

Turonian gastropods from the Coastal Basin of Gabon: Gabon store section, South of Libreville

Les gastéropodes du Turonien du bassin côtier du Gabon: Coupe de Gabon Store, Sud Libreville

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Abstract. The taxonomy and palaeoecology of the Turonian gastropods fauna from the geological section ãGabon Storeö (southern Libreville, Gabon) are discussed. Seven taxa are recognized: *Armenocerithium haidingeri* (Zekeli), *Cerithium* sp. A, *Cerithium* sp. B, *Cerithium* sp. C, *Nerinea* sp., *Pseudamaura* sp. and *Turritella* sp. Two genera *Armenocerithium* and *Nerinea* are reported from the Gabonese coastal basin for the first time. The association of macrobenthic fauna (gastropods and bivalves) indicates: (1) a medium water energy level and (2) a stable and soft substrate during Turonian deposit of the ãGabon storeö section.

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

Résumé. La taxonomie et la paléocologie de la faune des gastéropodes d'âge Turonien de la coupe de ãGabon Storeö (Sud de Libreville, Gabon) sont ici discutées. Sept espèces sont reconnues : *Armenocerithium haidingeri* (Zekeli), *Cerithium* sp. A, *Cerithium* sp. B, *Cerithium* sp. C, *Nerinea* sp., *Pseudamaura* sp. and *Turritella* sp. Deux genres : *Armenocerithium* et *Nerinea* sont reportés ici pour la première fois dans le bassin côtier gabonais. L'association de la macrofaune benthique indique : (1) une moyenne énergie d'eau et (2) un substrat stable et meuble durant le dépôt du Turonien de la coupe de ãGabon storeö.

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

INTRODUCTION

The Mesozoic rocks of the Gabonese Coastal Basin contain a rich macroinvertebrate fauna (e.g. gastropods, bivalves, echinoderms, ammonites), observed previously in the studied area (Lombard 1930, Furon 1931, 1950, Choubert 1935, Darteville & Brébion 1956, Darteville & Freneix 1957, Freneix 1959, 1966, Weydert & Collignon 1981, Hudeley & Belmonte 1970, Meister *et al.* 1996, 2003, Mbina Mounguengui 1998, Chevalier *et al.* 2002, Mbina Mounguengui & Lang 2003, Musavu Moussavou *et al.* 2013a, 2013b, 2014). However the gastropods have so far been little studied from a taxonomic point of view. Only Kossmat (1893), Darteville & Freneix (1956) and Musavu Moussavou *et al.* (2013b) provided taxonomical information. Therefore, the gastropods taxa of Gabon are still unknown, despite the abundance and often dominance of gastropod fossils in the rocks. This paper is an attempt to improve this situation. To this end, we made collections of gastropod fossils at the so-called ãGabon storeö section, southern 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 & Villemain 1990). The age of the deposits in the Libreville region is assigned to the Turonian based on ammonites (Hourcq & Hausknecht 1954, Meister *et al.* 2003). In the Libreville region, the sedimentary sequence is composed mainly of limestones, marls and clays with sandstone intercalations (e. g. Hourcq & Hausknecht 1954,

Gérard 1958, Weydert 1981, Mbina Mounguengui 1998). Also small coral bioherms have been reported within the limestone (Weydert 1981). The deposits contain a varied marine invertebrate fauna (Lombard 1930, Hourcq & Hausknecht 1954, Darteville & Brébion 1956, Hudeley & Belmonte 1970, Mbina Mounguengui 1998, Chevalier *et al.* 2002, Meister *et al.* 1996, 2003, Musavu Moussavou *et al.* 2013a, 2013b, 2014).

The studied ãGabon storeö section (Fig. 2) is located along the express road at GPS coordinates N 00°23'00" E 009°28'28" (Fig. 1). It is 6 m thick and composed of calcareous sandstone intercalated with silty limestone layers. The deposits contain bioclasts, gastropods, ostracods, echinoids and bivalves. According depositional environment from analyse of bivalve fauna, Musavu Moussavou *et al.* (2013b) suggested an intertidal zone represented by silty limestone and a shallow subtidal zone represented by calcareous sandstone.

