

Turonian bivalves from the Coastal Basin of Gabon, South of Libreville *Les bivalves du Turonien du bassin côtier du Gabon, Sud de Libreville*

Benjamin MUSAVU MOUSSAVOU*, Simplicie Marin NDONG ONDO & Makaya MØVOUBOU

Université des Sciences et Techniques de Masuku et URESTE, Faculté des Sciences, Département de Géologie, B.P. 913 Franceville, Gabon *(musavu@yahoo.fr).

Abstract. The taxonomy and palaeo-ecology of the Turonian marine bivalve fauna from the geological section -Gabon Storeø (South of Libreville, Gabon) are here discussed. Seven species are recognized: *Aphrodina angustosinuosa* (Riedel), *Aphrodina dutrugei* (Coquand), *Aphrodina* sp., *Granocardium productum* (Sowerby), *Lopha* cf. *lombardi* (Dartevelle & Freneix), *Pholadomya* cf. *adversa* Riedel and *Rastellum* sp. The composition of the bivalve fauna and the sedimentary characteristics indicate a low-energy littoral paleo-environment at the -Gabon Storeø section. Two types of depositional environment are suggested: (1) an intertidal zone, represented by silty limestone and (2) a shallow subtidal zone, such as a bay or lagoon, represented by calcareous sandstone.

Keywords: Turonian, bivalves, coastal basin, Libreville, Gabon.

Résumé. La taxonomie et la paléoécologie de la faune des bivalves marins d'âge Turonien de la coupe de -Gabon Storeø (Sud de Libreville, Gabon) sont ici discutées. Sept espèces sont reconnues : *Aphrodina angustosinuosa* (Riedel), *A. dutrugei* (Coquand), *Aphrodina* sp., *Granocardium productum* (Sowerby), *Lopha* cf. *lombardi* (Dartevelle & Freneix), *Pholadomya* cf. *adversa* Riedel et *Rastellum* sp. La composition de la faune des bivalves et les caractéristiques sédimentologiques de la coupe de -Gabon Storeø indiquent un environnement de type littoral de basse énergie. Deux types d'environnement de dépôt sont suggérés : (1) une zone intertidale, représentée par des calcaires silteux et (2) une zone subtidale, comme une baie ou lagune, représentée par des calcaires gréseux.

Mots-clés : Turonien, bivalves, bassin côtier, Libreville, Gabon.

INTRODUCTION

The Mesozoic sediments of the Gabonese Coastal Basin contain a rich macro-fauna (e.g. gastropods, bivalves, echinoderms, ammonites), observed previously in this region (Lombard 1930, Furon 1931, 1950, Choubert 1935, Dartevelle & Brébion 1956, Dartevelle & Freneix 1957, Freneix 1959, 1966, Weydert & Collignon 1981, Hudeley & Belmonte 1970, Meister *et al.* 1996, 2003, Mbina Mounquengui 1998, Chevalier *et al.* 2002, Mbina Mounquengui & Lang 2003, Musavu Moussavou *et al.* in press). Unfortunately, references to the marine bivalves are generally restricted to mere enumerations of species, without taxonomic descriptions or illustrations. Only Kossmat (1893), Lombard (1930), Dartevelle & Freneix (1957) and Musavu Moussavou *et al.* (in press) provide taxonomical information. Therefore the Mesozoic marine bivalve fauna of Gabon is still unknown, despite the abundance and often dominance of bivalve fossils in the deposits.

This paper is an attempt to improve this situation. To this end, we made collections of bivalve fossils at the so-called -Gabon Storeø section, south of Libreville.

GEOLOGICAL SETTING

The Libreville region is located in northwestern Gabon (Fig. 1). It belongs to the Gabon sedimentary coastal basin, which extends over 800 km along the West African Coast between 1° N and 4° S latitude with a surface of 90.000 km² (Teisserenc & Villemin 1990). The age of the deposits

in the Libreville region is assigned to the Turonian by ammonites (Hourcq & Hausknecht 1954, Meister *et al.* 2003). In the Libreville region, the sedimentary sequence is mainly composed of limestone, marls and clays with locally inter-bedded sandstone (e. g. Hourcq & Hausknecht 1954, Gérard 1958, Weydert 1981, Mbina Mounquengui 1998). Also small coral bioherms have been reported within the limestone (Weydert 1981). The deposits contain a varied marine fauna (Lombard 1930, Hourcq & Hausknecht 1954, Dartevelle & Brébion 1956, Hudeley & Belmonte 1970, Mbina Mounquengui 1998, Chevalier *et al.* 2002, Meister *et al.* 1996, 2003, Musavu Moussavou *et al.* in press). In total 25 species of bivalves have been reported from the Mesozoic of the Libreville region (Tab. 1).

The studied -Gabon Storeø section (Fig. 2) is located along the express road in front of the store with this name (Fig. 1). It is 6 m thick and composed of calcareous sandstone intercalated with silty limestone layers. The deposits contain bioclasts, gastropods, ostracods, echinoderms and bivalves.

MATERIAL

The present study was carried out on a total of 73 specimens of bivalves, including 15 single valves and 58 doublets, collected at the section. Preservation of the fossils is rather poor.

