



Monograph

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Ostracoda (Arthropoda, Crustacea) from the Riachuelo Formation, Sergipe-Alagoas Basin, Brazil, Upper Aptian-Albian

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Abstract. The Sergipe-Alagoas Basin has one of the most complete, exposed lithological successions of the Cretaceous period in the continental margin of Brazil. It captures several phases of the evolution of the South Atlantic Ocean, including rift, gulf and drift. The upper Aptian–Albian Riachuelo Formation corresponds to the first stages of the southern proto-Atlantic Ocean invasion in that basin. The present study reviews the taxonomic identification and ecology of 39 ostracod species of this formation, proposing a new genus – *Gabonorygma* gen. nov. – and three new species – *Praebythoceratina deltalata* sp. nov., *Gabonorygma sergipana* gen. et sp. nov. and *Brachycythere smithsoniana* sp. nov. Other taxa include *Conchoecia?* sp. 1, *Cytherella* sp. 1, *C. besrineensis* comb. nov., *Cytherelloidea* aff. *globosa*, *C. btaterensis*, *Bairdoppilata* sp. 1, *Bairdoppilata* sp. 2, *B. comanchensis* comb. nov., *B. pseudoseptentrionalis*, *Robsoniella falklandensis*, *Cetacella* sp. 1, *Paracypris eniotmetos*, *Harbinia sinuata?*, *H. crepata*, *Liasina* sp. 1, *Praebythoceratina amsittenensis* comb. nov., *P. trinodosa* comb. nov., *Patellacythere* sp. 1, *P. shimonensis* comb. nov., *Xestoleberis?* sp. 1, *Xestoleberis?* sp. 2, *Apatocythere?* sp. 1, *Neocythere?* aff. *pseudovanveeni*, *N. (Physocythere) tenuis*, *Aracajuia antiqua* comb. nov., *A. benderi*, *A. fragilis* comb. nov., *Eocytheropteron* sp. 1, *Metacytheropteron* aff. *minuta*, *Microceratina?* sp. 1, *M. azazoulensis*, *Veenia guianensis*, *Algeriana?* sp. 1, *Quasihermanites?* sp. 1 and *Sergipella viviersae*.

Keywords. Ostracoda, Early Cretaceous, northeastern Brazil, Proto-Atlantic Ocean, *Gabonorygma* gen. nov.

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Introduction

The Sergipe-Alagoas Basin is a marginal basin located in northeastern Brazil (9–11°30' S, 37–35°30' W). Its mainland portion is between 16 and 50 km long and 170 km wide, covering a total area of approximately 11 000 km² (Feijó 1994), bounded by the Pernambuco-Paraíba Basin to the northeast (Maragogi structural high) and the Jacuípe Basin to the southwest (Itapuã Fault) (Fig. 1). It has been the subject of several studies, mainly due to the amount of data acquired through well and outcrop sampling, seismic lines, gravimetric and magnetic surveys, etc. Most of these studies focused on its oil and gas producing strata, i.e., its basement (Proterozoic), the Carmópolis oil field (Late Jurassic–Aptian) and the Calumbi Formation (Santonian–Cainozoic) (Marques 1965; Souza-Lima *et al.* 2002; Campos Neto *et al.* 2007; Graddi *et al.* 2007).

Since the beginning of studies on ostracods from the Sergipe-Alagoas Basin in the 1960s (Krömmelbein 1962, 1964), the upper Aptian–Cenomanian Riachuelo Formation was at the heart of important findings. Krömmelbein (1967) identified and described the first Albian species of the basin, *Aracajuia benderi* Krömmelbein, 1967 and *Sergipella transatlantica* Krömmelbein, 1967. Following that, Krömmelbein & Weber (1971) found new taxa in the basal, transitional layers of the formation, in an extensive work on the Aptian–Albian formations of northeastern Brazil.

Bate (1972), followed by Smith (2000), worked extensively on the late Aptian *lagerstätte*-quality fossils of *Harbinia micropapillosa* (Bate, 1972). The most extensive taxonomic summarization of the Riachuelo Formation so far was published by Viviers *et al.* (2000), while establishing the first ostracod-based biostratigraphy of the basin, although no taxonomic details were provided. Do Carmo *et al.* (2008, 2012), Poropat & Colin (2012) and Antonietto *et al.* (2012, 2013) presented subsequent taxonomic updates for some of those species. The most recent taxonomic, stratigraphic and paleozoogeographical reviews of the late Aptian–early Albian of the formation is given by Antonietto *et al.* (2015).

An extensive taxonomic review of several ostracod species and genera of the upper Aptian–Albian strata of the Riachuelo Formation is herein presented. Its main objective is to better identify and describe the ostracod fauna observed in the formation during that stage. These species are also compared with those of coeval lithological units worldwide, so as to optimize synonymies between their faunas. The present study will impact future analyses of several aspects of these strata, such as biostratigraphical, paleoecological and paleozoogeographical correlations.

Geological and regional settings

The Sergipe-Alagoas Basin was originally described by Schaller (1969), and extensively reviewed by Feijó (1994) and Campos Neto *et al.* (2007). The basin lithology is mostly co-relatable to the evolutionary stages of the formation and expansion of the South Atlantic Ocean: syneclise, pre-rift, rift, gulf and drift (Ponte & Asmus 1976; Feijó 1994). The upper Aptian–Cenomanian Riachuelo Formation was established at the beginning of the drift phase, due to a transgression that allowed the sedimentation of openly marine sediments. This formation is composed of three members. At the basin margins and grabens, deltaic fans were formed and the coarse sediments brought by them constitute the Angico Member. At lower sedimentation areas, the Maruim Member dominates, with its carbonate ramps

and dolomitized oolitic/oncolytic banks deposited under fluctuating sea level conditions. The Taquari Member, on the other hand, corresponds to the calcareous mudstones and shales from lagoon and slope environments (Campos Neto *et al.* 2007) (Fig. 2).

The upper Aptian–Albian sediments of the Sergipe-Alagoas Basin were deposited during the establishment of the “Megatethys Ocean”, or “Mid Cretaceous Tethyan Realm” (Dias-Brito 2000). Based on the worldwide equatorial occurrence of pithonellid species during that age, a set of tropical marine environments occupying both hemispheres, approximately between latitudes 40° N and 40° S,

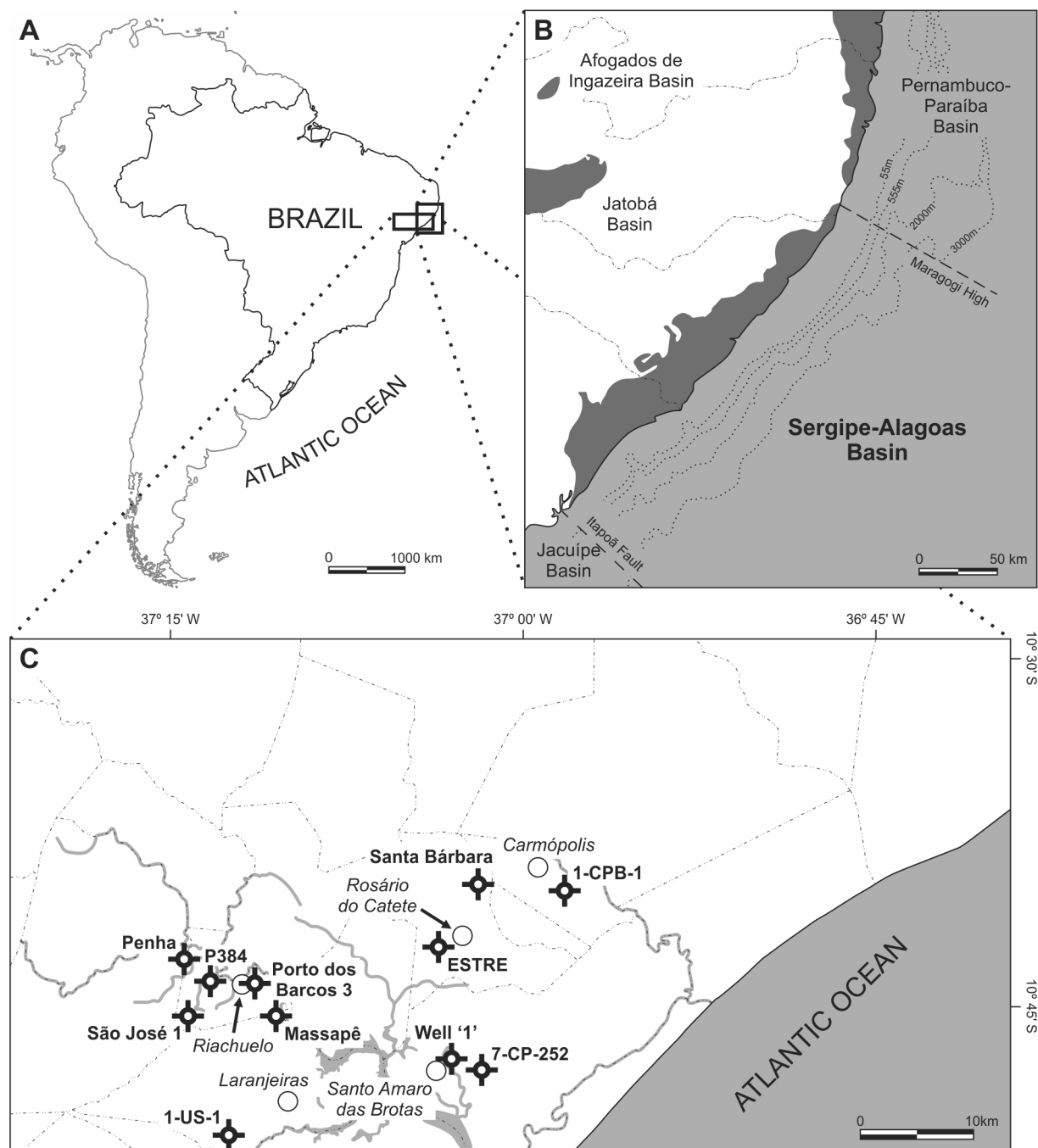


Fig. 1. Location of the Sergipe-Alagoas Basin in South America and Brazil, along with the outcrops and wells studied in the present work.

was proposed that would enable long-range distributions for these taxa during the Albian–Turonian. The southernmost limit of Megatethys in the Central Proto-Atlantic Ocean was coincident with the Walvis Ridge, an effective topographic barrier at that time. The concept of the upper Aptian–Albian Megatethys also seems to be applicable to ostracods, as summarized by Colin & Andreu (1990), Andreu (2002), Piovesan *et al.* (2013) and Antonietto *et al.* (2015) (Fig. 3). However, during the Cenomanian, constraints related to the presence of the Walvis Ridge seemed to vanish, as distribution of taxa across it began to appear (Antonietto *et al.* 2015).

Most of the visited outcrops were composed of interbedded Taquari and Angico Member sections. The Estre, Fazenda Santa Bárbara and Porto dos Barcos 3, however, were entirely in the Taquari depositional context, while the Massapê outcrop is partially in the Maruim Member. The Fazenda Santa Bárbara outcrop (10°39' S, 37°01' W) (Fig. 4A) comprises reddish calcareous mudstones, abundant in gastropod shells, but also possibly containing brachiopods. The Penha outcrop (10°42' S, 37°13' W) (Fig. 4B) presents fine yellow, calcareous sandstones followed by grey calcareous shale, laminate calcareous siltstones and fine laminate sandstones. Abundant occurrences of gastropods, bivalves and possible brachiopods are observed.

