica* Rozhdestvenskaja, 1972. Lv. Ho41. IRScNB n° b6818. **k** *Knoxiella* sp. A. Rv. Ho15. IRScNB n° b6819. **l** *Knoxiella* sp. A. Instar sticked on a Lv. Ho15. IRScNB n° b6820. **m** *Svantovites lethiersi* Casier 1979. Rv fragment. Ho15. IRScNB n° b6821. **n** *Ovatoquasillites avesnellensis* (Lethiers, 1973). Rc. Ho39. IRScNB n° b6822. **o** *Ovatoquasillites avesnellensis* (Lethiers, 1973). Rc. Ho48. IRScNB n° b6823

Svantovites lethiersi characterises a zone of the zonal sequence established on metacopid ostracods (Casier 1979), and this species is indicative of an open marine environment.

I have not found ostracods either in bed 48t of Sandberg et al. (1988) or in the overlaying grey shales. The bed 48t is a coquinite composed quasi exclusively of brachiopod fragments. The absence of ostracods in this tempestite is not abnormal, ostracods are generally pulverised in such environments and fragments of ostracods are probably transported elsewhere.

In the sample numbered Ho27 collected in the base of the dark grey shales below the bed 48b of Sandberg et al. (1988), dissociated silicified ostracod valves are present but they are poorly preserved. *Ovatoquassilites avesnellensis* (Lethiers, 1973) is the most abundant species in this level. *Glezeria minuta* Casier and Devleeschouwer, 1995, *Cryptophyllus* cf. *sinsinensis* (Casier and Devleeschouwer, 1995), *Cryptophyllus* sp. indet. and possibly a sole *Bairdia* sp. indet are also present in sample Ho27.

In sample Ho28 collected in the middle part of the dark grey shales, ostracods are rare and also poorly preserved. This level contains well-developed crystals of quartz giving evidence of the intense circulation of bottom water during diagenesis. This process is certainly responsible for the silicification and for the poor preservation of ostracods in the dark grey shales. *Cryptophyllus* sp. indet. is recognised in this sample, and possibly also *Healdianella tenuistriata* Casier and Devleeschouwer, 1995, and *Famenella* sp. A, aff. *postkairovaensis* Rozhdestvenskaja, 1972.

In the sample Ho29 collected in the bed 48b of Sandberg et al. (1988), and consequently in the Early *triangularis* conodont Zone, ostracods are abundant. *Ovatoquassilites avesnellensis* (Lethiers, 1973) is the most abundant species, but some *Ovatoquassilites alveolatus* Casier and Devleeschouwer, 1995, *Healdianella tenuistriata* Casier and Devleeschouwer, 1995, and rare *Balantoides* sp. A Casier and Devleeschouwer, 1995, *Cryptophyllus* cf. *sinsinensis* Casier and Devleeschouwer, 1995, and *Cryptophyllus* sp. indet. are also present.

Only some external and internal moulds of undeterminable ostracods were collected in the sample Ho30 collected 80 cm above the bed 48b of Sandberg et al. (1988).

In the sample Ho32, *Ovatoquassilites avesnellensis* (Lethiers, 1973) is again the most abundant species and is associated with some *Ovatoquassilites alveolatus* Casier and Devleeschouwer, 1995 and *Healdianella tenuistriata* Casier and Devleeschouwer, 1995.