MATERIAL AND METHODS

The material for this study comprises 35 specimens from the ãGabon Storeö section. All specimens were collected only from calcareous sandstone layers and are preserved as internal and composite moulds. The material is deposited in the collection of the Geology Department, Faculty of Sciences, Masuku University of Franceville (Gabon), under collection number MDG/LBV/Gas. In the descriptions of the fauna, we follow Yin & Yochelson (1983) for spire and size of specimen. They classified the specimens according to size into small (< 1.0 cm), moderately small (1.0 to 1.5 cm), medium (1.5-2.0 cm), moderately large (2.0-2.5 cm) and large (>2.5 cm).

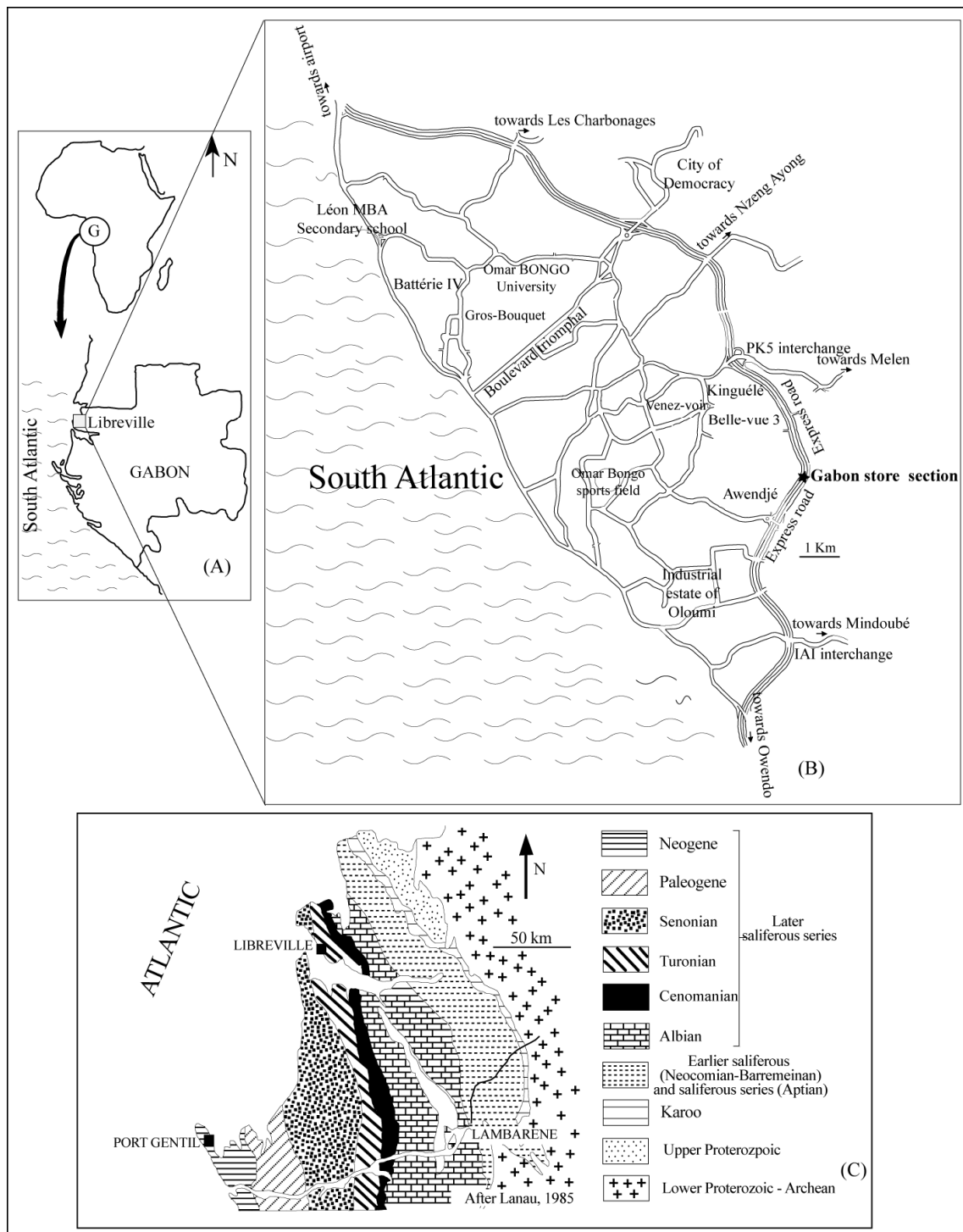


Figure 1. Locality map of Libreville region (A), “Gabon Store” section (B) and geological map of north of Gabonese coastal basin (C) (After Lanau, 1985).

They divided the spire into low-spined (pleural angle $>110^\circ$), moderately low-spined (angle 90° – 110°), moderately high-spined (angle 50° – 90°) and high-spined ($<50^\circ$). The terminology and classification used here are respectively that of Cox (1960) and Bouchet & Rocroi (2005). All the measurements are in millimeters. We have measured only specimens, which present a complete height. Abbreviations of measured parameters: n: number of measured specimens; H: height; D: maximum diameter; HA: height of aperture; WA: width of aperture; HL: height of last whorl; PA°: pleural angle (in degrees).

RESULTS

From the diversity and distribution point of view, the gastropod taxa from the “Gabon Store” section are characterized by a low diversity. In the present study, five genera including seven species (*Armenocerithium haidingeri* (Zekel), *Cerithium* sp. A, *Cerithium* sp. B, *Cerithium* sp. C, *Nerinea* sp., *Pseudamaura* sp. and *Turritella* sp.) have been determined. Two genera *Armenocerithium* and *Nerinea* are reported from the Gabonese coastal basin for first time. From the abundance