The Estre outcrop (10°41' S, 37°02' W; Fig. 4C) is a succession of marly to calcareous mudstones, carbonate/clay interbedding and bioturbated cream-coloured shale rich in impregnations of fossil-rich siliceous concretions and phytofossils. The outcrop P384 (10°43' S, 37°12' W; Fig. 4D) comprises cream-coloured laminate mudstones at both its bottom and top parts, with a mid-section of yellowish calcareous siltstones and cream-coloured sandstones. Ichnofossils, bivalves, phytoclasts and possible brachiopods are identifiable. The Porto dos Barcos 3 outcrop (10°43' S, 37°10' W; Fig. 4E) is a slightly saprolitic sequence that shows, bottom to top, levels of creamy calcareous siltstone, creamy and grey calcareous siltstone, yellowish mudstones, creamy calcareous siltstones and creamy micaceous mudstones. The

My	AGE LOCAL STAGE	OSTRACODE BIOSTRATIGRAPHY	LITHOLOGY				SEQUENCE	NATURE OF SEDIMENTATION	DEPOSITIONAL ENVIRONMENT	TECTONIC EVOLUTION		
			GROUP	FORMATION	MEMBER							
					SERGIPE SUB-BASIN	ALAGOAS SUB-BASIN						
100 110	CENOMANIAN	<i>Rehacythereis?</i> aff. <i>R. dentonensis</i> (OSE-3)	SERGIPE	RIACHUELO	ANGICO	MARUIM	TAQUARI	K70-K84	MARINE TRANSGRESSION	ALUVIO-DELTAIC FANS/ PLATFORM/ SLOPE	DRIFTE	
		<i>Nigeroloxoconcha</i> sp. GA A 22 (OSE-2)										
		?										
	ALBIAN	<i>Aracajuia antiqua</i> (MSA-1)										
		<i>Aracajuia benderi</i> (MSA-0)										<i>Metacytheropteron</i> sp. GA C 24 (MSA-0.5)
												<i>Reticulocosta edrianae</i> (MSA-0.4)
												<i>Bythoceratina amstittensis</i> (MSA-0.3)
												<i>Sergipella viviersae</i> (MSA-0.2)
												<i>Harbinia sinuata?</i> (MSA-0.1)
												APTIAN
ALA- GOAS												
							K64					
								K62			RIFTE	

Fig. 2. Lithological and biostratigraphical profiles of the Riachuelo Formation, Sergipe-Alagoas basin, northeastern Brazil, after Campos Neto *et al.* (2007) and Antonietto *et al.* (2015).

fossil record includes echinoderm spines, undetermined invertebrates, ammonoids, gastropods and bivalves.

The outcrop named Massapê (10°06' S, 37°10' W; Fig. 4F) begins with yellow to cream-coloured laminate calcareous and micaceous siltstones, overlain by fine to very fine yellowish calcareous/micaceous sandstones, followed by intercalations of yellow to creamy siltstones and mudstones, grey greywacke with dark impregnations and interposed levels of oolitic calcarenite and yellow sandstones with smoky quartz grains, sparse ooids and ichnofossils. The São José 1 outcrop (10°44' S, 37°13' W; Fig. 4G) presents the most complex lithology among those sampled. The basal siltstones with calcareous impregnations are covered by yellow silty, fine sandstones and calcareous yellow siltstones with limestone levels; massive yellow sandstones; limestone with abundant ichnofossils; marl-limestone intercalations; solid limestone; non-rhythmic intercalations of creamy laminate siltstone, marls and mudstones; and, finally, creamy to yellowish, medium to laminate thin calcareous sandstones. Fossil groups include ichnofossils, bivalves, gastropods, cephalopods (not associated with any particular *stratum*) and phytofossils.

Material and methods

The material studied herein comprises a total of 331 samples from the State of Sergipe, Brazil: 142 collected from outcrops of the Riachuelo Formation (Estre, Fazenda Santa Bárbara, Porto dos Barcos 3, Penha, São José 1, Massapê and P384), plus 189 from well cores (1-CPB-1, 7-CP-252, 1-US-1 and well '1') owned by Petróleo Brasileiro S.A. (Petrobras) (Table 1). Samples were prepared and packaged according to the methodology developed by the Laboratory of Micropaleontology of the University of Brasília (LabMicro-UnB), Brasília, Brazil. Sixty grams of each sample were prepared, and the remainder was packed in double plastic bags with catalogue-record sheets. This material is stored in the specific cabinet for prepared samples of the same laboratory.

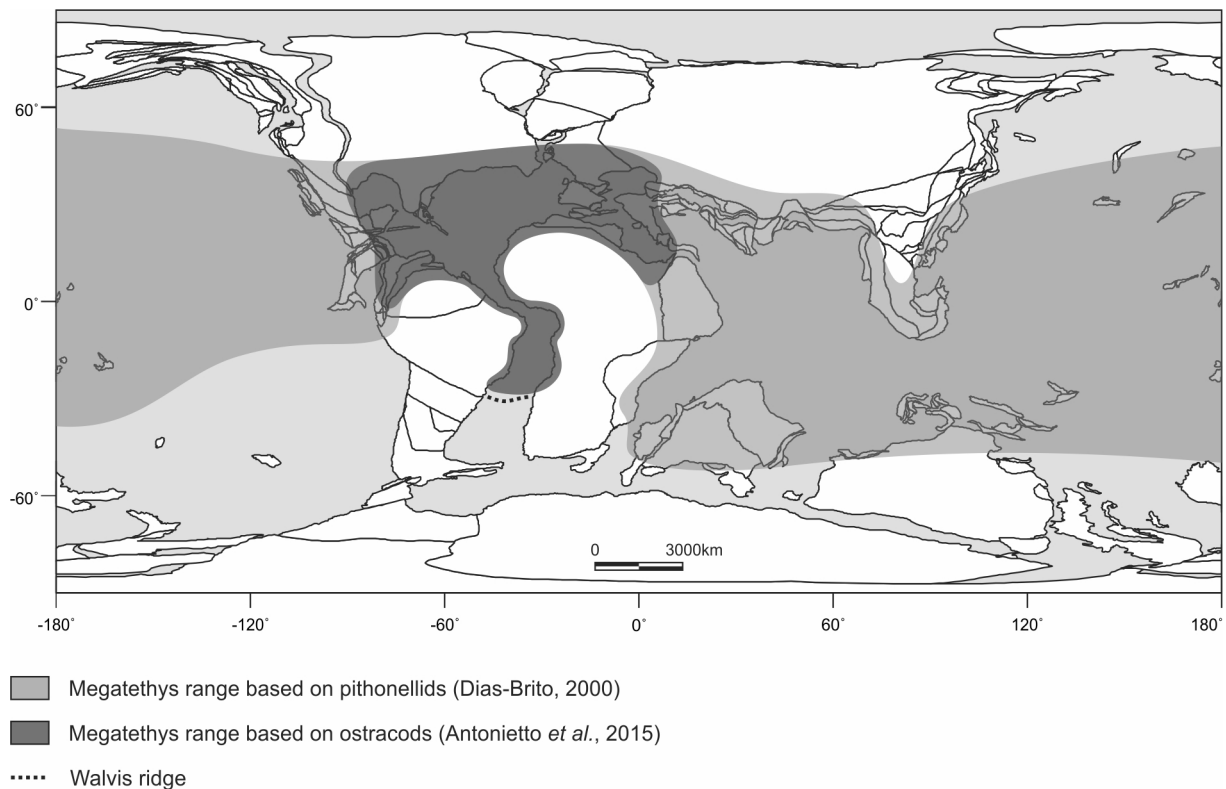


Fig. 3. Extension of the “Megatethys Ocean”, or “Mid Cretaceous Tethyan Realm”, during the Albian.



Fig. 4. Lithology of sampled Riachuelo Formation outcrops in the Sergipe-Alagoas Basin, Brazil: Santa Bárbara (A), Penha (B), Estre (C), P384 (D), Porto dos Barcos 3 (E), Massapê (F) and São José 1 (G).

Table 1. Sampled depths from wells ceded by Petrobras S.A. studied in the present work.

Well	Sampled depths studied (m)
1-CPB-1	198, 222, 345.5, 348, 348.5, 35, 354.5, 355.5, 356.5, 358.5, 359.5, 360.5 and 364.5
1-US-1	0, 12, 30, 60, 90, 98.5, 99.5, 100.5, 101.1, 120, 150, 180, 210, 240, 246, 261, 270, 270.05, 276, 291, 300, 306, 321, 330, 336, 351, 360, 366, 381, 390, 396, 399, 399.5, 400.5, 411, 420, 426, 441, 450, 456, 471, 480, 486, 501, 510, 516, 531, 540, 541, 546, 552, 552.5, 553.5, 554.5, 555.5, 561, 570, 576, 591, 600, 606, 621, 630, 636, 651, 660, 666, 678, 679.55, 681, 690, 696, 711, 720, 726, 741, 750, 756, 771, 780, 786, 801, 804, 810, 816, 831, 840, 846, 861, 870, 876, 891, 900, 906, 921, 930, 936, 951, 953, 953.1, 960, 966, 981, 990, 996, 1011, 1020, 1026, 1041, 1050, 1056, 1067, 1067.25, 1071, 1080, 1086, 1101, 1110, 1116, 1131, 1139.2, 1139, 1140, 1146, 1161, 1170, 1200, 1230, 1260, 1290, 1320, 1350, 1380, 1395, 1410 and 1425
7-CP-252	466, 466.2, 466.7, 467.5, 467.55, 467.9, 468.7, 469.2, 469.75, 469.8, 470.15, 470.6, 470.65, 471.25, 471.8, 472.25, 472.3, 472.6, 473.3, 473.8, 474.45, 474.5, 474.85, 475.3, 475.85, 476.25, 476.3, 476.5, 476.7, 477.1, 477.5, 477.95, 478.45, 478.85, 479.5, 480.3, 480.55, 480.95, 481.6, 481.8, 482.9, 483.5, 483.55, 484.15, 484.4, 484.75, 485.6, 486.05, 486.45, 487, 488.15, 488.4, 489.15, 489.2, 489.7, 490, 490.1, 490.35, 492.95, 493, 493.45, 493.5, 494.3, 494.75, 495.85, 495.9, 496.55, 496.6, 497.7, 498.3, 498.6, 502.4, 503.35, 503.53, 506.3, 507.15, 508.4, 508.75, 509.3, 511.35, 511.4, 511.9, 512.7, 514, 514.05, 515, 516, 517.45, 518.3, 518.8, 521, 521.4, 523.9, 527.1, 534.8, 535.55, 540.05, 552, 553.4, 558.9, 560.3, 564.8, 567.15, 568.15, 568.95 and 581.35
Well '1'	510 and 540

The sample contents separated for preparation were treated at the Laboratory of Micropaleontology as follows: first they were submerged in a solution containing 30% hydrogen peroxide (H₂O₂), aiming to fragment rock particles. Ethanol at 92 % was added to interrupt this reaction, and after that, the separation of grains by size took place, using mesh sieves of 630, 250, 160 and 80 µm. For samples MP-1430 to MP-1434, MP-1493, MP-1494 and MP-1678, the 80 µm sieve was replaced by a 90 µm–56 µm dual set.

Carapaces and valves of several species were studied at the LabMicro-UnB and the Smithsonian National Museum of Natural History (NMNH), Washington D.C., United States. For comparison, specimens of several genera belonging to NMNH collections were also studied. The study of the additional 189 already processed samples from Petrobras was done at the Centro de Pesquisas Leopoldo Américo Miguez de Mello (CENPES), Rio de Janeiro, Brazil. The type material of 37 species from 16 families is housed in the Research Collection of the LabMicro-UnB, under the prefix “CP” (“Coleção de Pesquisa”) and numerations from 668 to 735 and from 756 to 769. Additional type material from two other species is at CENPES, totaling three specimens under the prefix “LBP” (“Laboratório de Bioestratigrafia da Petrobras”).