The material is deposited in the collection of the Geology Department, Faculty of Sciences, Masuku University of Franceville (Gabon), under collection number MDG/LBV/Lm.

RESULTS

The fossil bivalve assemblages from the -Gabon Storeø section are rich in specimens but relatively poor in species diversity. We have identified 7 species from 5 genera, namely *Aphrodina angustosinuosa* (Riedel), *A. dutruegi* (Coquand), *Aphrodina* sp., *Granocardium productum* (Sowerby), *Lopha* cf. *lombardi* (Dartevelle & Freneix), *Pholadomya* cf. *adversa* Riedel and *Rastellum* sp. Two species, *A. dutruegi* and *P.* cf. *adversa*, are restricted to the silty limestone level (Fig. 2). *Aphrodina dutruegi* and *Lopha* cf. *Lombardi* were reported for the first in the Gabonese coastal basin and in the Libreville region respectively.

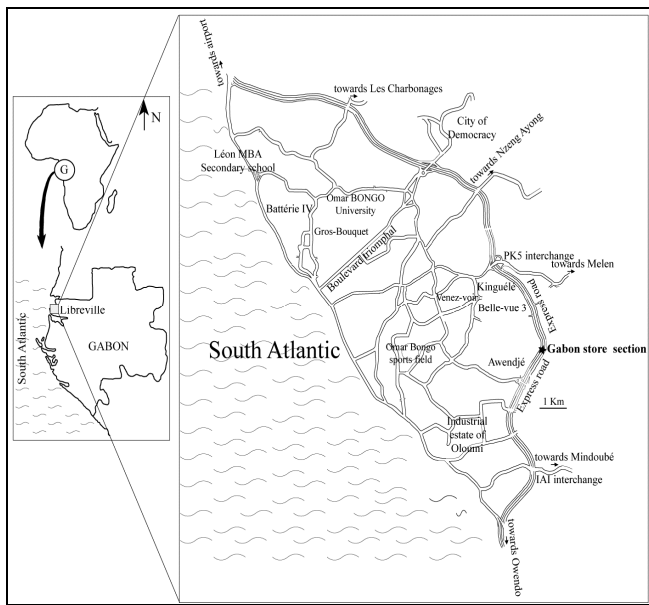


Figure 1. Location of Libreville region and -Gabon Storeø section.

Bivalve abundance, genera and species richness are higher within the first silty limestone level in comparison with other levels of the section (Fig. 2). Bivalves are present but relatively scarce in other levels. The species *Aphrodina dutruegi* dominates (50 specimens) in the section.

DISCUSSION

Bivalve diversity, distribution and stratigraphy

In comparison to bivalve fauna diversity and abundance values, previously known from other regions around Libreville (Kossmat 1893, Lombard 1930, Dartevelle *et al.* 1957), the fauna observed at the -Gabon storeø section occur in lower diversity (Tab. 1). Considering this poverty, the presence of a new genus and a new species in this region, namely a representative of the genus *Lopha* (*Lopha* cf. *lombardi*) and of *Aphrodina dutruegi*, is remarkable.

From Gabon, the genus *Lopha* is only known within the upper Cretaceous deposits (Coniacian to Santonian) of the Fernan Vaz Lagoon region (Dartevelle & Freneix, 1957), i.e. more than 200 km south of Libreville. The Gabon store section, which is assigned to the Turonian, provide representatives of the genus *Lopha*. This presence permits us herein to expand its geographical distribution until Libreville region, and its age range to Turonian.

Paleoenvironmental interpretation

Bivalve associations at the -Gabon storeø section occur in two different types of deposits, namely silty limestone and calcareous sandstone.

Abundance and diversity is higher within the silty limestone levels, than in other parts of the section. Fossils are represented by articulated as well as disarticulated valves suggesting that the association consists of specimens either buried *in situ* or transported over short distances. The limestone associations can be regarded as parautochthonous.

In calcareous sandstone levels, all valves are articulated. The absence of disarticulated valves in these levels indicates that there was no post-mortem transport and the association is autochthonous.