point of view, the gastropods assemblage from ðGabon storeõ section is dominated by representatives of the genus *Cerithium*. *Cerithium* sp. C dominates the assemblage with 19 specimens. The other species of *Cerithium* are represented by two or six specimens

SYSTEMATIC PALEONTOLOGY

Family TURRITELLIDAE Lovén 1847

Genus *Turritella* Lamarck 1799

Turritella sp. (Fig. 3 / 5)

Material: Six specimens from bed 1 (MDG/LBV/Gas - 12).

Measurements (mm)

Sample code	H	D	HA	WA	HL	PA
MDG/LBV - 2.1	35	18	4	4	12	15

Description: Large sized, slender, turriculate and high-spined gastropod. Spire long and consisting of 3-4 overlapping whorls with concave whorl sides and raised sutures. Whorls gradually decrease in height toward the apex. Ornament consisting of two prominent spiral cords. At the bottom of last whorl occurs two thins secondary cords. Aperture is small and round.

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

Discussion: The present material is similar, in ornamentation, to *Haszprunariella spiralis* (Kiel) from the Campanian of Spain, figured by Kiel (2001, pl. 34, fig. 7),

but *Turritella* sp. is higher than *H. spiralis*. According to Kiel (2001), this species dot not exceed 2 mm in height.

Family AMPULLINIDAE Cossman 1919

Genus *Pseudamaura* Fischer 1885

Pseudamaura sp. (Fig. 3 / 6ñ7)

Material: 2 specimens from bed 3 (MDG/LBV/Gas - 17).

Measurements (mm)

Sample code	H	D	HA	WA	HL	PA
MDG/LBV 17.2	135	85	87	43	92	102

Remark: The high whorls, canaliculated suture, small umbilicus and the distinct subsutural ramp suggest an allocation to *Pseudamaura*.