Height, length and width measurements for these specimens were mostly taken using an Olympus SZX12 microscope with a Q5 camera, plus QCapture 7 software. Some additional measurements were made with a Heerbrugg Wild M3Z microscope and Leica measuring lenses. Most of the scanning electron microscopy (SEM) was done using a Philips XL-30 scanning electron microscope and palladium-gold coating to enhance the contrast and definition. Additional photos were taken in a Zeiss EVO 40 at CENPES, under palladium-gold, and a JEOL JCM-5000 Neoscope at the LabMicro-UnB, under carbon coating.

The suprafamiliar classification used here follows Liebau (2005). The taxonomy of lower ranks are based on Maddocks (1969), Hanai (1970), Gründel & Kozur (1972), Gründel (1974, 1976, 1977, 1978a, 1978b) and Hou *et al.* (2002), as indicated in the “Remarks” sections for each species. The morphological terminology is the same as that in Sylvester-Bradley & Benson (1971), except for the usage of the term “ridge”, in which Kesling (1951) is followed. Terms used to describe the curvature of anterior and posterior ends – infra-curved, equi-curved and supra-curved – were adopted from Lüttig (1962). The use of the terms “hypotype” and “homeotype”, used to categorize types not contemplated by the ICZN, follows Schenk & McMasters (1956). Thirty-nine species were recovered and identified from the present samples.

Taxonomy

Subclass Ostracoda Latreille, 1802
Superorder Myodocopomorpha Kozur, 1972
Order Halocypridida Skogsberg, 1920
Suborder Halocypridina Skogsberg, 1920
Superfamily Halocypridoidea Dana, 1853
Family Halocyprididae Dana, 1853

Conchoecia Dana, 1849

Conchoecia? sp. 1

Fig. 5D–F

“*Conchoecia*” GA D 31 – Grosdidier 1979: 8, figs 60a–d.

Genus aff. “*Conchoecia*” sp. 150 – Rosenfeld & Raab 1983: 113, fig. 7.10. — Honigstein *et al.* 1985: figs 6.150, 7.150.

Conchoecia sp. 1 – Andreu-Boussut 1991: 437, figs 1.1–1.3. — Andreu 1992: 296, fig. 1.1.

Conchoecia? sp. Se6 aff. ‘C’ sp. GA D 31 – Viviers *et al.* 2000: 414, figs 10–11.

New material examined

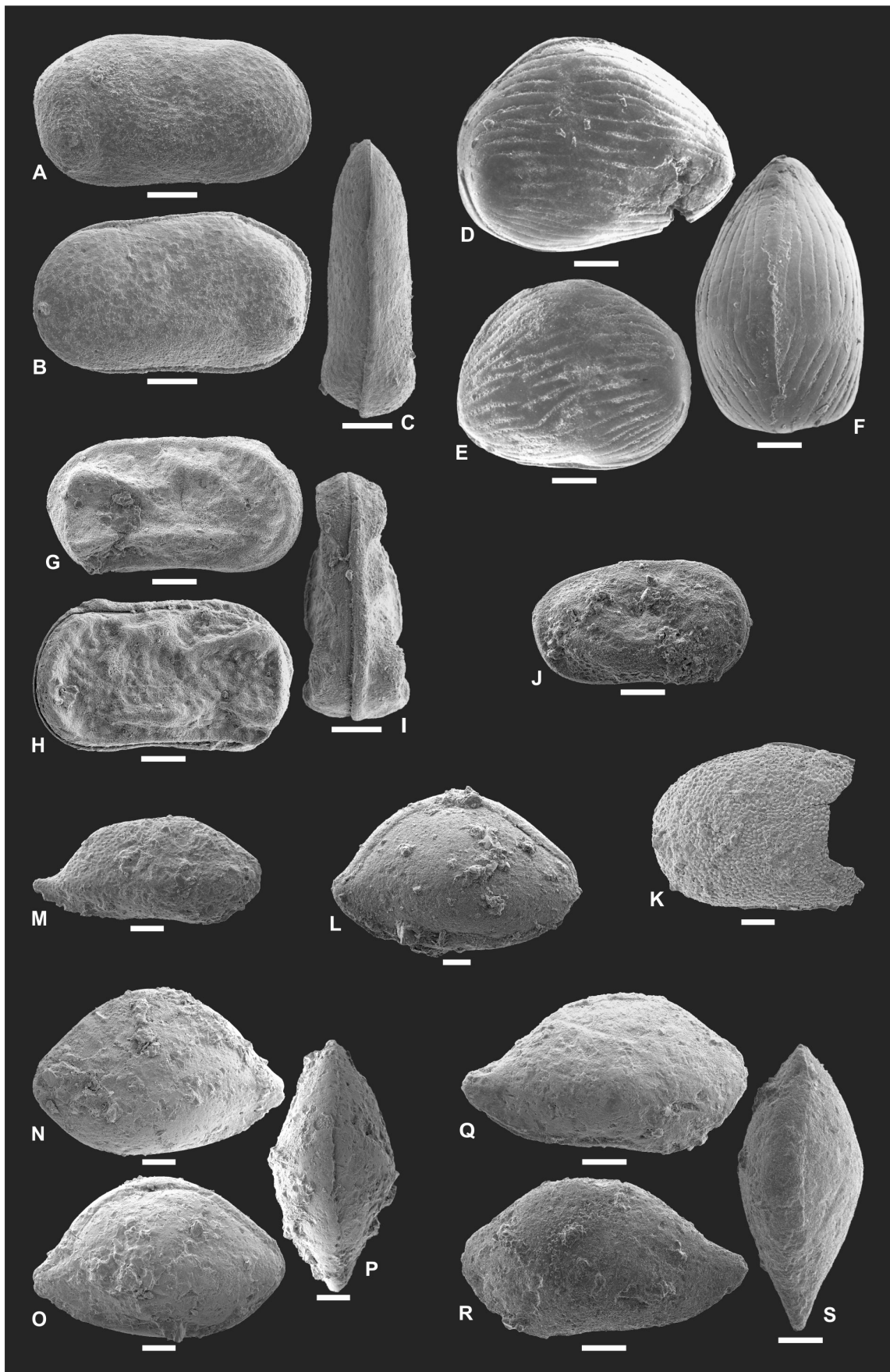
BRAZIL: 1-US-1 well, Laranjeiras Municipality, Sergipe State (depths of 876, 891 and 900 m); Well ‘1’, Laranjeiras Municipality, Sergipe State (depths of 510 to 540 m).

Measurements

Hypotype (LBP 10): carapace: length = 0.63 mm, height = 0.49 mm, width = 0.38 mm.

Hypotype (LBP 11): carapace: length = 0.53 mm, height = 0.43 mm.

Fig. 5. [facing page] Ostracods of the Riachuelo Formation, Sergipe-Alagoas Basin, Albian, Brazil. – **A–C.** *Cytherella besrineensis* (Bischoff, 1964) comb. nov. **A.** CP-669, right lateral view. **B–C.** CP-668. **B.** Left lateral view. **C.** Dorsal view. – **D–F.** *Conchoecia?* sp. 1. **D, F.** LBP 10. **D.** Right lateral view. **F.** Dorsal view. **E.** LBP 11, left lateral view. – **G–I.** *Cytherelloidea btaterensis* Bischoff, 1964. **G.** CP-671, right lateral view. **H.** CP-672, left lateral view. **I.** CP-673, dorsal view. – **J.** *Cytherelloidea* aff. *globosa* Kaye, 1964, CP-756, right lateral view. – **K.** *Cytherella* sp. 1, CP-670, lateral view. – **L.** *Bairdoppilata pseudoseptentrionalis* Mertens, 1956, CP-676, right lateral view. – **M.** *Bairdoppilata* sp. 1, CP-678, right lateral view. – **N–P.** *Bairdoppilata comanchensis* (Alexander, 1929) comb. nov., CP-674. **N.** Left lateral view. **O.** Right lateral view. **P.** Dorsal view. – **Q–S.** *Bairdoppilata* sp. 2, CP-757. **Q.** Right lateral view. **R.** Left lateral view. **S.** Dorsal view. Scale bars = 100 µm.



Remarks

The presence of halocypridids in the Early Cretaceous of the Atlantic Ocean was first noticed by Pokorný (1964), when dealing with ostracods from the Coniacian of Czechoslovakia. Since then, several taxa have been tentatively classified in the genus *Conchoecia* by several authors (e.g., Colin & Andreu 1990), although the only morphological resemblance to this Recent genus has to do with the presence of a rostrum (some of the specimens; certainly not the current ones) and striate ornamentation. More detailed studies on the internal features of those specimens have never been performed, and are also not possible with the present material. Therefore, we opt to maintain the current taxonomic status, but doubtfully, in the hope of collecting better preserved specimens in the future.

Paleoecology and distribution

Conchoecia? sp. 1 is a marine, shelf to neritic, possibly planktonic species occurring in the following localities and stages: Madiéla Formation, Gabon Basin, Gabon, lower–middle Albian (Grosdidier 1979); Talme Yafe, Yavne Shales and Hazera Formations, Levantine Basin, Israel, Albian–lower Cenomanian (Rosenfeld & Raab 1983); Agadir Basin, Morocco, upper Albian–lower Cenomanian (Andreu-Boussut 1991); and Maruim Member, Riachuelo Formation, Sergipe-Alagoas Basin, Brazil, upper Aptian–Albian, *Aracajuia benderi* zone (MSA-0), *Metacytheropteron* sp. aff. *M.* sp. GA C 24 subzone (MSA-0.5) (Viviers *et al.* 2000).

Superorder Podocopomorpha Kozur, 1972

Order Platycopida Sars, 1866

Superfamily Cytherelloidea Sars, 1866

Family Cytherellidae Sars, 1866

Cytherella Jones, 1849

Cytherella besrineensis (Bischoff, 1964) comb. nov.

Fig. 5A–C

Cytherelloidea besrineensis Bischoff, 1964: 15, figs 3.21–3.22.

Cytherelloidea besrineensis – Rosenfeld & Raab 1983: 92, figs 1.11–1.12. — Honigstein *et al.* 1985: 3, fig. 3.228.

Cytherella sp. Se3 – Viviers 2000: 415, fig. 8.13.

New material examined

BRAZIL: Estre outcrop, Rosário do Catete Municipality, Sergipe State (sample MP-1428), approximate coordinates 10°41' S, 37°02' W; Massapê outcrop, Riachuelo Municipality, Sergipe State (samples MP-1518 and MP-1520), approximate coordinates 10°06' S, 37°10' W; P384 outcrop, Riachuelo Municipality, Sergipe State (samples MP-1500, MP-1506 and MP-1509 to MP-1513), approximate coordinates 10°43' S, 37°12' W; Porto dos Barcos 3 outcrop, Riachuelo Municipality, Sergipe State (samples MP-1460, MP-1468 to MP-1472 and MP-1481), approximate coordinates 10°43' S, 37°10' W; São José 1 outcrop, Riachuelo Municipality, Sergipe State (samples MP-1558 and MP-1563), approximate coordinates 10°44' S, 37°13' W.

Type locality and age

Sample no. 202, Btater Village, Bhamdoun Town, Lebanon; Albian.

Measurements

Homeotype (CP-668): ♀, carapace: length = 0.56 mm, height = 0.30 mm, width = 0.20 mm.

Homeotype (CP-669): ♀, right valve: length = 0.55 mm, height = 0.28 mm.

Remarks

Cytherella besrineensis (Bischoff, 1964) comb. nov. was initially assigned by Bischoff (1964) to the genus *Cytherelloidea*, although it did not present any ridge on its lateral surface, which is diagnostic of that genus (Alexander 1929). Therefore, we transfer it to *Cytherella*, based on ornamentation similarities.