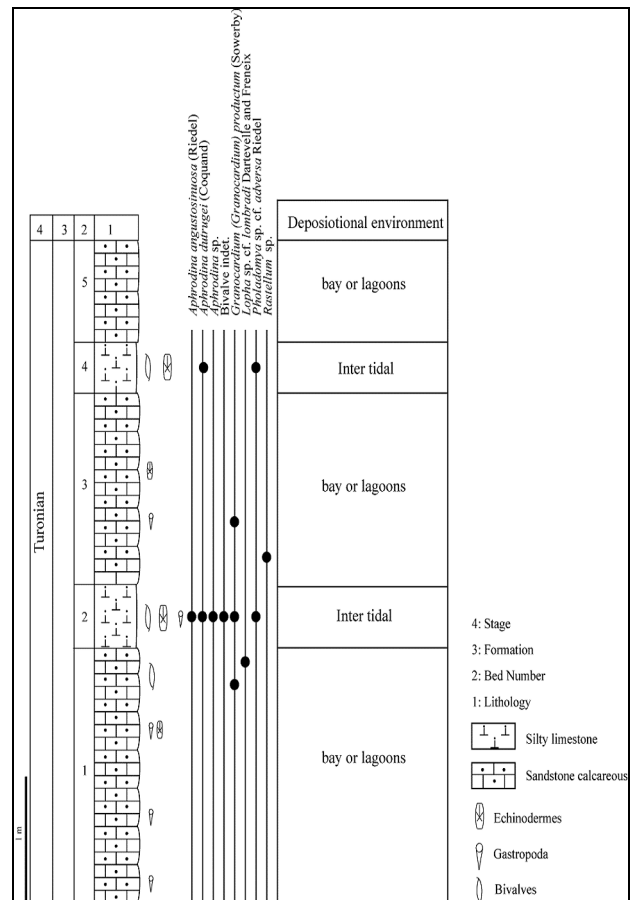


Figure 2. Lithostratigraphy of the -Gabon Storeø section and occurrences of bivalve assemblages.

CONCLUSION

The study of Turonian bivalves from the -Gabon storeø section reveals the following:

In comparison with previous studies from the Libreville area, bivalve associations from the -Gabon storeø section are present in lower diversity (only 7 species).

Three species out of seven, namely the dominant one, *Aphrodina dutruegi*, *Aphrodina angustosinuosa* and *Lopha* cf. *lombardi* are recorded here for the first time from the Mesozoic of the Libreville region.

Differences in taphonomy and lithology are indicative for two types of paleo-environments during Turonian times

at the -Gabon storeøsection, namely:

(1) a low-energy intertidal zone represented by a bivalve association partly consisting of dissociated valves in silty limestone matrix. The paleoenvironment can be reconstructed as intertidal mudflats.

(2) an equally low-energy zone represented by an association of bivalves exclusively preserved as doublets in lime-rich sandstone. These hiatal deposits must have been formed in calm, shallow waters, such as a bay or lagoons with a sandy substrate, hence with minimal deposition of fine clastics.

SYSTEMATIC PALEONTOLOGY

Here we describe species which are mentioned for the first time in the Turonian of the Gabonese coastal basin. In the descriptions, the terms small, medium and large are defined by the following size ranges: small, up to 10.0 mm long; medium, 10.1 mm to 30 mm; large 30.1 mm and over. All the measurements are in millimeters. Abbreviations of measured parameters: L: length; H: height; I: Inflation; n: number of measured specimens. The classification used here is that of Carter *et al.* (2011). Inflation has been measured only in specimens who present two valves.

Table 1. Mesozoic bivalve fauna from the Libreville region (Kossmat, 1893; Darteville & Freneix; Lombard, 1930 and this study).

Species	Kossmat (1893)	Lombard (1930)	Darteville & Freneix (1957)	Musavu Moussavou <i>et al.</i> (in press)	This study
<i>Acanthocardia tropica</i>	x		x		
<i>Acanthocardia tumida</i>	x		x		
<i>Aphrodina angustosinuosa</i>					x
<i>Aphrodina dutruegi</i>					x
<i>Aphrodina (Aphrodina) gabonensis</i>			x		
<i>Aphrodina</i> sp.					x
<i>Agelasma plenodonta</i>			x		
<i>Arcopagia gabunensis</i>	x				
Bivalve indet.					x
<i>Corbula involuta</i>	x				
<i>Corbula parsura</i>	x				
<i>Eriphyla lenticularis</i>			x		
<i>Exogyra olisiponensis</i>			x		
<i>Fragum perobliquum</i>			x		
<i>Granocardium (Granocardium) productum</i>			x		x
<i>Granocardium (Granocardium) sp.</i>				x	
<i>Inoceramus baumanni</i>	x		x		
<i>Inoceramus labiatus</i> Schlotteim	x		x		
<i>Lima (Plagiostoma) grenieri</i>		x	x	x	
<i>Lima (Plagiostoma) cf. perplana</i>				x	
<i>Lima (Plagiostoma) pseudohörnesi</i>				x	
<i>Lima (Plagiostoma) sp.</i>				x	
(?) <i>Liostrea</i> aff. <i>roachensis</i>		x			
<i>Lithophaga elongata</i>	x				
<i>Lopha</i> cf. <i>lombardi</i>					x
<i>Modiola</i> cf. <i>pedernalis</i>	x	x			
<i>Pholadomya</i> cf. <i>adversa</i>					x
<i>Pholadomya pedernalis</i>			x		
<i>Pleuromya</i> aff. <i>congoensis</i>			x		
<i>Rastellum diluvianum</i>				x	
<i>Rastellum</i> sp.				x	x

Class BIVALVIA Linnaeus 1758
 Grade EUPROTOBRANCHIA Nevesskaja 2009
 Megaorder POROMYATA Ridewood 1903
 Order PHOLADOMYIDA Newell 1965
 Superfamily PHOLADOMYOIDEA King 1844
 Family PHOLADOMYIDAE King 1844
 Subfamily PHOLADOMYINAE King 1844
 Genus *Pholadomya* Sowerby 1823

Pholadomya cf. adversa Riedel 1932 (Fig. 3/166)
 cf. 1932. *Pholadomya adversa* Riedel, p. 149, pl. 5, fig. 1.
 cf. 1954. *Pholadomya adversa* Riedel - Reymont, p. 667, 676.
 cf. 1957. *Pholadomya adversa* Riedel - Darteville & Freneix, p. 211, pl. 33, fig. 4a6b.