Description: Large-sized, subglobose and moderately low-spined gastropod. Spire conical and consisting of three overlapping convex whorls. Whorls gradually decrease in diameter toward the apex. Sub-sutural ramp flat and moderately wide. Last whorl large and accounting the main part of the specimen (96% in total height). Aperture is large and ovate in outline shaped. Outer lip strongly convex, inner lip slightly concave.

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

Discussion: The shape of the present material resembles *Ampullina* (*Pseudamaura*) *bulbiformis* (Sowerby), illustrated by Darteville & Brébion (1956: pl. 5, fig. 3), but the poor preservation of the specimens does not allow a conclusive identification.

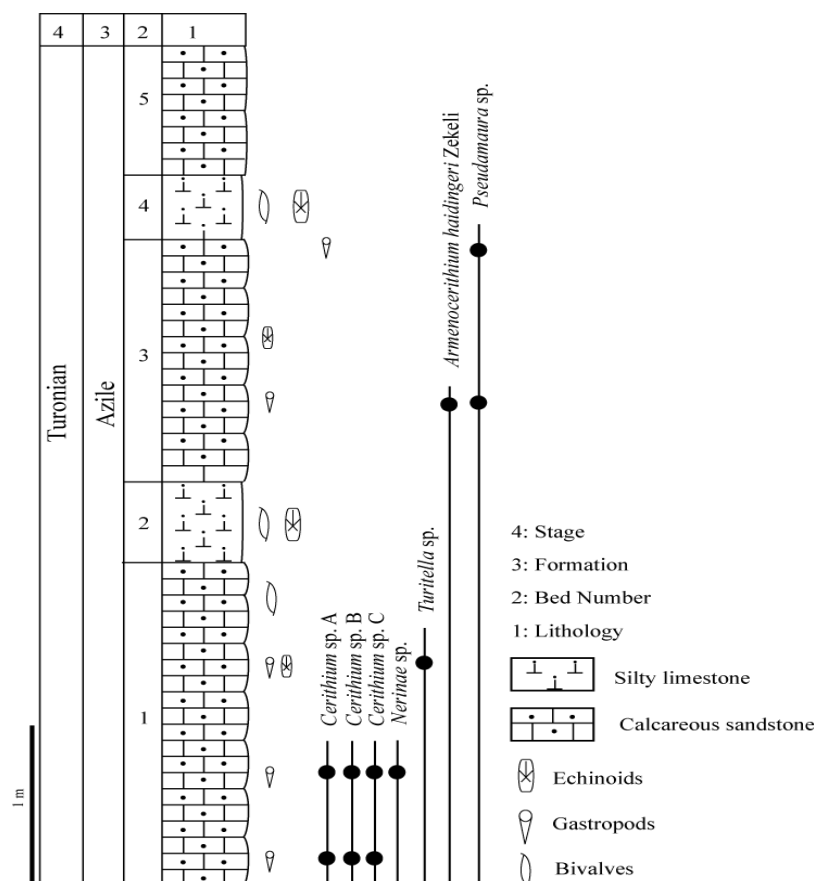


Figure 2. Lithostratigraphic section of the ðGabon Storeõ section and distribution of gastropods association.

Family NERINEOIDEA Zittel 1873

Genus *Nerinae* DeFrance 1825

Nerinae sp. (Fig. 4 / 1•2)

Material: One specimen from bed 1 (MDG/LBV/Gas - 28).

Measurements (mm):

Sample code	H	D	HA	WA	HL	PA
MDG/LBV • 28	90	28	-	-	16	20

Description: Large sized, turruculate and high-spired gastropod. Spire long and consisting of 10 overlapping whorls and accounting about 82% of the total shell height. Whorls gradually decrease in diameter toward apex. Ornament is poor and consisting of small axial tubercles. Apex not preserved. Aperture is obstructed. Longitudinal whorl section displaying three folds: a slight and sickle parietal fold, a well-developed triangular columellar fold and flat-topped labral fold.

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

Discussion: Due to the poor preservation of the specimens, identification at the species level is very difficult. However, the present material is similar to *Nerinea blancheti* Pictet & Campiche in internal fold pattern.