Paleoecology and distribution

Cytherella besrineensis comb. nov. is a marine, shelf species occurring in the following localities and stages: Talme Yafe, Rama, Telamim and Yavne Shales Formations, Levantine Basin, Israel, Aptian–Albian (Rosenfeld & Raab 1983; Honigstein *et al.* 1985); Levantine Basin, Lebanon, Aptian–Albian (Bischoff 1964); and Angico Member, Riachuelo Formation, Sergipe-Alagoas Basin, Brazil, middle Albian, *Praebythoceratina amsittenensis* subzone (MSA-0.3) (Viviers *et al.* 2000); in the present work, also in the Taquari and Maruim Members, uppermost Aptian–Albian, *Aracajuia benderi* (MSA-0) – *Sergipella viviersae* (MSA-0.2), *Praebythoceratina amsittenensis* (MSA-0.3) and *Reticulocosta edrianae* (MSA-0.4) subzones – and *Aracajuia antiqua* (MSA-1) zones.

Cytherella sp. 1

Fig. 5K

Material examined

BRAZIL: Estre outcrop, Rosário do Catete Municipality, Sergipe State (samples MP-1427 and MP-1429), approximate coordinates 10°41' S, 37°02' W.

Measurements

Hypotype (CP-670): valve: height = 0.51 mm.

Remarks

Despite its unusual fine, nodose ornamentation, *Cytherella* sp. 1 is comparable in overall shape to several *Cytherella* species with Albian (partly or not) distribution, which justifies its generic attribution. These include *Cytherella ovata* (Roemer, 1841) (several sedimentary units, ages and locations in Europe, and possibly nearby regions in America, Africa and Asia) (Brown 1957; Herrig 1966; Bassoulet & Damotte 1969; Swain & Brown 1972; Majoran 1989; Witte *et al.* 1992; El-Nady *et al.* 2008); *Cytherella comanchensis* Alexander, 1929 (Fort Worth Formation, United States, upper Albian) (Alexander 1929); and *Cytherella fredericksburgensis* Alexander, 1932 (Goodland Formation, United States, Albian) (Alexander 1932). However, because of the lack of well-preserved specimens in the current samples, it was not possible to provide a more specific identification of them.

Paleoecology and distribution

Cytherella sp. 1 is a marine, outer shelf species occurring in the Taquari Member, Riachuelo Formation, Sergipe-Alagoas Basin, Brazil, upper Albian (earlier than the *Reticulocosta edrianae* subzone (MSA-0.4)), *Aracajuia benderi* zone (MSA-0).

Cytherelloidea Alexander, 1929

Cytherelloidea btaterensis Bischoff, 1964

Fig. 5G–I

Cytherelloidea btaterensis Bischoff, 1964: 17, figs 2.16–2.17, 3.18–3.19.

Cytherelloidea btaterensis – Damotte & Saint-Marc 1972: 277, fig. 1.2. — Rosenfeld & Raab 1983: 92, figs 1.14–1.16. — Honigstein *et al.* 1985: 12, fig. 3.173.

New material examined

BRAZIL: Fazenda Santa Bárbara outcrop, Rosário do Catete Municipality, Sergipe State (sample MP-1420), approximate coordinates 10°39' S, 37°01' W; Massapê outcrop, Riachuelo Municipality, Sergipe State (samples MP-1515 and MP-1518 to MP-1520), approximate coordinates 10°06' S, 37°10' W; P384 outcrop, Riachuelo Municipality, Sergipe State (samples MP-1500 and MP-1509 to MP-1513), approximate coordinates 10°43' S, 37°12' W; Penha outcrop, Riachuelo Municipality, Sergipe State (samples MP-1449, MP-1452, MP-1457 and MP-1459), approximate coordinates 10°42' S, 37°13' W; Porto dos Barcos 3 outcrop, Riachuelo Municipality, Sergipe State (samples MP-1474 and MP-1477), approximate coordinates 10°43' S, 37°10' W; São José 1 outcrop, Riachuelo Municipality, Sergipe State (samples MP-1550 to MP-1555, MP-1558, MP-1563 and MP-1565), approximate coordinates 10°44' S, 37°13' W.

Type locality and age

Sample no. 211, Btater Village, Bhamdoun Town, Lebanon; Albian.

Measurements

Homeotype (CP-671): ♀, right valve: length = 0.58 mm, height = 0.30 mm.

Homeotype (CP-672): ♀, carapace: length = 0.59 mm, height = 0.32 mm, width = 0.27 mm.

Homeotype (CP-673): ♀, carapace: length = 0.54 mm, height = 0.30 mm, width = 0.23 mm.

Remarks

The diagnosis follows Bischoff (1964). *Cytherelloidea btaterensis* Bischoff, 1964 resembles *Cytherelloidea circumvallata* Bonnema, 1941 (middle Albian–early Cenomanian of the Netherlands) (Bonnema 1941; Gründel 1966), but the latter has an extra central ridge, which is absent in the former. *Cytherelloidea knaptonensis* Kay, 1963, from the Albian of Lebanon (Bischoff 1964), can be separated from the present species by its ornamentation, which does not include reticulations and punctuations between the ridges; also, the shape of the posterior ridge is remarkably different, especially along the dorso-posterior margin. A similar species, *Cytherelloidea kayei* Weaver, 1982 from the middle–late Cenomanian of England (Weaver 1982), has thicker ridges overall.

Paleoecology and distribution

Cytherelloidea btaterensis is a marine, shelf to neritic species occurring in the following localities and stages: Levantine Basin, Lebanon, Aptian–Albian (Bischoff 1964; Damotte & Saint-Marc 1972); Tamun, Hidra, Rama, Yakhini, Yavne Shales and Talme Yafe Formations, Levantine Basin, Israel, Aptian–Albian (Rosenfeld & Raab 1983; Honigstein *et al.* 1985); and in the present work, Angico and Taquari Members, Riachuelo Formation, Sergipe-Alagoas Basin, Brazil, uppermost Aptian–Albian, *Aracajuia benderi* (MSA-0) – *Sergipella viviersae* (MSA-0.2), *Praebythoceratina amsittenensis* (MSA-0.3) and *Reticulocosta edrianae* (MSA-0.4) subzones – and *Aracajuia antiqua* (MSA-1) zones.

Cytherelloidea aff. *globosa* Kaye, 1964

Fig. 5J

?*Cytherelloidea globosa* Kaye, 1964: 71, pl. 9, figs 9.7, 9.9–9.10.

Cytherelloidea globosa – ?Weaver 1982: 21, figs 3.20–3.21.

Material examined

BRAZIL: Estre outcrop, Rosário do Catete Municipality, Sergipe State (samples MP-1422 and MP-1428), approximate coordinates 10°41' S, 37°02' W.

Measurements

Hypotype (CP-756): right valve: length = 0.51 mm, height = 0.29 mm.

Remarks

The specimens of *Cytherelloidea* aff. *globosa* Kaye, 1964 are similar to those of *Cytherella globosa* Kaye, 1964, from the Albian–Cenomanian of England (Kaye 1964; Weaver 1982). They differ, though, by a more pronouncedly sloping posterior section of the dorsal margin and the absence of the postero-ventral tubercle in right view. It is not clear, however, to which extent these differences are merely morphological or caused by diagenetic processes, considering that the present specimens are poorly preserved.

Paleoecology and distribution

Cytherelloidea aff. *globosa* is a marine, outer shelf species that occurs in the Taquari Member, Riachuelo Formation, Sergipe-Alagoas Basin, Brazil, middle Albian, *Aracajuia benderi* zone (MSA-0), *Reticulocosta edrianae* subzone (MSA-0.4).

Order Podocopida Sars, 1866

Suborder Bairdiocopina Gründel, 1967

Superfamily Bairdioidea Sars, 1888

Family Bairdiidae Sars, 1888

Subfamily Bairdiinae Sars, 1888

Bairdoppilata Coryell *et al.*, 1935

Bairdoppilata comanchensis (Alexander, 1929) comb. nov.

Fig. 5N–P

Bairdia comanchensis Alexander, 1929: 63, figs 2.15, 3.4.

Bairdia comanchensis – Howe & Laurencich 1958: 66, unnumbered figs. — Moysey & Maddocks 1982: 144, figs 1.2a–b, 4.13–4.14.

Bairdia cf. *comanchensis* – ?Grekoff & Deroo 1956: 217, figs 46.9–46.10.

Bairdia aff. *comanchensis* – ?Neufville 1973: 127, fig. 7.4.3a–b. — Reyment 1981: 142, fig. 2a–b.

Bairdia spp. – Rosenfeld & Raab 1974 pars: 6, fig. 1.14. Honigstein *et al.* 1985 pars: 3, figs 9.94, 9.94.

Bairdia pseudoseptentrionalis (Mertens, 1956) – Shahin 1991: 136, figs 1.16–1.17.

Bairdoppilata aff. *pseudoseptentrionalis* – Andreu & Bilotte 2006: 60, figs 1.15–1.17.

non *Bairdia comanchensis* – Swain & Brown 1964: 12, fig. 1.5a–c.

non *Bairdia* spp. – Rosenfeld & Raab 1974 pars: 6, figs. 1.15–1.16.

New material examined

BRAZIL: 1-US-1 well, Laranjeiras Municipality, Sergipe State (depths of 552, 570, 600, 810, 816 and 840 m); Massapê outcrop, Riachuelo Municipality, Sergipe State (samples MP-1514, MP-1516 to MP-1520, MP-1522, MP-1542, MP-1543 and MP-1546), approximate coordinates 10°06' S, 37°10' W.

Type locality and *stratum*

“Station 24”, Johnson County, Texas, United States; upper Denton Formation, upper Albian.

Measurements

Hypotype (CP-674): carapace: length = 0.76 mm, height = 0.49 mm, width = 0.38 mm.

Hypotype (CP-675): right valve: length = 0.75 mm, height = 0.42 mm.

Remarks

The new generic identification for *Bairdoppilata comanchensis* (Alexander, 1929) comb. nov. follows Maddocks (1969) and Becker *et al.* (1989). According to both, the genus *Bairdia* McCoy, 1844 (to which the present species was first assigned) is restricted to the Paleozoic period; the former also mentions that *Bairdoppilata* is virtually identical in external view to *Bairdia*, but presents a series of denticles ahead of both extremities of its hinge in internal view, and is confined to the Cretaceous–Recent. The present authors rely on both statements for the generic change herein performed. Several occurrences (including possible ones) of *Bairdoppilata pseudoseptentrionalis* Mertens, 1956 (Shahin 1991; Andreu & Bilotte 2006) are transferred to *Bairdoppilata comanchensis* comb. nov. based on differences in size and overall external shape from these specimens to the ones assigned by Mertens (1956). One of the specimens identified as *Bairdoppilata comanchensis* in Swain & Brown (1964: pl. 1, fig. 5a, c) belongs in fact to *B. rotunda* (Alexander, 1929) – see the generic review in Howe & Laurencich (1958); the other one is from an unnamed taxon. The specimen in Neufville (1973), also figured in Reyment (1981), might belong to *B. comanchensis* comb. nov., despite differences in carapace size and dorsal margin morphology, possibly caused, respectively, by environmental and diagenetic factors. One of the specimens of *Bairdia* spp. figured in Rosenfeld & Raab (1974: pl. 1, fig. 14) also belongs to the same species, but these authors do not specify its range and geographical distribution, instead grouping it with all the others identified as *Bairdia*; this problem was partly solved by Honigstein *et al.* (1985), who restricted the *Bairdoppilata comanchensis* specimens to the late Cenomanian–Turonian.