Material: 4 specimens from beds 2 and 4 (MDG/LBV/BV/Lm - 16).

Measurements (mm):

n = 4	L	H	I
Range	59669	23636	31638
Mean	64	29.5	34.5

Remarks. The poor preservation of the specimens does not allow a conclusive identification.

Stratigraphic and geographic distribution: Coniacian to Campanian of Cameroon, Angola, Democratic Republic of Congo (Darteville & Freneix 1957), Turonian of Gabon (this study) and Campanian of Brazil (Benaim & Senra 2008).

Megaorder CARDIATA Férussac 1822
 Superorder CARDIIFORMII Férussac 1822
 Order CARDIIDA Férussac 1822
 Suborder CARDIIDINA Férussac 1822
 Superfamily CARDIOIDEA Lamarck 1809
 Family CARDIIDAE Lamarck 1809
 Subfamily CARDIINAE Lamarck 1809
 Tribe CARDIINI Lamarck 1809
 Genus *Granocardium* Gabb 1869

Granocardium productum (Sowerby 1832) (Fig. 3/10614)
 1832. *Cardium productum* - Sowerby, p. 417, pl. 34, fig. 15.
 1934. *Granocardium productum* (Sowerby) - Andert, p. 254, pl. 12, figs. 10611.
 1957. *Granocardium (Granocardium) productum* (Sowerby) - Darteville & Freneix, p. 168, pl. 28, figs. 8a6b, 9, pl. 29, fig. 15.
 2012. *Granocardium productum* (Sowerby) - Benyoucef *et al.*, pl. 3, fig. 8.

Material: 10 specimens from beds 1, 2 and 3 (MDG/LBV/BV/Lm - 17)

Measurements (mm):

n = 8	L	H	I
Range	19629	27635	15628
Mean	24	31	21.5

Stratigraphic and geographic distribution: Cenomanian to Coniacian of Algeria, Cameroon, Democratic Republic of Congo, India, Madagascar, Morocco, Tunisia (Darteville & Freneix 1957, Benyoucef *et al.* 2012). In Gabon, this species has been found in Turonian to Senonian deposits (Darteville & Freneix 1957, this study).

Superfamily VENEROIDEA Rafinesque 1815
 Family VENERIDAE Rafinesque 1815
 Subfamily VENERINAE Rafinesque 1815
 Tribe VENERINI Rafinesque 1815
 Genus *Aphrodina* Conrad 1868

Aphrodina dutrugi (Coquand 1862) (Fig. 4/5, 6, 11, 136 15)

1862. *Venus Dutrugi* Coquand, p. 193, pl. 7, figs. 5, 6.
 1962. *Meretrix dutrugi* (Coquand) - Abbass, p.147, pl. 22, fig. 22.
 1963. *Venus dutrugi* Coquand - Fawzi, p. 79.
 2005. *Aphrodina dutrugi* (Coquand) - Ahmad, p. 191, pl. 1, figs. 169.

Material: 50 specimens from beds 2 and 4 (MDG/LBV/BV/Lm - 18).

Measurements (mm):

n = 32	L	H	I
Range	28639	25638	10620
Mean	33.5	31.5	15

Description: Shell medium to large, equivalve, inequilateral, trigonal to elongate in outline. In some specimens length slightly exceeding height. Umbones prominent, prosogyrate, contiguous, placed anterior, slightly incurved. Anterodorsal margin strongly to weakly concave; posterodorsal weakly convex. Anterior margin slightly rostrate with small deep channel, rounded in outline; posterior margin evenly rounded, with long and deep channel, passing smoothly into the weakly convex ventral margin. Inflation very variable, point of maximum inflation located at around 30% of height below dorsal extremity of umbones. Sculpture of fine concentric growth line when present. Shell surface is usually smooth.

Stratigraphic and geographic distribution: Cenomanian to Turonian of North Africa and Jordan (Abass 1962, Ahmad 2005). In Gabon, this species is recorded for the first time.