Family CERATHIIDAE Férussac 1899

Genus *Cerithium* Bruguière 1789

Cerithium sp. A (Fig. 4 / 5•7, 10, 11)

Material: Two specimens from bed 1 (MDG/LBV/Gas - 29).

Measurements (mm):

Sample code	H	D	HA	WA	HL	PA°
MDG/LBV•29.1	84	30	-	-	15	20

Description: Large pyramidal gastropod with spire of 8-9 overlapping whorls, accounting about 85% of the total shell height. Whorls gradually decrease in diameter toward the apex. Ornament consisting of granular spiral cord. Longitudinally, tubercles form strong axial ribs. Apex commonly damaged. Aperture is obstructed. Base rounded. The longitudinal section shows quadrangular whorls without distinct folds.

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

Discussion: The present specimens resemble *Cerithium* cf. *heeri* Pictet & Renevier, illustrated by Myczynski & Iturralde-Vinent (2005). *Cerithium* sp. A differs from *Cerithium* cf. *heeri* by its tubercles, which form strong axial ribs. *Cerithium heeri* was originally described from Aptian of France.

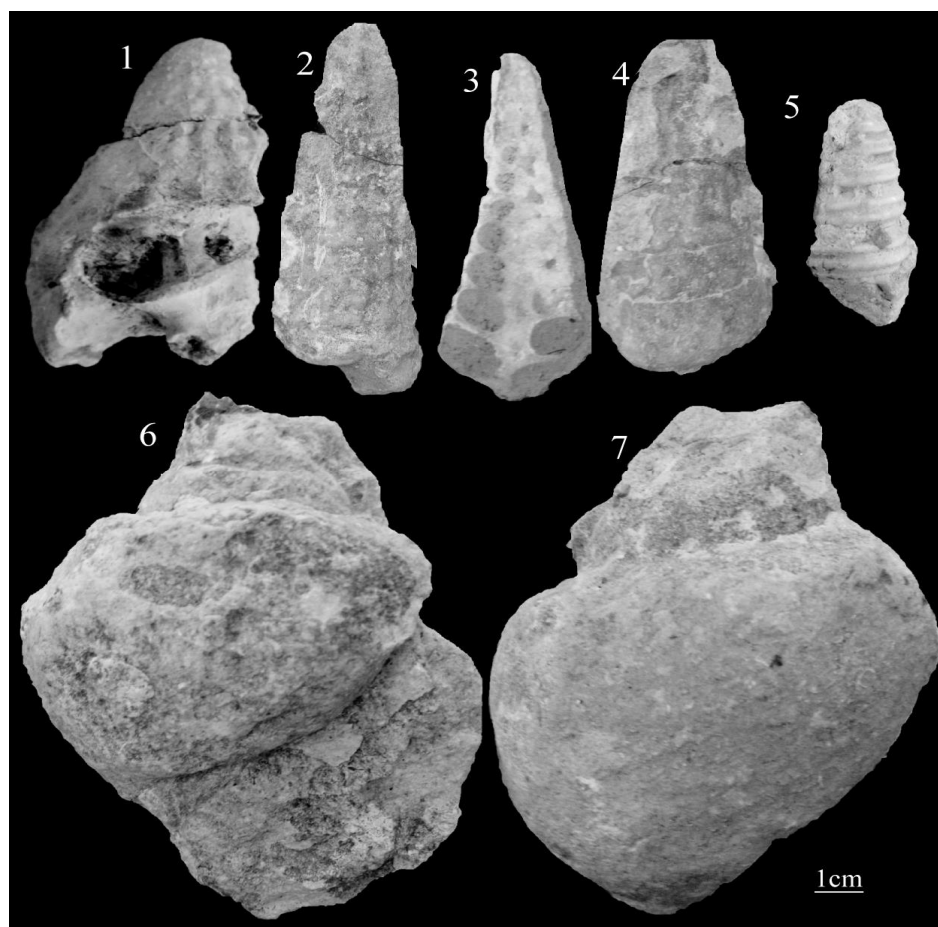


Figure 3. 1. *Armenocerithium haidingeri* (Zekeli) MDG/LBV/Gas • 32, bed 1. Apertural view. 2-4. *Cerithium* sp. C MDG/LBV/Gas - 31, bed 1; 2: Apertural view, 3: axial whorl section, 4: abapertural view. 5. *Turritella* sp. MDG/LBV/Gas - 12, bed 1. Apertural view. 6•7. *Pseudamaura* sp. MDG/LBV/Gas - 17, bed 3; 6: Apertural view, 7: abapertural view.