Paleoecology and distribution

Bairdoppilata comanchensis comb. nov. is a transitional to marine (shelf to neritic) species occurring in the following localities and stages: Denton, Walnut (middle Albian) and Weno (Albian) Formations, United States (Alexander 1929; Howe & Laurencich 1958; Moysey & Maddocks 1982); Raha and Abu Qada Formations, Egypt, Cenomanian (Shahin 1991); Marnes de la Fontaine Salée and Grès de las Sals Formations, Aquitaine Basin, France, Cenomanian–Turonian (Andreu & Bilotte 2006); possibly Ora shale, upper part of the ‘En Yorqe’am Member and the Avnon Member, Hazera Formation; Yotvata Member, in the Negba, Moza, Bet Hakerem, Kefar Sha’ul, ‘Isfiya, Khureibe and Daliya Formations; Levantine Basin, Israel, upper Cenomanian–Turonian (Rosenfeld & Raab 1974; Honigstein *et al.* 1985); and in the present work, Angico, Taquari and Maruim Members, Riachuelo Formation, Sergipe-Alagoas Basin, Brazil, uppermost Albian, *Aracajuia antiqua* zone (MSA-1).

Bairdoppilata pseudoseptentrionalis Mertens, 1956

Fig. 5L

Bairdoppilata pseudoseptentrionalis Mertens, 1956: 182, figs 8.7–8.10, 13.89–13.90.

Bairdoppilata pseudoseptentrionalis – Howe & Laencich 1958: 82, unnumbered figs. — Weaver 1982: 24, figs 4.1–4.3. — ?Jarvis *et al.* 1988: 34, fig. 15j.

Cytherina subdeltoidea Münster, 1830 – ?Roemer 1841: 105, fig. 16.22. — ?Reuss 1845: 54, fig. 5.38.

Cythere (Bairdia) subdeltoidea – Jones 1849 pars: 23, fig. 5.15a–c, e–f.

Bairdia subdeltoidea – ?Jones & Hinde 1890: 5, figs 2.31–2.34.

Bairdia pseudoseptentrionalis – Oertli 1963: pl. 72, pl. 73, fig. 1, pl. 76. — ?Kaye 1965: 223, figs 2.1, 2.3–2.6. — ?Gründel 1966: 15, fig. 1.18. — ?Keen & Siddiqui 1971: 63, fig. 1.2. — Hart 1973: 281, fig. 4. — ?Babinot *et al.* 1985a: 172, fig. 51.1.

Bairdia sp. – Majoran 1989: 9, figs 2.5–2.7.

Bairdoppilata sp. 1 – Piovesan *et al.* 2013: 244, fig. 3.8a–b.

non *Cythere (Bairdia) subdeltoidea* – Jones 1849 pars: 23, fig. 5.15d.

non *Bairdia pseudoseptentrionalis* – El-Nady *et al.* 2008: 544, fig. 2.6.

non *Bairdia* gr. *pseudoseptentrionalis* – Babinot *et al.* 1985b: 224, figs 55.15–55.16.

New material examined

BRAZIL: P384 outcrop, Riachuelo Municipality, Sergipe State (MP-1509 to MP-1513), approximate coordinates 10°43' S, 37°12' W; Porto dos Barcos 3 outcrop, Riachuelo Municipality, Sergipe State (samples MP-1460, MP-1468 and MP-1469), approximate coordinates 10°43' S, 37°10' W; São José 1 outcrop, Riachuelo Municipality, Sergipe State (samples MP-1574, MP-1680 and MP-1697), approximate coordinates 10°44' S, 37°13' W.

Type locality and *stratum*

194 well, Dalum oil field, Germany; Lower Chalk Group, upper Albian.

Measurements

Homeotype (CP-676): carapace: length = 0.91 mm, height = 0.58 mm, width = 0.44 mm.

Homeotype (CP-677): left valve: length = 0.91 mm, height = 0.55 mm.

Remarks

The diagnosis follows Mertens (1956). Historically, *Bairdoppilata pseudoseptentrionalis* Mertens, 1956 has been mistaken for *B. subdeltoidea* (Münster, 1830), as the former species has never been adequately illustrated since its description by Münster (1830). Several sub-species were added to *Bairdoppilata subdeltoidea* during the 19th century, which increases the difficulties in establishing its current taxonomic status. The most recent review of the species is in Deroo (1956), who renamed it as *Bairdoppilata roemeri*, with a lower Cretaceous–Tertiary stratigraphic range. Assuming the species is still valid, it has to be separated from *Bairdoppilata pseudoseptentrionalis*, at least in terms of age; the former is considered later Cretaceous–Tertiary (Münster 1830), while the latter is from the late Albian–Cenomanian (Mertens 1956). The specimens in Kaye (1965), Gründel (1966) and Jarvis *et al.* (1988) present a straighter posterior portion of the dorsal margin in the left valve, when compared to the more rounded one in *B. pseudoseptentrionalis*. In Keen & Siddiqui (1971) and Babinot *et al.* (1985b), the specimens presents a generally wider overlapping and less rounded overall shape.

Paleoecology and distribution

Bairdoppilata pseudoseptentrionalis is a shelf to neritic marine species occurring in the following localities and stages: Anglo-Paris Basin, France, middle Albian (Oertli 1963); Lower Chalk Group, Germany, Albian–Cenomanian (Mertens 1956); Gault, Greensand and Holywell Nodular Chalk (including Plenus Marl Member) Formations, Anglo-Paris Basin, England, Albian–Cenomanian (Jones 1849; Hart 1973; Weaver 1982); Bordj Ghdir Basin, Algeria, lower Cenomanian (Majoran 1989);

Florianópolis and Guarujá Formation, Santos Basin, upper Aptian–middle Albian (Piovesan *et al.* 2013); and in the present work, Angico and Taquari Members, Riachuelo Formation, Sergipe-Alagoas Basin, uppermost Aptian–middle Albian, *Aracajuia benderi* zone (MSA-0), *Sergipella viviersae* (MSA-0.2) and *Praebythoceratina amsittenensis* (MSA-0.3) subzones, Brazil.

Bairdoppilata sp. 1

Fig. 5M

Material examined

BRAZIL: Massapê outcrop, Riachuelo Municipality, Sergipe State (samples MP-1516, MP-1518, MP-1520, MP-1545 and MP-1546), approximate coordinates 10°06' S, 37°10' W.

Measurements

Hypotype (CP-678): right valve: length = 0.69 mm, height = 0.32 mm.

Remarks

Bairdoppilata sp. 1 is remarkable among *Bairdoppilata* species of the lower Cretaceous because of the combination of the following features: an elongate overall shape, elongate posterior end, comparable to *B. southerhamensis* Weaver, 1982 (although this species' carapace displays greater height) (Weaver 1982), and punctuate ornamentation. The current specimens probably represent a new species, but due to the small amount of material (composed solely of valves) recovered, we opt to leave it in open nomenclature.

Paleoecology and distribution

Bairdoppilata sp. 1 is a marine, shelf species occurring in the Maruim Member, Riachuelo Formation, Sergipe-Alagoas Basin, Brazil, Albian, *Aracajuia antiqua* zone (MSA-1).

Bairdoppilata sp. 2

Fig. 5Q–S

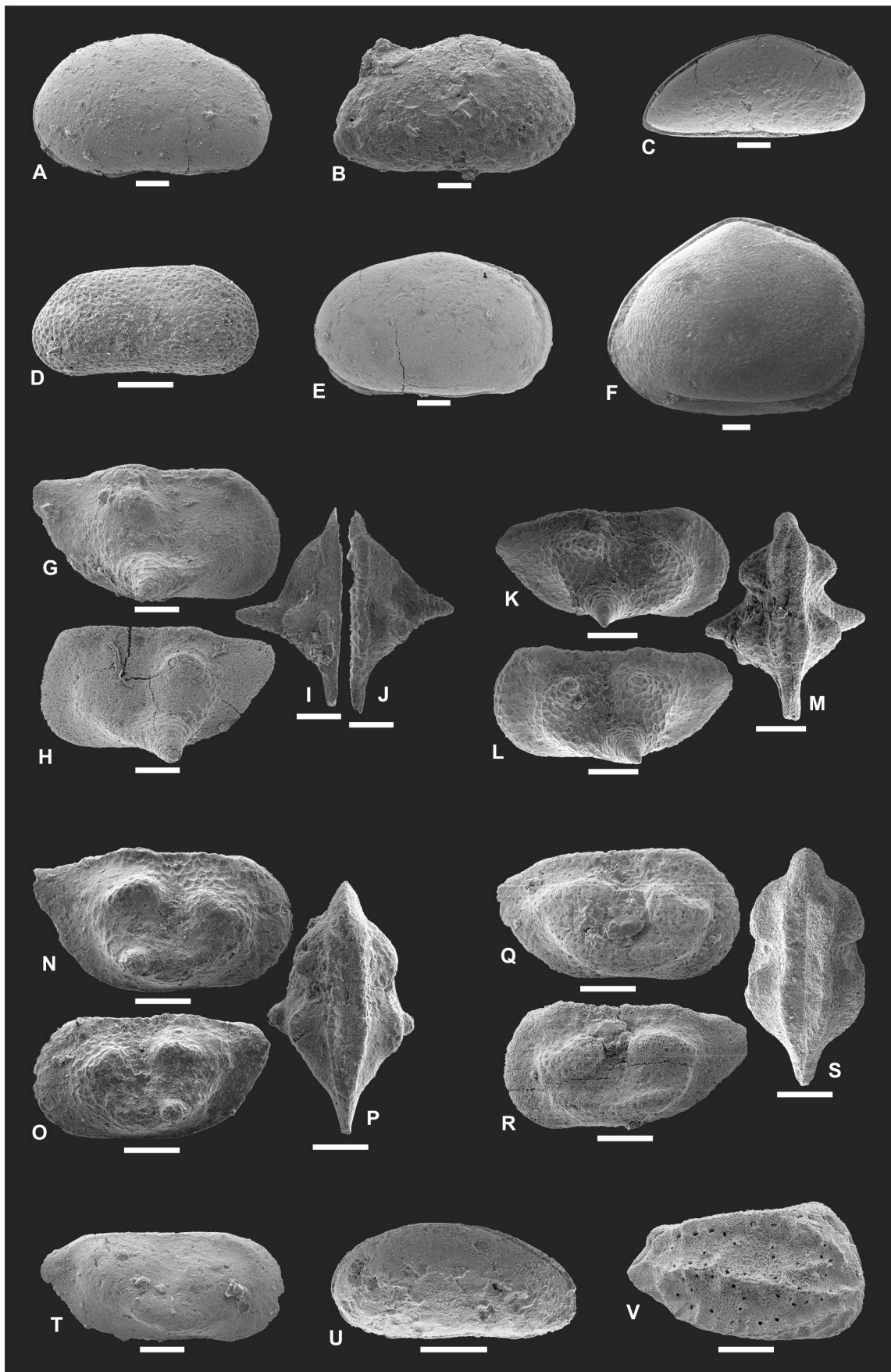
Material examined

BRAZIL: Massapê outcrop, Riachuelo Municipality, Sergipe State (sample MP-1521), approximate coordinates 10°06' S, 37°10' W.

Measurements

Hypotype (CP-757): carapace: length = 0.64 mm, height = 0.34 mm, width = 0.29 mm.

Fig. 6. [facing page] Ostracods of the Riachuelo Formation, Sergipe-Alagoas Basin, Albian, Brazil. – **A.** *Robsoniella falklandensis* Dingle, 1984; CP-733, right lateral view. – **B.** *Cetacella* sp. 1; CP-734, right lateral view. – **C.** *Paracypris eniotmetos* Nicolaidis & Piovesan, 2013; CP-679, right lateral view. – **D.** *Liasina* sp. 1; CP-682, right lateral view. – **E.** *Harbinia crepata* Do Carmo *et al.*, 2013; CP-681, right lateral view. – **F.** *Harbinia sinuata?* (Krömmelbein & Weber, 1971); LBP 09, right lateral view. – **G–J.** *Praebythoceratina deltalata* sp. nov. **G.** CP-683, right lateral view. **H.** CP-684, left lateral view. **I.** CP-759, dorsal view. **J.** CP-758, dorsal view. – **K–M.** *Praebythoceratina trinodosa* (Alexander, 1934) comb. nov. **K.** CP-691, right lateral view. **L.** CP-692, left lateral view. **M.** CP-690, dorsal view. – **N–P.** *Praebythoceratina amsittenensis* (Andreu-Boussut, 1991) comb. nov. **N.** CP-687, right lateral view. **O.** CP-769, left lateral view. **P.** CP-689, dorsal view. – **Q–S.** *Patellacythere shimonensis* (Rosenfeld & Raab, 1983) comb. nov. **Q.** CP-685, right lateral view. **R.** CP-686, left lateral view. **S.** CP-760, dorsal view. – **T.** *Patellacythere* sp. 1; CP-694, right lateral view. – **U.** *Xestoleberis?* sp. 1; CP-761, right lateral view. – **V.** *Aracajuia benderi* Krömmelbein, 1967; CP-711, right lateral view. Scale bars = 100 µm.



