Annales de Paléontologie 102 (2016) 11–29

Disponible en ligne sur
ScienceDirect
www.sciencedirect.com

Elsevier Masson France
EM|consulte
www.em-consulte.com

Original article

Middle/Late Givetian ostracod assemblages from the Aisne quarry (Durbuy area, Ardenne, Belgium). Biostratigraphic and palaeoecological implications

Les assemblages d'ostracodes du Givétien Moyen et Supérieur de la carrière d'Aisne (région de Durbuy, Ardenne, Belgique). Implications biostratigraphiques et paléoécologiques

Sébastien Maillet[a,*], Taniel Danelian[a], Jean-Georges Casier[b]

[a] *UMR 8198, Evo-Eco-Paléo, université de Lille – Sciences et Technologies, CNRS, 59655 Villeneuve-d'Ascq, France*
[b] *D.O. Terre et Histoire de la Vie, Institut Royal des Sciences Naturelles de Belgique, rue Vautier, 29, 1000 Bruxelles, Belgium*

ARTICLE INFO

Article history:
Received 22 October 2015
Accepted 15 December 2015
Available online 23 February 2016

Keywords:
Dinant Synclinorium
Fromelennes Formation
Biostratigraphy
Palaeoecology
Middle Devonian
Taghanic Biocrisis
Biozone
Crustaceans

ABSTRACT

The ostracod fauna of the Aisne quarry section (south-eastern border of the Dinant Synclinorium, Ardenne, Belgium) is studied here in order to complete the Middle Devonian record of these micro-crustaceans on the Ardennean platform, allowing thus biostratigraphic correlations at regional scale. Sixty-four ostracod taxa are recognized throughout the Givetian carbonate sequence of Aisne; one new species (*Cryptophyllus magnei* Maillet and Casier n. sp.) is formally described. In the lower part of the section, assemblages contain numerous species that are known to occur as early as the Late Eifelian. The recognized ostracod assemblages and lithostratigraphic correlations with analogous sequences in the Givetian historical type-area (Givet, French Ardenne), which are dated by conodonts, suggest that the sequence of the Aisne quarry is much more expanded. Three acme biozones are established herein for the Givetian stage; they will be useful for both regional (Ardenne area) and supra-regional correlations between the Boulonnais, Ardenne and Eifel areas. The sedimentary palaeoenvironments recorded in the carbonate sequence of the Aisne quarry are reconstructed based on the ostracod faunas. Finally, the biotic response of ostracods to the Taghanic Biocrisis is discussed.

Mots clés :
Synclinorium de Dinant
Formation de Fromelennes
Biostratigraphie
Paléoecologie
Dévonien Moyen
Crise du Taghanic
Biozone
Crustacés

RÉSUMÉ

Les ostracodes de la coupe de la carrière d'Aisne (bordure sud-est du Synclinorium de Dinant, Ardenne, Belgique) sont étudiés afin de compléter l'inventaire de ces micro-crustacés au niveau de la plate-forme ardennaise au cours du Dévonien Moyen, permettant ainsi d'effectuer des corrélations biostratigraphiques à l'échelle régionale. Soixante-quatre taxons sont reconnus dans la séquence carbonatée du Givétien d'Aisne ; une espèce nouvelle (*Cryptophyllus magnei* Maillet and Casier n. sp.) est décrite. Dans la partie inférieure de la coupe, les assemblages sont composés d'espèces pour la plupart déjà recensées dès l'Eifélien Supérieur en Ardenne. Les assemblages d'ostracodes en présence et des corrélations lithostratigraphiques avec des séquences analogues de la région-type historique du Givétien (Givet, Ardenne française), datées par les conodontes, montrent que la séquence de la carrière d'Aisne est bien plus étendue. Trois biozones d'acmé sont proposées pour le Givétien et sont utilisables à la fois pour des corrélations régionales en Ardenne et supra-régionales entre le Boulonnais, l'Ardenne et l'Eifel. Les paléoenvironnements de la séquence carbonatée d'Aisne sont reconstitués grâce à l'étude des faunes d'ostracodes. Enfin, la réponse biotique des ostracodes à la crise du Taghanic est discutée.

* Corresponding author.
E-mail address: Sebastien.Maillet@univ-lille1.fr (S. Maillet).

http://dx.doi.org/10.1016/j.annpal.2015.12.002
0753-3969/

1. Introduction

Several global biotic events and environmental changes are known to have occurred during the Givetian stage (Middle Devonian) and their investigation is one of the aims of the IGCP 596 UNESCO program "Climate change and biodiversity patterns in the Mid-Paleozoic". Amongst them, the Taghanic Biocrisis is probably one of the most severe Middle Devonian environmental and biotic events. The last few years we have launched the detailed study of the ostracod faunas of the Middle and Upper Givetian sequences of the Dinant Synclinorium (Ardenne Allochthon), which exposes exceptional outcrops, including the historical type-area of the Givetian stage.

Maillet et al. (2011) studied in detail the lithology of the Fromelennes Formation (= Fm) in its type-area (Fromelennes, Givet area, France), which represents a sedimentary sequence that covers essentially the Middle to Late Givetian time-interval; they have also presented a preliminary account of the ostracod fauna. Maillet et al. (2013a) studied in detail and synthesized all ostracod data from the type-area of the Fromelennes Fm in an updated biochronostratigraphic framework based essentially on conodonts found previously in these sections. It is worth noting that the carbonate sequences in this area were accumulated on a Givetian peri-reefal shelf environment.