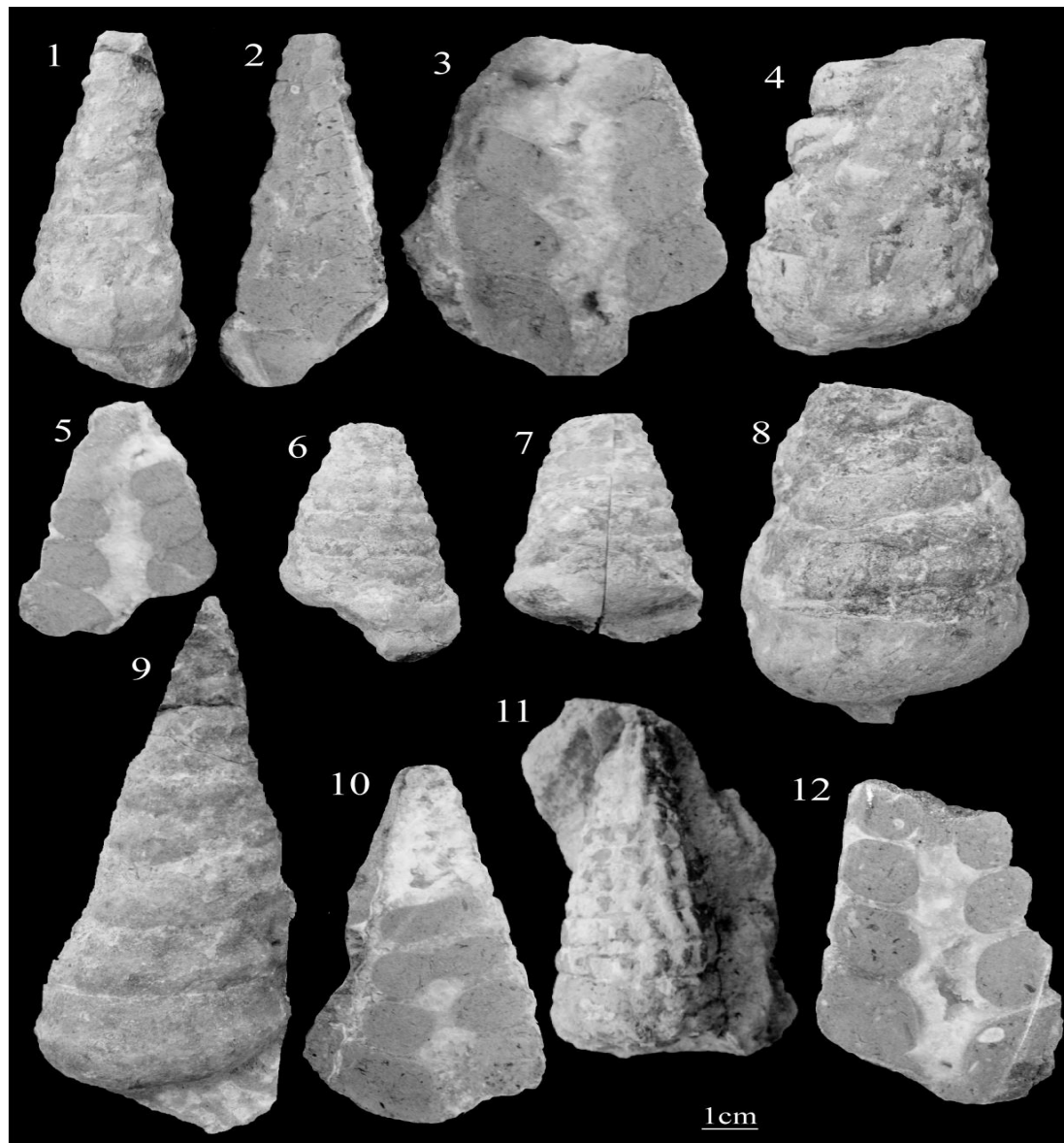


Figure 4. 1ñ2. *Nerinae* sp. MDG/LBV/Gas ñ 28, bed 1. 1: Apertural view, 2: axial whorl section. 5ñ7, 10, 11. *Cerithium* sp. A MDG/LBV/Gas - 29, bed 1. 5, 10: Axial whorl section, 6, 11: abapertural view, 7: apertural view. 3, 4, 8, 9, 12. *Cerithium* sp. B MDG/LBV/Gas - 30, bed 1. 3; 12: Axial whorl section, 4, 8: abapertural view, 9: apertural view.

***Cerithium* sp. B** (Fig. 4 / 3, 4, 8, 9, 12)

Material: 4 specimens from bed 1 (MDG/LBV/Gas - 30).

Measurements (mm):

Sample code	H	D	HA	WA	HL	PA°
MDG/LBV/Gas ñ 30	126	40	34	21	23	38

Description: Large sized, turriculate and high-spined gastropod. Spire long and consisting of 9-10 overlapping whorls and accounting about 81% of the total shell height. Whorls gradually decrease in diameter toward the apex. Ornament consisting of two granular spiral cords. Tubercles are strong and shifted for one cord to other. Apex commonly damaged. Aperture is large and subround. The longitudinal section shows quadrangular whorls without distinct folds. Base contains a rostrum.

Remarks: This morphotype differs from *Cerithium* sp. A by its tubercles which are strong and shifted for one cord to other and by the presence of rostrum at its base.

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

Discussion: The specimens are characterized by their turriculate shape, high spire and two granular cords. This species resembles *Cerithium binodosum* Roemer but differs by its big tubercles and the absence of obscure costae.