Remarks

The specimens of *Bairdoppilata* sp. 2 resemble those of *Bairdoppilata* sp. 1, although they are less elongate and present a smooth lateral view. Compared to *B. southerhamensis* in Weaver (1982), it is less rounded in lateral view and narrower than the latter.

Paleoecology and distribution

Bairdoppilata sp. 2 is a marine, inner shelf species occurring in the Maruim Member, Riachuelo Formation, Sergipe-Alagoas Basin, Brazil, Albian, *Aracajuia antiqua* zone (MSA-1).

Family Bythocyprididae (Maddocks, 1969)

Robsoniella Kuznetsova, 1956

Robsoniella falklandensis Dingle, 1984

Fig. 6A

Robsoniella falklandensis Dingle, 1984: 118, fig. 8c–f.

Indet sp. A – ?Oertli 1974: 947, figs 6.1–6.11.

Robsoniella cf. *falklandensis* – ?Damotte 1992: 826, fig. 1.8.

New material examined

BRAZIL: Porto dos Barcos 3 outcrop, Riachuelo Municipality, Sergipe State (samples MP-1468 and MP-1470), approximate coordinates 10°43' S, 37°10' W.

Type locality and *stratum*

Not designated.

Measurements

Homeotype (CP-733): right valve: length = 0.72 mm, height = 0.43 mm.

Remarks

The diagnosis follows Dingle (1984). The genus *Robsoniella* was originally placed in the family Healdiidae Harlton, 1933 by Kuznetsova (1956). After review by Gramm & Kuznetsova (1970), it was separated into its own family, Robsoniellidae Gramm & Kuznetsova, 1970. Dingle (1984) first noted its affiliation to the superfamily Bairdioidea Sars, 1888, despite classifying it as a Bairdiidae Sars, 1888. However, it shares several morphological characters with the Bythocyprididae Maddocks, 1969, as already pointed out by Babinot *et al.* (2009), although this study gave no further explanation. Bythocyprididae was originally proposed by Maddocks (1969) as a subfamily of Bairdiidae Sars, 1888, namely Bythocypridinae Maddocks, 1969. Its status was reviewed by Kozur (1972), who elevated it to the family level. Specimens in Oertli (1974) and Damotte (1992) present a very similar general layout in lateral view, although not enough to consider them as being *Robsoniella falklandensis*.

Paleoecology and distribution

Robsoniella falklandensis Dingle, 1984 is a marine, outer shelf to neritic species occurring in the following localities and stages: Mzinene Formation, South Africa, Cenomanian (Dingle 1984); and in the Taquari Member, Riachuelo Formation, Sergipe-Alagoas Basin, Brazil, middle Albian, *Aracajuia benderi* zone (MSA-0), *Praebythoceratina amsittenensis* subzone (MSA-0.3).

Suborder Cypridocopina Jones, 1901
Superfamily Cypridoidea Baird, 1845
Family Candonidae Kaufmann, 1900
Subfamily Cyclocypridinae Kaufmann, 1900

Cetacella Martin, 1958

Cetacella sp. 1

Fig. 6B

Cetacella GA D 25 – Grosdidier 1979: 8, fig. 53a–c.

New material examined

BRAZIL: 1-US-1 well, Laranjeiras Municipality, Sergipe State (depths of 750, 1110 and 1131 m); Massapê outcrop, Riachuelo Municipality, Sergipe State (samples MP-1517, MP-1534, MP-1544, MP-1545 and MP-1547), approximate coordinates 10°06' S, 37°10' W.

Measurements

Hypotype (CP-734): right valve: length = 0.73 mm, height = 0.42 mm.

Remarks

The generic diagnosis follows Martin (1958). *Cetacella* GA D 25 in Grosdidier (1979) also belongs to this species.

Paleoecology and distribution

Cetacella sp. 1 is a marine, shelf species occurring in the following localities and stages: Madiéla Formation, Gabon Basin, Gabon, upper Aptian–lower Albian (Grosdidier 1979). In the present work: Maruim Member, Riachuelo Formation, Sergipe-Alagoas Basin, Brazil, uppermost Aptian–Albian, *Aracajuia benderi* (MSA-0) – *Sergipella viviersae* (MSA-0.2) and *Metacytheropteron* sp. aff. *M.* sp. GA C 24 (MSA-0.5) subzones – and *Aracajuia antiqua* (MSA-1) zones.

Subfamily Paracypridinae Sars, 1923

Paracypris Sars, 1866

Paracypris eniotmetos Nicolaidis & Piovesan, 2013

Fig. 6C

Paracypris eniotmetos Nicolaidis & Piovesan, 2013: 244, fig. 3.10a–e.

Paracypris aff. *mdaouerensis* Bassoullet & Damotte, 1969 – Viviers *et al.* 2000: 418, figs 10.16, 10.21–10.22.

Paracypris sp. P3 – Viviers *et al.* 2000: 418, figs 10.10–10.11.

New material examined

BRAZIL: 1-US-1 well, Laranjeiras Municipality, Sergipe State (depths of 300, 390, 804 and 831 m); Estre outcrop, Rosário do Catete Municipality, Sergipe State (sample MP-1423), approximate coordinates 10°41' S, 37°02' W; Fazenda Santa Bárbara outcrop, Rosário do Catete Municipality, Sergipe State (sample MP-1420), approximate coordinates 10°39' S, 37°01' W; Massapê outcrop, Riachuelo Municipality, Sergipe State (samples MP-1514, MP-1515, MP-1517 to MP-1521, MP-1531 and MP-

1545 to MP-1547), approximate coordinates 10°06' S, 37°10' W; P384 outcrop, Riachuelo Municipality, Sergipe State (samples MP-1497, MP-1506 and MP-1511 to MP-1513), approximate coordinates 10°43' S, 37°12' W; Penha outcrop, Riachuelo Municipality, Sergipe State (samples MP-1449 to MP-1453, MP-1456, MP-1457 and MP-1459), approximate coordinates 10°42' S, 37°13' W; Porto dos Barcos 3 outcrop, Riachuelo Municipality, Sergipe State (samples MP-1460 to MP-1466 and MP-1468 to MP-1472), approximate coordinates 10°43' S, 37°10' W; São José 1 outcrop, Riachuelo Municipality, Sergipe State (samples MP-1550 to MP-1555, MP-1557 to MP-1568, MP-1570 to MP-1577, MP-1680 and MP-1695 to MP-1697), approximate coordinates 10°44' S, 37°13' W.

Type locality and *stratum*

PAB-15 well at a depth of 1029 m, Espírito Santo Basin, Espírito Santo State, Brazil; São Mateus Formation, Albian.

Measurements

Homeotype (CP-679): carapace: length = 0.67 mm, height = 0.30 mm, width = 0.20 mm.

Homeotype (CP-680): right valve: length = 0.58 mm, height = 0.24 mm.

Remarks

The diagnosis follows Piovesan *et al.* (2013), although no striate forms were observed in the present samples.

Paleoecology and distribution

Paracypris eniotmetos Nicolaidis & Piovesan, 2013 is a transitional to marine (shelf) species occurring in the following localities and stages: Potiguar Basin, Jandaíra Formation, Coniacian–Santonian (Viviers *et al.* 2000); Santos Basin, Florianópolis, Juréia and Itanhaém Formations, Albian–lower Santonian; Espírito Santo Basin, São Mateus Formation, Albian (Piovesan *et al.* 2013); Sergipe-Alagoas Basin, Angico and Taquari Members, Riachuelo Formation, upper Aptian–Albian, *Aracajuia benderi* zone (MSA-0), *Harbinia sinuata*? (MSA-0.1), *Praebythoceratina amsittenensis* (MSA-0.3) and *Reticulocosta edrianae* (MSA-0.4) subzones (Viviers *et al.* 2000); and in the present work, also in the Taquari and Maruim Members, *Sergipella viviersae* subzone (MSA-0.2) and *Aracajuia antiqua* zone (MSA-1), Brazil.

Family Quadracyprididae Hou, 2002
Subfamily Quadracypridinae Hou, 2002

Harbinia Tsao, 1959 *emend.* Hou 1984

Harbinia crepata Do Carmo *et al.*, 2013
Fig. 6E

Harbinia crepata Do Carmo *et al.*, 2013: 95, figs 3.9–3.18.

Gen. ind. sp. aff. 207 – Silva-Telles Júnior & Viana 1990: 314, figs 2.1, 2.3.

New material examined

BRAZIL: Estre outcrop, Rosário do Catete Municipality, Sergipe State (sample MP-1423), approximate coordinates 10°41' S, 37°02' W; São José 1 outcrop, Riachuelo Municipality, Sergipe State (samples MP-1561 and MP-1573), approximate coordinates 10°44' S, 37°13' W.

Type locality and *stratum*

CE-1 well, at a depth of 2079.5 m, Ceará State, Brazil; Alagamar Formation, Potiguar Basin, middle–upper Aptian.

Measurements

Hypotype (CP-681): right valve: length = 0.72 mm, height = 0.43 mm.

Remarks

The diagnosis follows Do Carmo *et al.* (2013).

Paleoecology and distribution

Harbinia crepata Do Carmo *et al.*, 2013 is a freshwater to shelf species occurring in the following localities and stages: Crato Member, Santana Formation, Araripe Basin, Aptian (Silva-Telles Júnior & Viana 1990); Alagamar Formation, Potiguar Basin, middle–upper Aptian (Do Carmo *et al.* 2013); and in the present work, Angico and Taquari Members, Riachuelo Formation, Sergipe-Alagoas Basin, uppermost Aptian–lower Albian, *Aracajuia benderi* zone (MSA-0), *Sergipella viviersae* subzone (MSA-0.2), Brazil.

Harbinia sinuata? (Krömmelbein & Weber, 1971) *emend.* Do Carmo *et al.* 2013

Fig. 6F

?*Hourcquia angulata sinuata* Krömmelbein & Weber, 1971: 35, fig. 6.24a–c.

Harbinia sinuata – ?Ramos *et al.* 2006: 344, fig. 4i–l. — ?Do Carmo *et al.* 2008: 796, fig. 6.10. — ?Do Carmo *et al.* 2013: 95, figs 4.1–4.24.

Pattersoncypris sinuata – ?Poropat & Colin 2012: 714, fig. 4.2.

“*Cytheridea*”? sp. gr. 201/218 – ?Moura & Praça 1985: 407, figs 2.19, 2.22.

“*Cypridea*” spp. ex. gr. 201/218 – ?Moura 1988: 1212, figs 2.7, 2.10.

Hourcquia angulata ssp. – ?Silva-Telles Júnior & Viana 1990: 320, fig. 3.4.

Hourcquia gr. *angulata* – Colin & Dépêche 1997: 434, fig. 2.19.

New material examined

BRAZIL: 1-CPB-1 well, Carmópolis Municipality, Sergipe State (depth of 354.5 m); 7-CP-252 well, Santo Amaro das Brotas Municipality, Sergipe State (depths of 478.45, 478.85, 481.6, 482.9 and 484.4 m).