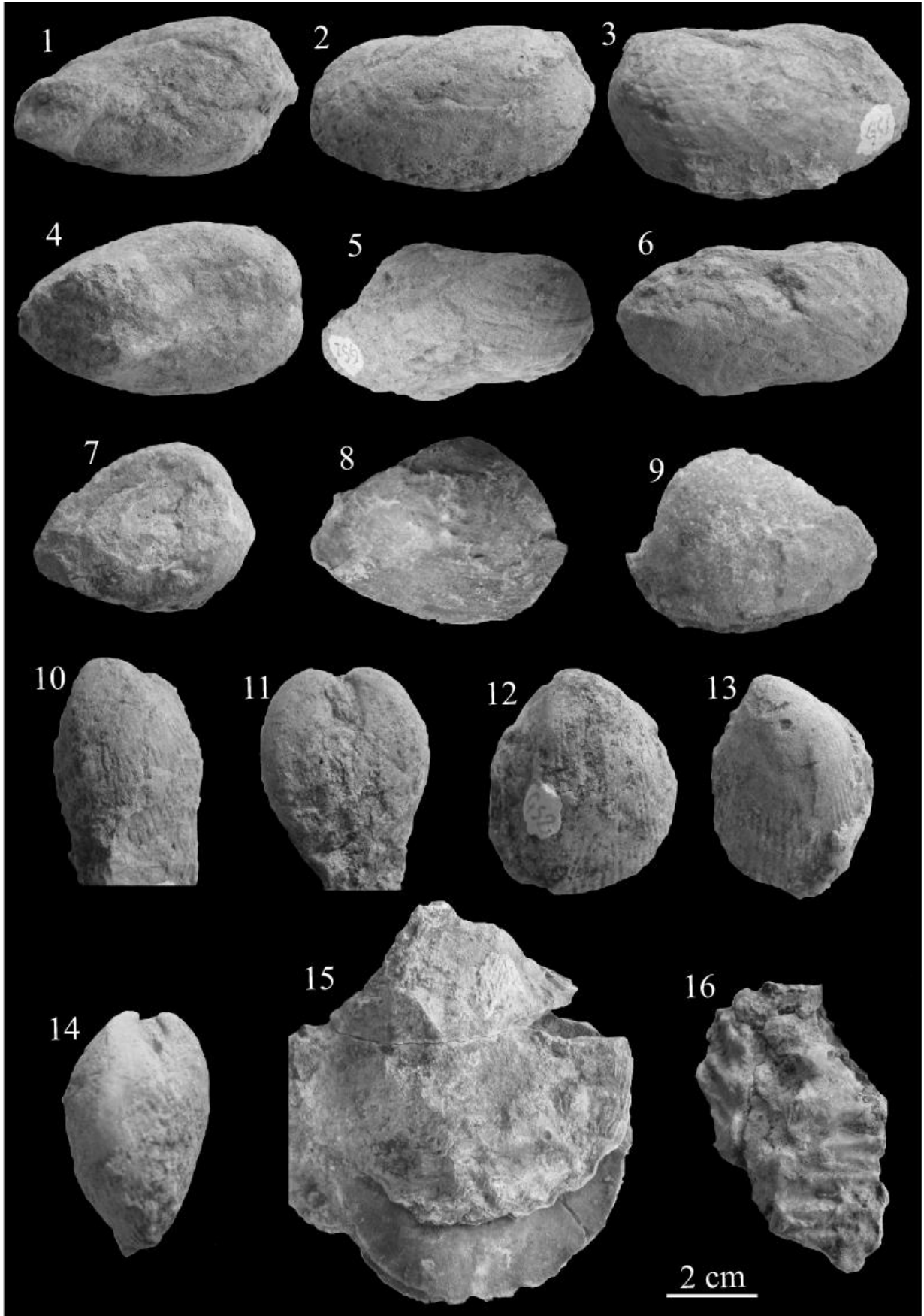


Figure 3. **166.** *Pholadomya* cf. *adversa* Riedel MDG/LBV/BV/Lm - 16, bed 2. **769.** Bivalve indet. MDG/LBV/BV/Lm - 22, bed 2. **10614.** *Granocardium productum* (Sowerby) (10611) MDG/LBV/BV/Lm - 17.1, bed 2; (12613) MDG/LBV/BV/Lm - 17.2, bed 1; (14) MDG/LBV/BV/Lm - 17.3, bed 3. **15.** *Lopha* cf. *lombardi* Darteville & Freneix MDG/LBV/BV/Lm - 21, bed 1. **16.** *Rastellum* sp. MDG/LBV/BV/Lm - 6, bed 3.