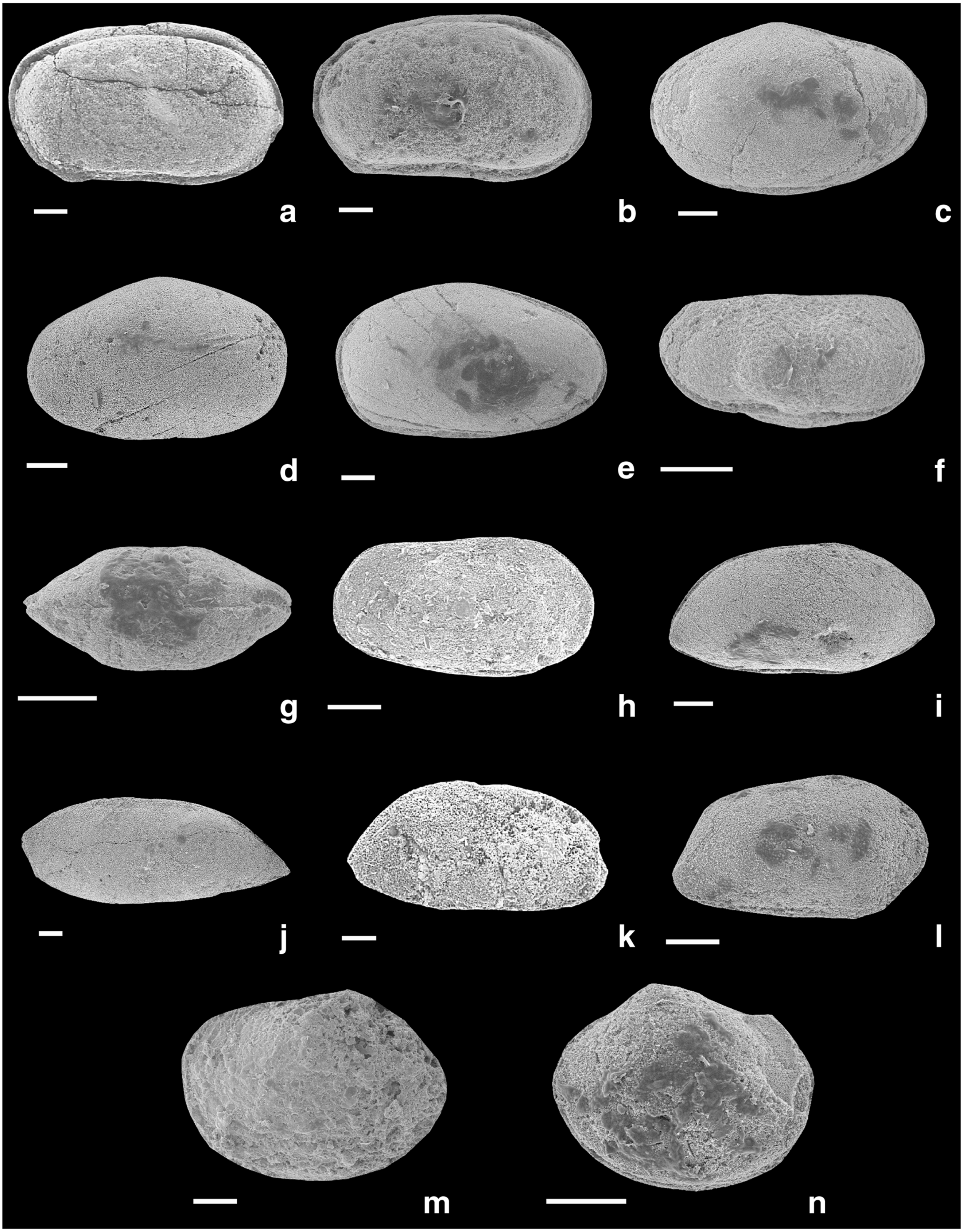
Samples Ho31, Ho33, Ho34 and Ho36 are barren and samples Ho35 and Ho37 contain only undeterminable ostracods.

From sample Ho38 to sample Ho48 (the latter collected 3.10 m above the fault figured on Fig. 2), the diversification of ostracods increases with the progressive entry of *Decoranewsomites* sp. A, *Youngiella mica* Rozhdestvenskaja, 1972, *Ochescapha beckeri* Groos, 1969 sensu Becker and Bless (1974), *Bairdiacypris?* sp. A and *Adelphobolbina* sp. A, aff. *europaea* Becker and Bless, 1971. This new association is clearly indicative of deeper marine conditions.

Finally, a new association of ostracods is present in the sample numbered 56, with the entry of *Bairdiacypris? anteroangulosa* Casier and Lethiers, 1997, *Kozlowskiella?* sp. A, and several species belonging to the genus *Acratia*.