Measurements

Homeotype (LBP 9): carapace: length = 0.93 mm, height = 0.76 mm.

Remarks

The suprageneric taxonomy follows Hou *et al.* (2002) and the generic one follows Do Carmo *et al.* (2013). However, although the specimens observed are very similar to *Harbinia sinuata* (Krömmelbein & Weber, 1971), they differ in the shape of the dorsal anterior margin adjacent to the “hump” region, characteristic of the genus *Harbinia* Tsao, 1959. In the specimens of Krömmelbein & Weber (1971) and Do Carmo *et al.* (2013), this area of the dorsal margin is flatter, which overall widens the anterior end. The present specimens seem to be similarly, although more discretely, ornamented as other *Harbinia* species (Krömmelbein & Weber 1971; Hou 1984; Antonietto *et al.* 2012; Do Carmo *et al.* 2013). For these reasons, the current specimens are identified dubiously as *Harbinia sinuata*.

Paleoecology and distribution

Harbinia sinuata? is a freshwater to transitional species occurring in the following localities and stages: Bongor, Doba and Doseo Basins, Chad, upper Aptian (Colin & Dépêche 1997); and Riachuelo Formation, Sergipe-Alagoas Basin (Krömmelbein & Weber 1971), Brazil, upper Aptian, *Aracajuia benderi* zone (MSA-0), *Harbinia sinuata?* subzone (MSA-0.1).

Superfamily Pontocypridoidea Müller, 1894
Family Pontocyprididae Müller, 1894

Liasina Gramann, 1963

Liasina sp. 1
Fig. 6D

Bythocypris? sp. Se1 aff. *B.?* sp. GA C 28 – Viviers *et al.* 2000: 414, figs 9.8–9.9.
Australoecia sp. 1 – Piovesan *et al.* 2013: 245, fig. 4.5a–b.

New material examined

BRAZIL: São José 1 outcrop, Riachuelo Municipality, Sergipe State (sample MP-1552), approximate coordinates 10°44' S, 37°13' W.

Measurements

Hypotype (CP-682): right valve: length = 0.41 mm, height = 0.20 mm.

Remarks

The generic diagnosis follows Gramann (1963). *Liasina* sp. 1, in contrast to most *Liasina* species, is not smooth in lateral view, but rather pitted. The very restricted number of specimens does not allow a complete description of this probably new species. Specimens in Viviers *et al.* (2000), namely *Bythocypris?* sp. Se1, and Piovesan *et al.* (2013) also belong to *Liasina* sp. 1.

Paleoecology and distribution

Liasina sp. 1 is a marine, shelf species occurring in the following localities and stages: Itanhaém and Itajaí-Açu Formations, Santos Basin, Albian (Piovesan *et al.* 2013); Angico (Viviers *et al.* 2000) and Taquari (present work) Members, Riachuelo Formation, Sergipe-Alagoas Basin, uppermost Aptian–lower Albian, *Aracajuia benderi* zone (MSA-0), *Sergipella viviersae* subzone (MSA-0.2), Brazil.

Suborder Cytherocopina Gründel, 1967
Infraorder Archaeocytherinina Liebau, 1991
Superfamily Bythocytheroidea Sars, 1926
Family Bythocytheridae Sars, 1926
Subfamily Bythocytherinae Sars, 1926
Tribe Bythoceratinini Gründel & Kozur, 1972

Praebythoceratina Gründel & Kozur, 1972 *emend.* Becker, 1990

Praebythoceratina deltalata sp. nov.

urn:lsid:zoobank.org:act:AEA6A7C1-F7C3-4BCF-B8CB-3CED348DC62F

Fig. 6G–J

Monoceratina sp. A – ?Donze 1964: 148, fig. 7.145.

Diagnosis

A species of *Praebythoceratina* distinguished by the combination of the following features: ornamentation consisting of irregularly shaped reticulations at the postero-central and ventro-posterior areas, a tubercle in the dorso-central area and an irregularly reticulate spine in the ventro-central area. In dorsal view, the spine presents a widened basis, forming a triangle-shaped ala running from the postero-ventral to the antero-ventral areas.

Etymology

From the Greek *delta*, meaning “d”, and the Latin *alata*, meaning “with a wing”. *Praebythoceratina deltalata* sp. nov. presents a spine in its ventro-posterior region that is shaped like a triangular ala (hence *delta*, as the letter “d” in the Greek alphabet resembles a triangle).

Type Material**Holotype**

CP-683 (right valve), stored dry in a micropaleontological slide.

Paratypes

CP-684 (left valve), CP-758 (right valve) and CP-759 (left valve), stored as the holotype.

Other materials examined

BRAZIL: São José 1 outcrop, Riachuelo Municipality, Sergipe State (samples MP-1551, MP-1552, MP-1554, MP-1558, MP-1559, MP-1561, MP-1564, MP-1565, MP-1567, MP-1568 and MP-1570 to MP-1576), approximate coordinates 10°44' S, 37°13' W.

Type locality and *stratum*

Sample MP-1680, São José 1 outcrop, Riachuelo Municipality, Sergipe-Alagoas Basin, Sergipe State, Brazil, approximate coordinates: 10°44' S, 37°13' W; Riachuelo Formation, *Aracajuia benderi* zone (MSA-0), *Sergipella viviersae* subzone (MSA-0.2), uppermost Aptian–lower Albian.

Measurements

Holotype (CP-683): right valve: length = 0.56 mm, height = 0.29 mm.

Paratype (CP-684): left valve: length = 0.53 mm, height = 0.29 mm.

Paratype (CP-758): right valve: length = 0.47 mm.

Paratype (CP-759): left valve: length = 0.45 mm, height = 0.23 mm.

Description

In lateral view, medium-sized subtriangular to sub-rectangular carapace, with greatest height at postero-central and greatest length at centro-dorsal regions. Round anterior end, becoming slightly rectilinear close to dorsal margin, where an obtuse cardinal angle is formed. Sharp, supra-curved posterior end, forming dorsal caudal process. Rectilinear dorsal margin, becoming concave only at centro-posterior region. Regularly straight ventral margin, with slight concavity at oral region. Primary ornamentation consisting of tubercle in dorso-central area, irregularly reticulate spine in ventro-central area and highly inconspicuous, large and low marginal rib running from dorso-posterior to antero-ventral margins. Very shallow S_1 and S_2 sulci. Secondary ornamentation includes irregularly shaped reticulations at postero-central and ventro-posterior areas. Weakly developed rounded eye tubercle. In dorsal view, strongly sagittiform; spine presents a widened basis, forming wide triangle-shaped ala running from postero-ventral to antero-ventral areas. Presence of dorsal ridge creates a flat surface adjacent to hinge line. In internal view, adont hinge, composed in right valve by sulcus running along most of dorsal margin.

Weakly developed inner lamella, observable along anterior end and ventral region of posterior end; not visible in oral region, where valve margin bends inwards expressively.

Remarks

Subfamiliar and tribal identifications follow Gründel & Kozur (1971), while the generic is based on Becker (1990). Occurrences herein described correspond to the first early Cretaceous records of *Praebythoceratina* Gründel & Kozur, 1972, hitherto restricted to the Triassic–Jurassic. Most specimens of *Praebythoceratina deltalata* sp. nov. were found broken, thereby limiting the designation of type specimens. This species is very similar in general layout to *Bythoceratina umbonatooides* (Kaye, 1964), *B. umbonata* (Williamson, 1847) and *Monoceratina longispina* (Bosquet, 1854) from the Albian–Cenomanian of England (Kaye 1964, 1965; Weaver 1982). However, they differ in the position of the dorsal tubercle (postero-dorsal in the former, antero-dorsal in the latter) and in the carina-like morphology of the spine basis in *P. deltalata* sp. nov. (absent in *B. umbonatooides*). Several species, including *P. amsittenensis* (Andreu-Boussut, 1991) comb. nov. from the Albian of Morocco (Andreu-Boussut 1991), *B. tamarae* Rosenfeld, 1974 and *B. avnonensis* Rosenfeld, 1974 from the upper Cenomanian of Israel (Rosenfeld & Raab 1974), are distinguished from *P. deltalata* sp. nov. by the same features. Donze (1964) illustrated *Monoceratina* sp. A from the Berriasian of France in dorsal view, which is strongly similar. However, there is not enough information to perform length/height/width measurements of these specimens, and therefore they cannot safely be assumed to belong to *P. deltalata* sp. nov.

Paleoecology and distribution

Praebythoceratina deltalata sp. nov. is a marine, shelf species occurring in the Angico and Taquari Members, Riachuelo Formation, Sergipe-Alagoas Basin, Brazil, uppermost Aptian–lower Albian, *Aracajuia benderi* zone (MSA-0), *Sergipella viviersae* subzone (MSA-0.2).

Praebythoceratina amsittenensis (Andreu-Boussut, 1991) comb. nov.

Fig. 6N–P

Bythoceratina amsittenensis Andreu-Boussut, 1991: 496, figs 41.6–41.11.

“*Patellacythere*” GA E 27 – Grosdidier 1979 pars: 8, fig. 51a, c.

Bythoceratina? sp. P1 – ?Viviers *et al.* 2000: 411, figs 11.12–11.14.

non “*Patellacythere*” GA E 27 – Grosdidier 1979 pars: 8, fig. 51b.

New material examined

BRAZIL: 1-CPB-1 well, Carmópolis Municipality, Sergipe State (depths of 345.5, 348 and 348.5 m); 7-CP-252 well, Santo Amaro das Brotas Municipality, Sergipe State (depths of 473.8 and 475.3 m); Estre outcrop, Rosário do Catete Municipality, Sergipe State (sample MP-1423), approximate coordinates 10°41' S, 37°02' W; Fazenda Santa Bárbara outcrop, Rosário do Catete Municipality, Sergipe State (sample MP-1420), approximate coordinates 10°39' S, 37°01' W; P384 outcrop, Riachuelo Municipality, Sergipe State (samples MP-1497, MP-1506, MP-1508 and MP-1510 to MP-1513), approximate coordinates 10°43' S, 37°12' W; Porto dos Barcos 3 outcrop, Riachuelo Municipality, Sergipe State (samples MP-1460 to MP-1463, MP-1464, MP-1468 to MP-1472, MP-1476, MP-1477 and MP-1481), approximate coordinates 10°43' S, 37°10' W.

Type locality and stratum

Samples Am.95, Am.100, Am.105 and Am.110, Jbel Amsittène, Morocco; Oued Tidsi Formation, Albian.

Measurements

Homeotype (CP-687): right valve: length = 0.47 mm, height = 0.26 mm.

Homeotype (CP-688): right valve: length = 0.46 mm, height = 0.23 mm.

Homeotype (CP-689): carapace: length = 0.46 mm, height = 0.23 mm, width = 0.22 mm.

Homeotype (CP-769): left valve: length = 0.43 mm, height = 0.23 mm.

Remarks

The generic identification is based on Becker (1990), while the specific follows Andreu-Boussut (1991). Some of the specimens from the Aptian of Gabon identified by Grosdidier (1979) as “*Patellacythere*” GA E 27 belong to this species, while others are related to *Patellacythere shimonensis* (Rosenfeld & Raab, 1983) comb. nov. *Bythoceratina?* sp. P1 in Viviers *et al.* (2000) probably also belongs to the present species, but it is not possible to fully confirm this, as the figured specimen is poorly preserved.

Paleoecology and distribution

Praebythoceratina amsittenensis comb. nov. is a marine, shelf species occurring in the following localities and stages: Madiéla Formation, Gabon Basin, Gabon, upper Aptian–lower Albian (Grosdidier 1979); Oued Tidsi Formation, Morocco, Albian (Andreu-Boussut 1991); and Taquari Member, Riachuelo Formation, Sergipe-Alagoas Basin, Brazil, uppermost Aptian–middle Albian, *Aracajuia benderi* zone (MSA-0), *Sergipella viviersae* (MSA-0.2) and *Praebythoceratina amsittenensis* (MSA-0.3) subzones.