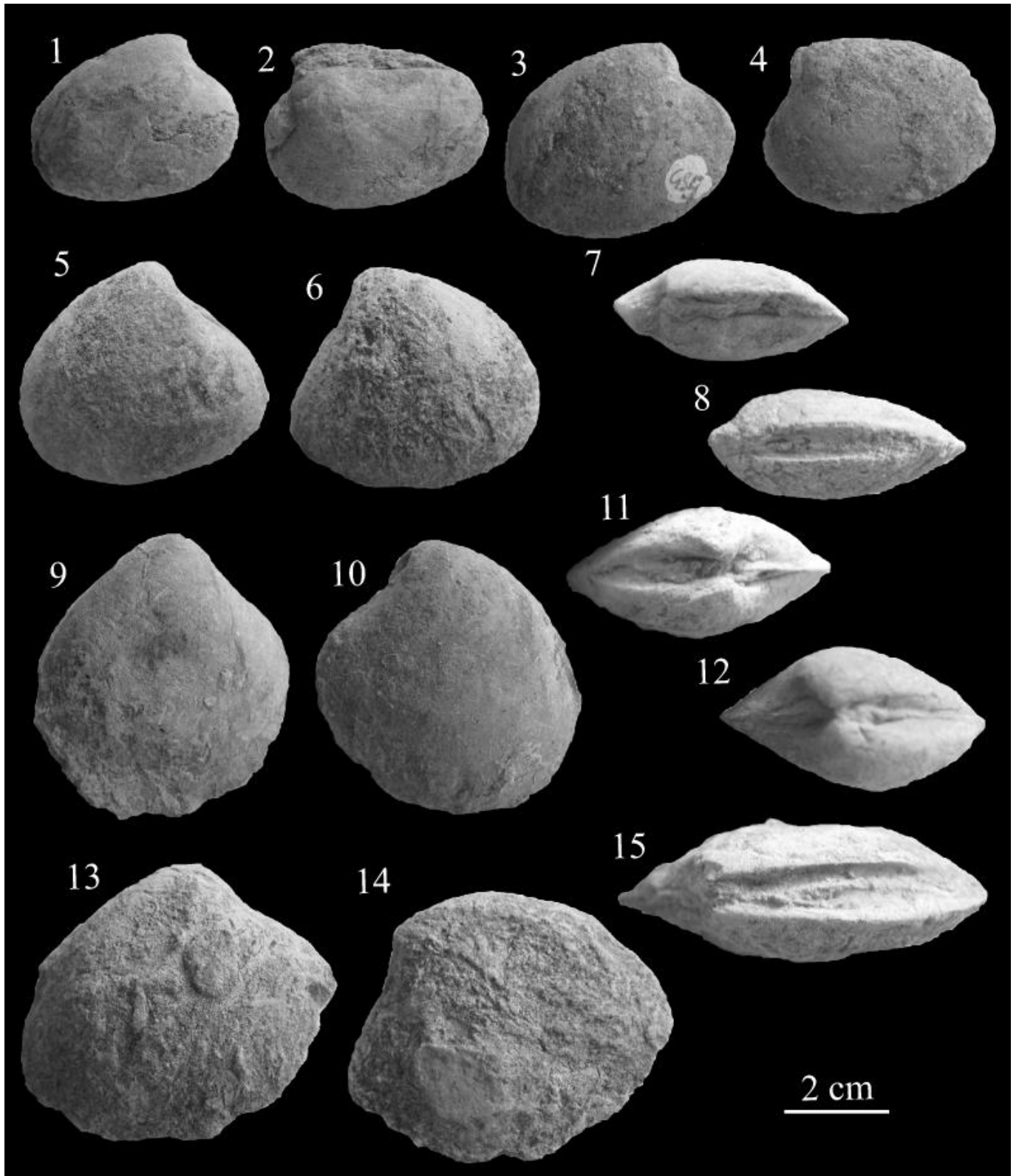


Figure 4. **164, 7, 8.** *Aphrodina* sp. MDG/LBV/BV/Lm - 20, bed 2. **5, 6, 11, 13615.** *Aphrodina dutruegi* (Coquand) (5, 6, 11) MDG/LBV/BV/Lm - 18. 1, bed 4; (13615) MDG/LBV/BV/Lm - 18. 2, bed 2. **9, 10, 12.** *Aphrodina angustosinuosa* (Riedel) MDG/LBV/BV/Lm - 19, bed 2.

Aphrodina angustosinuosa (Riedel 1932) (Fig. 4/9610, 12) 1932. *Callistina? angustosinuosa* (Sowerby) - Riedel, p. 62, pl. 11, fig. 1

1957. *Aphrodina* (*Aphrodina*) *angustosinuosa* (Riedel) - Darteville & Freneix, p. 185, pl. 31, fig. 7; pl. 32, fig. 1a6c.

Material: 5 specimens from bed 2 (MDG/LBV/BV/Lm - 19).

Measurements (mm):

n = 5	L	H	I
Range	31643	30646	15620
Mean	22	38	17.5

Remarks: This species differs from *Aphrodina dutruegi* (Coquand) in being slightly higher than long.

Stratigraphic and geographic distribution: Cenomanian to Maastrichtian? of Angola, Cameroon, Democratic Republic of Congo (Darteville & Freneix 1957). In Gabon, this species was known from Senonian deposits at Caverne Idembé (Darteville & Freneix 1957). Its range is expanded to the Turonian of the Libreville region.

Aphrodina sp. (Fig. 4/164, 7, 8)

Material: 2 specimens from bed 2 (MDG/LBV/BV/Lm - 20).

Measurements (mm):

n = 2	L	H	I
Range	36638	30634	13615
Mean	37	32	14

Description : Shell large-sized, elongate-ovate, inequilateral, equivalve in outline. Umbones situated anteriorly; beaks prosogyrate. Anterodorsal margin short and straight; posterodorsal margin slightly convex. Anterior margin rostrate or rounded in outline. Posterior margin straight passing smoothly into the weakly convex ventral margin. Shell surface smooth.

Stratigraphic and geographic distribution: Turonian of Gabon (this study).