The *Ovatoquassilites avesnellensis* Zone, new zone of metacopid ostracods in the base of the Famennian of the Dinant Synclinorium

In 1974, Lethiers suggested a zonal scheme based on ostracods for the Upper Devonian of Northern France (Boulonnais) and Belgium. Later, Casier (1975, 1979, 1982, 2003) demonstrated that the zonation established in Germany on entomozoid ostracods by Rabien (1954) is applicable to the upper part of the Frasnian and the base of the Famennian in the Dinant Synclinorium. But these entomozoid ostracods form part of the Myodocopid Mega-Assemblage indicative of poorly oxygenated environments (e.g. in the Matagne black shales Fm in Belgium, or in the Cypridinen Schiefers in Germany). For the Eifelian Mega-Assemblage, on continental shelves, Casier (1979) examined critically the zonal sequence of Lethiers (1974) and proposed three zones for the Frasnian based exclusively on metacopid ostracods. These ostracods were cosmopolitan during the Devonian, are generally well ornamented and consequently easily identifiable compared to the Podocopina ostracods. They are also more easily extractable undamaged than palaeocopid ostracods, also cosmopolitan in the marine realm. The zones recognised are the following: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◀ **Fig. 4** Ostracods recognised in the Hony section. *Lv* left valve view, *Rv* right valve, *Lc* left lateral view of a carapace, *Rc* right lateral view of a carapace, *Dv* dorsal view. IRScNB n°… 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** *Ovatoquasillites alveolatus* Casier and Devleeschouwer 1995. Rc. Ho39. IRScNB n° b6824. **b** *Ovatoquasillites alveolatus* Casier and Devleeschouwer 1995. Rc. Ho38. IRScNB n° b6825. **c** *Healdianella tenuistriata* Casier and Devleeschouwer 1995. Rc. Ho38. IRScNB n° b6826. **d** *Healdianella tenuistriata* Casier and Devleeschouwer 1995. Lc. Ho38. IRScNB n° b6827. **e** *Healdianella* sp. A Casier and Devleeschouwer 1995. Rc. Ho38. IRScNB n° b6828. **f** *Decoranewsomites* sp. A. Rc. Ho38. IRScNB n° b6829. **g** *Decoranewsomites* sp. A. Dv. Ho38. IRScNB n° b6830. **h** *Famenella* sp. A, aff. *Postkairovaensis* Rozhdestvenskaja, 1972. Rc. Ho39. IRScNB n° b6831. **i** *Acratia sagittaeformis* Lethiers and Casier 1999. Rc. Ho56. IRScNB n° b6832. **j** *Acratia* cf. *sagittaeformis* Lethiers and Casier 1999. Rc fragment. Ho56. IRScNB n° b6833. **k** *Bairdiacypris?* sp. A. Rc. Ho40. IRScNB n° b6834. **l** *Baidiacypris* cf. *anteroangulosa* Casier and Lethiers, 1997. Rc. Ho56. IRScNB n° b6835. **m** *Cryptophyllus* cf. *sinsinensis* Casier and Devleeschouwer 1995. Rv. Ho27. IRScNB n° b6836. **n** *Cryptophyllus* sp. indet. Lc. Ho15. IRScNB n° b6837

1. *Polyzygia beckmanni beckmanni* Zone (=*Polyzygia beckmanni* Zone of Lethiers (1974)) in the upper part of the Givetian (top of the Fromelennes Fm) and the base of the Frasnian;
2. *Favulella lecomptei* Zone (=*Favulella lecomptei* Sub-zone of Lethiers (1974)) in the middle part of the Frasnian;
3. *Svantovites lethiersi* Zone (Casier 1979) in the upper part of the Frasnian. The presence of this species in the base of the Famennian mentioned by Lethiers (1974) has not been formally confirmed by a study of the Senzeille section (Casier 1992).

I institute here an *Ovatoquassilites avesnellensis* Zone for the base of the Famennian. The species is present in the Famennian type-region, from the lower member of the Senzeille Fm (=unit G of Gosselet (1877) = "transition shales of Casier (1982) = member 1 of Bultynck and Martin (1995)) to the lower part of the Mariembourg Fm. The species is known in the base of the Famennian at Senzeille, Sinsin, Hony and Lambermont, in Belgium, and in the Pont-de-Sains trench in the Avesnois, France. The species characterised the *quadrangulata-avesnellensis* Sub-zone of the zonation proposed by Lethiers (1974) but its stratigraphic distribution is greater than previously suspected by this researcher.