***Cerithium* sp. C** (Fig. 3 / 2ñ4)

Material: 19 specimens from bed 1 (MDG/LBV/Gas - 31), 3 of which are complete.

Measurements (mm):

Sample code	H	D	HA	WA	HL	PA°
MDG/LBV/Gas ñ 31.1	72	26	18	10	15	30
MDG/LBV/Gas ñ 31.2	81	26	19	11	18	20
MDG/LBV/Gas ñ 31.3	83	30	-	-	15	25

Description: Large sized, turriculate and high-spined gastropod. Spire long and accounting of 7-8 overlapping

whorls and forming about 81% of the total shell height. Whorls gradually decrease in diameter toward the apex. Ornament consisting of two granular cords. Tubercles are small and shifted for one cord to other. Apex commonly damaged. Aperture is small and rhomboidal. The longitudinal section shows quadrangular whorls without distinct folds. Base contains a small rostrum.

Remarks: This morphotype differs with *Cerithium* sp. B in having small tubercles and a small rostrum at its base

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

Discussion: The present specimens seem to resemble *Cerithium binodosum* Roemer from Senonian of Poland, illustrated by Abdel-Gawad (1986), but differs by its sutures which are modarately deep.

Family DIZOPTYXIDAE Pechelintsev 1965

Genus *Armenocerithium* Egojan 1955

Armenocerithium haidingeri (Zekeli 1852) (Fig. 3/1)

1852. *Cerithium Haidingeri* Zekeli, p. 115, pl. 24, figs. 3ñ5.

1865. *Cerithium* (? *Vibex*) *Haidingeri* Zekeli - Stoliczka, p. 214.

2009. *Armenocerithium haidingeri* (Zekeli) - Kollmann, p.44, pl. 1, figs. 7ñ9.