The aim of this paper is to document the ostracod fauna and palaeoenvironmental changes recorded during the Middle to Late Givetian transition in shelf carbonate sequences that crop out in the south-eastern part of the Dinant Synclinorium (Ardenne Allochthon). The Aisne quarry section, displaying a more expanded sequence of the Middle-Upper Givetian Fromelennes Fm than in the type-area, and its ostracod fossil record are both studied for the first time. In spite of the apparent absence of conodonts and the less diverse and less abundant ostracod fauna, the study of this section provides insights into slightly deeper carbonate palaeoenvironmental settings than the Givet type-area outcrops.

2. Geographical, geological and palaeogeographic settings

The studied section is situated in an actively exploited quarry, known as the "Prealle quarry", situated nearby the village of Aisne (50°21'30.84″ N; 5°33'31.24″E) a few kilometres eastwards of the town of Durbuy (Fig. 1A, B). The sedimentary rocks of this area belong to the south-eastern part of the Dinant Synclinorium (northern part of the Ardenne Allochthon). Within this structural unit, the thickness of Devonian sedimentary sequences increases from the North-West to the South-East. The Ardenne belongs to the Rhenish Slate Mountains, itself being part of the Rheno-Hercynian belt of the Mid-European Variscides (Préat et al., 2006).

During the Middle Devonian, the area was part of a wide carbonate platform (Préat and Mamet, 1989; Boulvain et al., 2009) situated at a palaeolatitude of about 30°S and extending along the southern passive margin of Laurussia, facing the Rheno-Hercynian Ocean (Sintubin, 2008). From the Avesnois area through Givet (north-eastern France) to Liège (eastern Belgium), the Givetian sedimentary sequences of the Dinant Synclinorium display a remarkable lateral continuity (Préat et al., 2006; Boulvain et al., 2009), which provides valuable insights into the spatial extension and palaeoenvironmental evolution of a Middle Devonian carbonate platform and its reefal barriers. It is comparable to reefal ecosystems present today in the Great Barrier Reef of eastern Australia.

3. The Aisne quarry section

This paper represents the first study of the lithostratigraphy and ostracod faunas of the Aisne quarry. Historically, only a few studies have dealt with the Middle Devonian deposits of the Durbuy area. Fourmarier (1900) was the first to establish a detailed geological map and to describe the Middle and Upper Devonian deposits of the Durbuy area. More recently, Coen and Coen-Aubert (1971) studied another section at Durbuy (the Warre-Tohogne crossroad section) where part of the Fromelennes Fm crops out. An updated and detailed geological map of the Durbuy area will be published soon (Barchy and Marion, 2016).

The Aisne quarry displays a Middle/Upper Givetian carbonate sequence reaching about 275 m-thick (Figs. 1, 2). Despite the presence of some faults towards its base, the Fromelennes Fm reaches here a thickness of about 250 m. Its boundaries with the underlying Mont d'Haurs Fm and the overlying Nismes Fm can be clearly observed. Within the Fromelennes Fm itself, all the boundaries between the three members (= mbs) are visible; however, the Flohimont/Moulin Boreux boundary is accessible while the Moulin Boreux/Fort Hulobiet one is not.

The oldest levels of the studied section crop out in the north-eastern part of the quarry (Fig. 1A) as a 23 m-thick interval of massive limestones (ranging between 1 and 4 m in thickness), which are assigned to the top of the Mont d'Haurs Fm (Fig. 2). These limestones contain numerous skeletal remains of rugose corals (both solitary and colonial forms).

These massive limestones are overlain by about one metre of argillaceous limestones belonging to the base of the Fromelennes Fm (Flohimont Mb). Then, the sequence is interrupted by a relatively important fault covered by screes over 3 m. Above, the outcrop displays a 24 m-thick continuous sequence beginning with a thick unit of thin-bedded plate-splitting argillaceous limestones that include several intercalations of dolomitic limestones (Fig. 2). These more competent carbonate levels contain abundant crinoids, brachiopods and reefal organisms (rugose and tabulate corals). Following 50 cm of observation gap, the sequence exposes then shales that contain small carbonate lenses, overlain by argillaceous limestones with again intercalations of more resistant dolomitic beds. The fauna present in these last levels consists essentially of crinoids and some gastropods.

The boundary between the Flohimont and Moulin Boreux mbs is situated in an 11 m-thick interval of argillaceous beds at the base passing upwards to thick-bedded dolomitic limestones (Fig. 1A, D). Some levels are rich in skeletal debris of reefal organisms. Further up, the sequence is covered by screes over *ca.* 13 m due to the ongoing activity of the quarry and the possible presence of a fault.

The rest of the sedimentary sequence was studied in the north-western part of the quarry, which displays the end of a North-plunging periclinal structure of an anticline (Fig. 1 A, C). The oldest visible levels in the core of the periclinal structure are younger than the sequence described previously, but they belong to the Moulin Boreux Mb too. They are composed of 2 to 5 m-thick beds of dolomitic limestones, which contain only very rare debris of reefal organisms. They are intercalated with few thinner-bedded argillaceous limestones that contain more abundant faunas, of which brachiopods, gastropods and rugose and tabulate corals. Towards the top of this 41 m-thick interval lies a remarkable 2 m-thick bed with numerous grey-blue clayey nodules organized in several layers (Fig. 2). The sequence is overlain by a noticeable 4 m-thick bed of very argillaceous brown limestone, in which the fauna is extremely prolific, including abundant brachiopods and reef-building organisms (globular stromatoporoids, very abundant tabulate corals with both branching and massive forms, and solitary rugose corals) (Fig. 2). Most of the brachiopods consist of large-sized Stringocephalids (? *Stringocephalus burtini* (Defrance, 1825)), which could be correlated with the last Stringocephalids level known from other sections in the Ardenne, a well-known biotic event that occurred in the Middle Givetian (base of the