I estimate that ostracods are actually insufficiently known in the middle and upper part of the Famennian of the Dinant Synclinorium, to propose some zones for the Eifelian Mega-Assemblage during that period.

The ostracod chronology based on Thuringian ostracods proposed for the first time by Blumenstengel (1965) is not applicable to the Upper Devonian of the Dinant Synclinorium. These spiny ostracods belonging to the Thuringian Mega-Assemblage, characterising deeper and maybe colder environments, were not present in the Dinant Synclinorium during the Late Devonian.

Conclusions

Ostracods are quasi-absent in the upper part of the Frasnian but locally very abundant in the base of the Famennian exposed in the railway section at Hony.

The discovery of silicified valves and carapaces of ostracods close to the F/F boundary is the first important information furnished by their study. Glassy spherules believed to be of impact origin have been reported close to the F/F boundary in the Hony section (Claeys and Casier 1994). These spherules have a broad range of chemical composition with generally high [K_2O/Na_2O] and [$Al_2O_3/(Na_2O+ K_2O)$], and they contain small inclusions of lechatelierite (*Ibid*). Later, a geochemical study for trace and major elements was made to test the possibility of an Ir anomaly associated to this spherule layer (Claeys et al. 1996) but no significant positive anomaly was detected. Nevertheless, the geochemical analysis showed that chalcophile elements increased close to the F/F boundary. These positive changes were interpreted as giving evidence of a reduction of oxygen content of the sea water during the deposition of the investigated shales (*Ibid*). The presence of silicified valves and carapaces of ostracods close to the F/F boundary give evidence for an intense circulation of bottom water during the diagenesis of the sediments and this may explain both the increase of chalcophile elements and the absence of a significant iridium anomaly at this level.

Note that the spherules found at Hony are not contemporaneous with those found previously in the Senzeille section (Claeys et al. 1992). These latter are in reality in the base of the second member of the Senzeille Fm and consequently after the paroxysmal phase of the Late Devonian mass extinction. The progressive recovery of the fauna was totally accomplished by this time.

The discovery in the base of the Famennian of an ostracod fauna comparable to those found west at Sinsin (Casier and Devleeschouwer 1995) and Senzeille (Casier 2017), and east at Lambermont (unpublished at present) is the second important information furnished by the study of ostracods in the Hony railway section. This fauna is indicative of very shallow and sometimes semi-restricted environments (Assemblage I of Casier (1987), see also Casier (2017)). In the base of the Famennian at Sinsin, ostracods are poorly diversified in spite of an abnormally high abundance: 98% of the ostracod fauna is composed of only 5 species and in one bed 95% of ostracods belong to one species (Casier and Devleeschouwer 1995). Moreover, stacked valves due to very small waves related to the lap of the water are observed in that section. This arrangement was favoured by the poor diversity and the great abundance of dissociated valves belonging to the preservation of several instars for each specimen, and is known today from shores of lakes, lagoons and sabkha (Guernet and Lethiers 1989; Casier and Devleeschouwer 1995; Casier 2017). But these ostracods have been mobilised periodically probably by seismic activity (not by storms because dissociated valves are particularly well preserved), and displaced a very short distance from the shoreline as explained by their abnormally high concentration and the exceptionally good preservation of dissociated valves of adults and instars. At Sinsin, ostracods sometimes constitute true ostracodites whereas at Senzeille, the fauna is in contrast very disseminated and consequently indicates a greater distance from the coast for the deposition of the lower member of the Senzeille Formation (=unit "G" of Gosselet (1877), transition shales of Casier (1992) and member 1 of Bultynck and Martin (1995).

At Hony, some stacked valves due to very small waves related to the lap of the water are also reported by Devleeschouwer in several beds (Unpublished master thesis, Free University of Brussels, 1994).

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Compliance with ethical standards

Conflict of interest: The authors declare that they have no conflict of interest.