Megaorder OSTREATA Férussac 1822

Superorder OSTREIFORMII Férussac 1822

Order OSTREIDA Férussac 1822

Suborder OSTREIDINA Férussac 1822

Superfamily OSTREOIDEAE Rafinesque 1815

Family OSTREIDAE Rafinesque 1815

Subfamily LOPHINAE Vialov 1936

Tribe LOPHINI Vialov 1936

Genus *Lopha* Röding 1798

Lopha cf. lombardi Darteville & Freneix 1957 (Fig. 3/15)

1957. cf. *Lopha lombardi* Darteville & Freneix, p. 108, pl. 15, figs. 7a6b, pl. 16, figs. 164, pl. 17, figs. 167, pl. 18, figs. 166, pl. 19, figs. 1, 2a6b, 3a6b.

Material: 1 specimen from bed 1 (MDG/LBV/BV/Lm - 21).

Measurements (mm):

n = 1	L	H	I
	65	85	

Remark. The poor preservation of our material does not allow a decisive identification.

Stratigraphic and geographic distribution: Coniacian to Maastrichtian of Gabon, Democratic Republic of Congo and Congo (Darteville & Freneix 1957).

Family ARCTOSTREIDAE Vialov 1983

Subfamily PALAEOLOPHINAE Malchus 1990

Tribe OSILLOPHINI Malchus 1990

Genus *Rastellum* Faujas-Saint-Fond 1799

Rastellum sp. (Fig. 3/16)

Material: 1 specimen from bed 3 (MDG/LBV/BV/Lm - 6).

Measurements (mm):

n = 1	L	H	I
	35	28	

Remark: The specimen may belong to the genus *Rastellum* because of the presence of the narrow crest.

Description: The fossil at our disposal shows a part of the inner surface of a shell with a narrow crest running along the median axis, from which radiate robust ribs turning to folds.

Stratigraphic and geographic distribution: *Rastellum* has been recorded in the Cretaceous of Europe (e. g. Freneix & Viaud 1986, Aqrabawi 1993), Brazil (Seeling & Bengston 1999), Gabon (Musavu Moussavou *et al.* in press and this study).

ACKNOWLEDGMENTS

This study is financially supported by the Geology Department of the Faculty of Sciences, Masuku University of Franceville (Gabon). We are particularly grateful to Dr. Dirk Van Damme and the Journal editorial board for their constructive comments which greatly improved the manuscript.

REFERENCES

- Abbas H.L. 1962. A monograph of the Egyptian Cretaceous pelecypods. *Geol. Survey Mineral Research Depart. UAR, Palaeont. Series*, 1, 224 p.
- Ahmad F. 2005. The heterodont bivalve *Aphrodina dutruegi* (Coquand, 1862) from The Cenomanian of Jordan. *Riv. It. di Paleont. e Stratigrafia*, 111, 1916195.
- Andert H. 1934. Die Kreideablagerungen zwischen Elbe und Jeschken. Die Fauna der obersten Kreide in Sachsen, Böhmen und Schlesien. *Abh. Preussischen Geol. Landesamt*, N. F. H., 159, 477 p.
- Aqrabawi M. 1993. Oysters (Bivalvia-Pterimorphia) of the Upper Cretaceous rocks of Jordan: palaeontology, stratigraphy and comparison with the Upper Cretaceous oysters of northwest Europe. *Mitt. Geol-Paläont. Institut der Universität Hamburg* 75, 16136.