Material: One incomplete specimen from bed 1 (MDG/LBV/Gas ñ 32).

Measurements (mm):

Sample code	H	D	HA	WA	HL	PA
MDG/LBV/Gas ñ 32	78	29	-	-	18	28

Description: Large sized, turruculate and high-spined gastropod. Spire conical and consisting of 6 overlapping flat whorls and accounting about 27% of the total height. Apex commonly damaged. Ornament consisting of axial ribs. Aperture is broken. Base contains a rostrum.

Stratigraphic and geographic distribution: Late Cretaceous of Austria (Stoliczka 1865, Kollmann 2009), Turonian of Gabon (this study).

PALAEOECOLOGY

The gastropod fauna of the ñGabon storeñ section is characterized by representatives of Ampullinidae, Cerathiidae, Dizoptyxidae, Nerineoidea and Turritellidae. The ñGabon storeñ section contains also other macrobenthic fauna such as bivalve which have been studied by Musavu Moussavou et al. (2013a). The palaeoecology of gastropods and bivalves is summarised in Tab. 1.

	Family	Life habit	Trophic groups	Nr of genera	Nr of species	Nr of individuals
Gastropods	Turritellidae	SI	S	1	1	6
	Ampullinidae	EM	D/H	1	1	2
	Nerineoidea	SI/EM	S	1	1	1
	Cerathiidae	EM	D/H?	1	3	25
	Dizoptyxidae	SI/EM	S	1	1	1
Bivalves	Pholadomyidae	DI	S	1	1	4
	Cardiidae	SI	S	1	1	10
	Veneridae	SI	S	1	3	57
	Ostreidae	EC	S	2	2	2

Table 1. Life habit, trophic groups and abundance of the studied gastropods and bivalves families. DIñdeep infaunal, SI - shallow-infaunal, EM - epifaunal mobile, S - suspension feeders, H - herbivores, D - deposit-feeder. Bivalves data after Musavu Moussavou et al (2013a).

It is based on Delvene (2003), Berndt (2002), Ayoub Hannaa (2011), Ayoub Hannaa & Fursich (2012). Gastropod and bivalve fauna consists of altogether 111 individuals. Bivalves dominate in terms of taxa as well as individuals (76%). With respect to life habits, shallow-infaunal organisms prevail (68.47%), followed by epifaunal mobile (24.32%). Deep-infaunal and epifaunal cemented are rare (together 5.4%). This indicates the existence of soft substrate (Delvene 2003, Ayoub-Hannaa 2011, Ayoub-Hannaa & Fursich 2012). The presence of large and heavy gastropods such as *Pseudamaura* sp. indicates a certain stability of the substrate. According to their feeding habits, suspension-feeders (76.57%) dominate strongly the association. Deposit-feeders represent 23.43%. This means that water energy was medium, low enough for organic matter, nutrients for deposit-feeders, to accumulate in the sediment, but sufficiently high for suspension-feeder (Delvene 2003; Ayoub-Hannaa 2011). This interpretation is

supported by the presence of an association of bivalves, which are exclusively preserved as doublets in lime-rich sandstone (Musavu Moussavou et al. 2013a). Gastropods live in marine environment, but also in terrestrial and fluvial realm (Termier & Termier, 1952; Moret, 1966; Verniory, 1970). Stenohaline groups, e.g., echinoids, which associated gastropods, indicate normal marine conditions.

CONCLUSION

The study of Turonian gastropods from the ñGabon storeñ section reveals the following:

1. Five genera are identified. Among them, two genera *Armenocerithium* and *Nerinae* are reported from the Gabonese coastal basin for the first time.

2. The co-occurrence of epifaunal mobile and shallow-infaunal gastropods indicates that the substrate was soft and stable during Turonian deposits.

3. The presence of deposit-feeders and suspension-feeders in the association reflects a medium water energy. The water energy was low enough for organic matter, the food for deposit-feeders, to accumulate in the sediment, but sufficiently high for suspension-feeder.

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