Appendix 1: Taxonomic and stratigraphical positions of ostracod taxa in the Hony railway section (Taxonomic classification of Becker 2002)

Order Palaeocopida Henningsmoen, 1953

Suborder Palaeocopina Henningsmoen, 1953

Superfamily Hollinoidea Swartz, 1936
Family Hollinellidae Bless and Jordan, 1971
Adelphobolbina sp. A, aff. *europaea* Becker and Bless, 1971 (Fig. 3a). Ho40, 41.
Superfamily Beyrichioidea Matthew, 1886
Family Beyrichidae Matthew, 1886
Kozlowskiella? sp. A (Fig. 3b). Ho56.
Ochescapha? sp. 110 Becker and Bless, 1974 (Fig. 3c). Ho56.
Ochescapha beckeri Groos, 1969 sensu Becker and Bless (1974) (Fig. 3d). Ho39, 40.
Superfamily Nodelloidea Becker, 1968
Family Nodellidae Zaspelova, 1952.
Glezeria minuta Casier and Delveeschouwer, 1995 (= *Glezeria belgica* (Matern, 1929) *in* Becker and Bless, 1974). (Figs. 3e,f). Ho27.
Superfamily Drepanelloidea Ulrich and Bassler, 1923
Family Aechminellidae Sohn, 1961
Balantoides sp. A Casier and Delveeschouwer, 1995 (Fig. 3g,h). Ho29, 38, 39, 41, 48.

Superfamily Youngielloidea Kellett, 1933
Family Youngiellidae Kellett, 1933
Youngiella mica Rozhdestvenskaja, 1972 (Fig. 3i). Ho38, 40.

Suborder Platycopina Sars, 1866

Superfamily Kloedenelloidea Ulrich and Bassler, 1908
Family Geisinidae Sohn, 1961
Knoxiella sp. B, aff. *domanica* Rozhdestvenskaja, 1972 (= *Knoxiella* sp. 108 Becker and Bless, 1974) (Fig. 3j). Ho38, 39, 40, 41, 48.
Knoxiella sp. A (Fig. 3k,l). Ho15.

?Suborder Eridostracina Adamczak, 1961

Family Cryptophyllidae Adamczak, 1961
Cryptophyllus cf. *sinsinensis* Casier and Devleeschouwer, 1995 (Fig. 4m). Ho27, 29, 41.
Cryptophyllus sp. indet. (Fig. 4n). Ho15, 27, 28, 29, 39, 40.

Order Podocopida Sars, 1866

Suborder Metacopina Sylvester-Bradley, 1961

Superfamily Thlipsuroidea Ulrich, 1894
Family Thlipsuridae Ulrich, 1894
Svantovites lethiersi Casier, 1979 (Fig. 3m). Ho15.
Ovatoquasillites avesnellensis (Lethiers, 1973) (Figs. 3n,o). Ho27, 29, 32, 38, 39, 40, 41, 48.
Ovatoquasillites alveolatus Casier and Devleeschouwer, 1995 (Fig. 4a,b). Ho29, 32, 38, 39, 40, 41, 48.

Suborder Podocopina Sars, 1866

Superfamily Bairdiocypridoidea Shaver, 1961
Family Bairdiocyprididae Shaver, 1961
Healdianella tenuistriata Casier and Devleeschouwer, 1995 (Figs. 4c,d). Ho28?, Ho29, 32, 38, 39, 56.
Healdianella sp. A Casier and Devleeschouwer, 1995 (Fig. 4e). Ho38, 39, 40.
Family Pachydomellidae Berdan and Sohn, 1961
Decoranewsomites sp. A (Figs. 4f,g). Ho38.
Superfamily Bairdioidea Sars, 1888
Family Bairdiidae Sars, 1888
Famenella sp. A, aff. *postkairovaensis* Rozhdestvenskaja, 1972 (Fig. 4h). Ho28?, Ho39.
Acratia sagittaeformis Lethiers and Casier, 1999 (Fig. 4i). Ho56.
Acratia cf. *sagittaeformis* Lethiers and Casier, 1999 (Fig. 4j). Ho56.
Acratia sp. indet. Ho56.
Bairdiacypris? sp. A (Fig. 4k). Ho40.

Baidiacypris cf. *anteroangulosa* Casier and Lethiers, 1997 (Fig. 4l). Ho56.
Bairdia sp. indet. Ho27?, Ho39.

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