- Benaim N.P. & Senra M.C.E. 2008. O gênero *Pholadomya* Sowerby, 1823 (Mollusca: Bivalvia) na formação Jandaíra (Cretáceo Superior), Bacia Potiguar: implicações paleoecológicas e paleogeográficas. *Anu. Inst. Geoci.* 31, 1, Rio de Janeiro
- Benyoucef M., Meister C., Bensalah M. & Zohra Malti, F. 2012. La plateforme pré-africaine (Cénomaniens supérieuró Turonien inférieur) dans la région de Béchar (Algérie): stratigraphie, paléoenvironnement et signification paléobiogéographique. *Rev. Paléobiol.*, 31, 2056218.
- Carter J.G., Altaba C.R., Anderson L.C. *et al.* 2011. A synoptical classification of the Bivalvia (Mollusca). *Paleontological Contributions 4*. Kansas University, Paleontological Institute. The Univ. of Kansas, Lawrence, Kansas, 1647.
- Chevalier L., Makanga J.F. & Thomas R.J. 2002. *Carte géologique de la République gabonaise au 1/1 000 000. Notice explicative*. Council for Geoscience, 195 p.
- Choubert B. 1935. Sur les terrains crétacés de la zone côtière du Gabon. *C. R. Ac. Sc. Paris*, 201, 4016403.
- Coquand H. 1862. Géologie et paléontologie de la région sud de la province de Constantine, *Mém. Soc. d'Emulation de la Provence*, 2, 343 p.
- Darteville E. & Brébion Ph. 1956. Mollusques fossiles du Crétacé de la côte occidentale d'Afrique du Cameroun à l'Angola. I. - Gastéropodes. *Ann. Mus. Roy. Congo belge, in 8, Sci. géol.*, 15, 128 p.
- Darteville E. & Freneix S. 1957. Mollusques fossiles du Crétacé de la côte occidentale d'Afrique du Cameroun à l'Angola. II. - Lamellibranches. *Ann. Mus. Roy. Congo belge, in 8, Sci. géol.*, 20, 271 p.
- Fawzi M.A. 1963. La faune cénomaniens d'Égypte. *Geol. Survey Egypt*, 2, 133 p. Caïre
- Freneix S. 1959. Mollusques fossiles du Crétacé de la côte occidentale d'Afrique du Cameroun à l'Angola. III. - Conclusions stratigraphiques et paléontologiques. *Ann. Mus. Roy. Congo belge, in 8, Sci. géol.*, 24, 126 p.
- Freneix S. 1966. Faunes de Bivalves et corrélation des faunes marines du Crétacé des bassins côtiers de l'Ouest africain-Bassins sédimentaires du littoral africain. In: Reyre, D. (Ed.), Symposium New Delhi, 1964, Ass. Ser. Géol. Africains, Paris, 1, 52678.
- Freneix S. & Viaud J.-M. 1986. Huitres du Crétacé supérieur du bassin de Challans-Commequiers (Vendée). Biostratigraphie, taxonomie, paléobiologie. *Bull. trim. Soc. Géol. Normandie*, 73, 1-2, 14679.
- Furon R. 1931. Sur la géologie du Gabon (A.E.F.). *C. R. Acad. Sci. Paris*, 192, 1686169.
- Furon R. 1950. *Géologie de l'Afrique*. Paris, ed. Payot, 1, 350 p.
- Gérard G. 1958. *Carte géologique de l'Afrique Equatoriale Française au 1/ 2 000 000. Notice explicative*. Gouvernement Général de l'Afrique Equatoriale Française, Direction des Mines et de la Géologie, 198 p.
- Hourcq V. & Hausknecht J.-J. 1954. *Notice explicative sur la faille Libreville-Ouest et carte géologique de reconnaissance au 1/500 000*. Gouvernement Général de l'Afrique Equatoriale Française, Paris, 25 p.
- Hudeley H. & Belmonte Y. 1970. Carte géologique de la République gabonaise au 1/1000000. Notice explicative. *BRGM, Mém.*, 72, 191 p.
- Kossmat F. 1893. Über einige Kreideversteinerungen vom Gabun. *Sitz. Akad. Wiss. Wien*, 102, 5756590.
- Lombard J. 1930. Céphalopodes et Lamellibranches crétacés du Congo Français. *Bull. Soc. géol. France*, 4, 30, 2776322.
- Mbina Mounguengui M. 1998. *Dynamique sédimentaire et fluctuations eustatiques au cours du Cénomaniens et du Turonien basal dans le Nord du bassin côtier gabonais*. Thèse Univ. Bourgogne, 376 p.
- Mbina Mounguengui M & Lang J. 2003. Evolution de la dynamique sédimentaire au cours du Cénomaniens et du Turonien dans le Nord du bassin côtier gabonais. *Afr. Geo. Rev.*, 10, 1 and 2, 856102.
- Meister C., Mbina Mounguengui M. & Lang J. 1996. Les ammonites Cénomano-Turonien du Gabon: Intérêt pour la liaison Téthys-Atlantique Sud et corrélations. - 39^{ème} Congrès Brésilien de Géologie. *IGCP projet 3881 (South Atlantic Mesozoic Correlations SAMC)*, News 5, Abstract: 4056407.
- Meister C., Mbina Mounguengui M. & Lang, J. 2003. Les ammonites du Cénomano-Turonien du bassin côtier nord-gabonais: systématique et intérêt paléogéographique pour la liaison Téthys-Atlantique Sud. *Rev. Paléob.* 22, 1, 3416335.
- Musavu Moussavou B., Makaya M'Voubou, Ndong Ondo S.M. (in press). Turonian bivalves from Gabonese coastal basin: case of Belle vue 3 section, South of Libreville region. *Bull. Soc. géol. France*, 185, 1.
- Reyment R.A. 1954. The stratigraphy of the southern Cameroons. *Geol. Fören. Forhandl. Stockholm*, Bd. 76, 479, 6616683.
- Seeling J. & Bengtson P. (1999). Cenomanian oyster from the Sergipe Basin, Brazil. *Cr. Res.*, 20, 7476765.
- Sowerby J. C. 181261845. *The mineral Conchology of Great Britain*. London, Benjamin Meredith, 7, 648 p.
- Teisserenc P. & Villemin J. 1990. Sedimentary Basin of Gabon - Geology and Oils Systems. In: Divergent/Passive margin basins (J.D. Edwards & P.A. Santogrossi, Eds). *Bull. Americ. Ass. Petr. Geo.*, 48, 1176199.
- Weydert P. 1981. Les faciès péri-récifaux du Turonien de Libreville (Gabon): significations paléoecologiques au cours de l'ouverture de l'Atlantique. *C. R. Ac. Sci., Paris*, 295, 956100.
- Weydert P. & Collignon M. 1981. *Schindewolfites gabonensis* nov. sp. et *Furoniceras?*, ammonites du Turonien de Libreville (Gabon). *Doc. Labo. Lyon, H.S.*, 6, 2936299.

Manuscrit reçu le 18/02/2013
Version révisée acceptée le 27/09/2013
Version finale reçue le 28/11/2013
Mise en ligne le 23/04/2014