Praebythoceratina trinodosa (Alexander, 1934) comb. nov.

Fig. 6K–M

Monoceratina trinodosa Alexander, 1934: p. 64, fig. 8.10.

New material examined

BRAZIL: São José 1 outcrop, Riachuelo Municipality, Sergipe State (samples MP-1550, MP-1552 to MP-1554, MP-1558, MP-1563 to MP-1565, MP-1571 and MP-1574 to MP-1576), approximate coordinates 10°44' S, 37°13' W.

Type locality and stratum

Fort Worth, Texas, United States; Weno Formation, upper Albian.

Measurements

Homeotype (CP-690): carapace: length = 0.42 mm, height = 0.22 mm, width = 0.22 mm.

Homeotype (CP-691): right valve: length = 0.47 mm, height = 0.25 mm.

Homeotype (CP-692): left valve: length = 0.48 mm, height = 0.22 mm.

Homeotype (CP-693): right valve: length = 0.49 mm, height = 0.24 mm.

Remarks

The generic identification follows Becker (1990), while the specific follows Alexander (1934). Despite being poorly preserved, the holotype of *Praebythoceratina trinodosa* (Alexander, 1934) comb. nov. presents typical morphological traits that are not common in other Early Cretaceous bythocytherid species – a postero-dorsal tubercle over the lateral u-shaped inflation and the presence of reticulate ornamentation at the central area that slightly fades along adjacent areas – but observable in the present specimens. Compared to *P. amsittenensis* comb. nov., *P. trinodosa* comb. nov. is more slender in lateral view and presents more developed antero-dorsal and postero-dorsal tubercles.

Paleoecology and distribution

Praebythoceratina trinodosa comb. nov. is a marine, shelf species occurring in the following localities and stages: United States, upper Albian (Alexander 1934); and in the present work, Angico and Taquari Members, Riachuelo Formation, Sergipe-Alagoas Basin, Brazil, uppermost Aptian–lower Albian, *Aracajuia benderi* zone (MSA-0), *Sergipella viviersae* subzone (MSA-0.2).

Tribe Bythocytherini Sars, 1926

Patellacythere Gründel & Kozur, 1972

Patellacythere shimonensis (Rosenfeld & Raab, 1983) comb. nov.

Fig. 6Q–S

Monoceratina shimonensis Rosenfeld & Raab, 1983: 112, figs 7.5–7.7.

Monoceratina shimonensis – Honigstein *et al.* 1985: 2, fig. 6.159.

“*Patellacythere*” GA E 27 – Grosdidier 1979: 8, fig. 51b.

‘*Patellacythere*’ sp. GA E 27 – Viviers *et al.* 2000: 427, figs 15.14–15.15.

New material examined

BRAZIL: Penha outcrop, Riachuelo Municipality, Sergipe State (samples MP-1450 to MP-1453, MP-1457 and MP-1459), approximate coordinates 10°42' S, 37°13' W; São José 1 outcrop, Riachuelo Municipality, Sergipe State (samples MP-1550 to MP-1558, MP-1560, MP-1562, MP-1565 to MP-1570, MP-1572, MP-1573 and MP-1575), approximate coordinates 10°44' S, 37°13' W.

Type locality and *stratum*

Shimon-1 well, at a depth of 969 m, Israel; Talme Yafe Formation, Levantine Basin, Albian.

Measurements

Homeotype (CP-685): right valve: length = 0.44 mm, height = 0.23 mm.

Homeotype (CP-686): left valve: length = 0.44 mm, height = 0.22 mm.

Homeotype (CP-760): carapace: length = 0.41 mm, height = 0.21 mm, width = 0.22 mm.

Remarks

The specific diagnosis follows Rosenfeld & Raab (1983). The family Bythocytheridae has been thoroughly reviewed by Gründel & Kozur (1972), Schornikov (1990) and Schornikov & Mikhailova (1990), who restricted the range of *Monoceratina* Roth, 1934 to the Devonian–Permian. Therefore, the present authors reassign *Patellacythere shimonensis* comb. nov. to *Patellacythere* from *Monoceratina* Roth, 1928, based on both morphologic and biostratigraphical affinities.

Paleoecology and distribution

Patellacythere shimonensis comb. nov. is a marine, shelf to neritic species occurring in the following localities and stages: Madiéla Formation, Gabon Basin, Gabon, upper Aptian–lower Albian (Grosdidier 1979); Talme Yafe Formation, Levantine Basin, Israel, Albian (Rosenfeld & Raab 1983); and Angico Member, Riachuelo Formation, Sergipe-Alagoas Basin, Brazil, uppermost Aptian–lower Albian (Viviers *et al.* 2000); in the present work, extended to the Taquari Member, although restricted to the *Aracajuia benderi* zone (MSA-0), *Sergipella viviersae* subzone (MSA-0.2).

Patellacythere sp. 1

Fig. 6T

New material examined

BRAZIL: Porto dos Barcos 3 outcrop, Riachuelo Municipality, Sergipe State (sample MP-1468).

Measurements

Hypotype (CP-694): right valve: length = 0.55 mm, height = 0.24 mm.

Remarks

The only specimen of *Patellacythere* sp. 1 found in the present samples resembles those of *P. parva* Weaver, 1982, although not the ones in Witte (1992), which are incomplete, having lost most of their posterior ends. However, *Patellacythere* sp. 1 has a slightly less developed lateral u-shaped swelling, and therefore is dubiously placed in the current species.

Paleoecology and distribution

Patellacythere sp. 1 is a marine, inner shelf species occurring in the Taquari Member, Riachuelo Formation, Sergipe-Alagoas Basin, Brazil, middle Albian, *Aracajuia benderi* zone (MSA-0), *Reticulocosta edrianae* subzone (MSA-0.4).

Superfamily Xestoleberidoidea Sars, 1928

Family Xestoleberidae Sars, 1928

Xestoleberis Sars, 1866

Xestoleberis? sp. 1

Fig. 6U

Material examined

BRAZIL: 1-US-1 well, Laranjeiras Municipality, Sergipe State (depths of 480, 552, 554.5, 1080 and 1086 m); Massapê outcrop, Riachuelo Municipality, Sergipe State (samples MP-1518, MP-1534, MP-1544, MP-1545 and MP-1547), approximate coordinates 10°06' S, 37°10' W.

Measurements

Hypotype (CP-761): carapace: length = 0.37 mm, height = 0.17 mm.

Remarks

The present specimens share the typical morphology of *Xestoleberis* Sars, 1928: a small and smooth carapace, with greatest width at the postero-dorsal region. None of the specimens collected are disarticulated, and thus none of their internal features can be observed. According to Kempf (1986), more than 300 taxa have been described and assigned to this genus, despite its quite conservative shell morphology and the fact that it was originally described based on soft part morphology (Puckett *et al.* 2012). Many papers describe, identify or partially identify *Xestoleberis* species in the Cretaceous (Veen 1936; Bonnema 1941; Schmidt 1948; Benson & Tatro 1964; van den Bold 1964; Holden 1964; Crane 1965; Herrig 1966; Rosenfeld & Raab 1974; Dingle 1980; Weaver 1982; Damotte & Fleury 1987; Ismail & Soliman 1997; Gebhardt 1999; Morsi *et al.* 2008; Piovesan *et al.* 2009, 2013; Tesakova 2010; Babinot & Colin 2011; Puckett *et al.* 2012). For these reasons, the species observed from the Riachuelo Formation is left in open nomenclature, as *Xestoleberis?* sp. 1.

Paleoecology and distribution

Xestoleberis? sp. 1 is a marine, shelf species occurring in the Maruim Member, Riachuelo Formation, Sergipe-Alagoas Basin, Brazil, uppermost Albian, *Aracajuia antiqua* zone (MSA-1).

Xestoleberis? sp. 2

Fig. 7A–C

Material examined

BRAZIL: 1-US-1 well, Laranjeiras Municipality, Sergipe State (depth of 861 m); Estre outcrop, Rosário do Catete Municipality, Sergipe State (sample MP-1423), approximate coordinates 10°41' S, 37°02' W; Porto dos Barcos 3 outcrop, Riachuelo Municipality, Sergipe State (sample MP-1460), approximate coordinates 10°43' S, 37°10' W.

Measurements

Hypotype (CP-697): carapace: length = 0.52 mm, height = 0.28 mm, width = 0.25 mm.

Hypotype (CP-735): left valve: length = 0.58 mm, height = 0.30 mm.

Remarks

For uncertainties in the generic diagnosis, see remarks on *Xestoleberis?* sp. 1. *Xestoleberis?* sp. 2 differs from the former by its larger size and sturdier general layout, both in lateral and dorsal views.

Paleoecology and distribution

Xestoleberis? sp. 2 is a marine, inner shelf species occurring in the Taquari Member, Riachuelo Formation, Sergipe-Alagoas Basin, Brazil, middle Albian, *Aracajuia benderi* zone (MSA-0), *Praebythoceratina amsittenensis* subzone (MSA-0.3).

Infraorder Nomocytherinina Liebau, 1991

Superfamily Cytherideoidea Sars, 1925

Family Cytherideidae Sars, 1925

Subfamily Schulerideinae Mandelstam, 1960

Tribe Schulerideini Mandelstam, 1960

Apatocythere Triebel, 1940

Apatocythere? sp. 1

Fig. 7D–H

Material examined

BRAZIL: P384 outcrop, Riachuelo Municipality, Sergipe State (samples MP-1511 to MP-1513), approximate coordinates 10°43' S, 37°12' W.

Measurements

Hypotype (CP-762): ♀, carapace: length = 0.60 mm, height = 0.36 mm, width = 0.30 mm.

Hypotype (CP-763): ♂, carapace: length = 0.66 mm, height = 0.35 mm; width = 0.31 mm.

Remarks

The suprageneric diagnosis follows Neale (1982). No internal features were observable in the present specimens, although their general shape and size resemble those of *Apatocythere* species in Triebel (1940). Because of that, the present authors maintain the dubious identification of *Apatocythere?* sp. 1.

Paleoecology and distribution

Apatocythere? sp. 1 is a marine, outer shelf species occurring in the Taquari Member, Riachuelo Formation, Sergipe-Alagoas Basin, Brazil, middle Albian, *Aracajuia benderi* zone (MSA-0), *Praebythoceratina amsittenensis* subzone (MSA-0.3).

Family Krithidae Mandelstam, 1960
Subfamily Cuneocytherinae Mandelstam, 1960
Tribe Dicrorygmini Gründel & Kozur, 1975

Gabonorygma gen. nov.

urn:lsid:zoobank.org:act:74466CBB-D7CA-4BA8-9749-533416ECBC34

Diagnosis

A genus of Dicrorygmini with the following distinguishing features: sub-rounded to sub-rectangular carapace with rounded, convex dorsal margin, smooth or punctate ornamentation, weakly developed hinge line elements, narrow marginal area and lamellae and valves highly bent inwards in the oral region, sometimes partially obliterating the view of the inner margin and selvage.

Etymology

From the Latin *Gabon*, meaning “Gabon”, a country where specimens of the genus are common in Early Cretaceous strata; and the Greek *orygma*, meaning “tunnel”, a reference to this genus belonging to the tribe Dicrorygmini Gründel & Kozur, 1975.

Type species

Dicrorygma (Orthorygma) brotzeni Christensen, 1965.

Remarks

The tribal and subfamilial diagnoses follow Gründel (1978b). The Dicrorygmini is a small tribe probably composed by the following genera: *Archeocuneocythere* Mandelstam, 1947, *Dicrorygma* Poag Jr, 1965, *Orthorygma* Christensen, 1965 (= *Oertliana* Kilenyi, 1965), here raised to the generic level, and *Gabonorygma* gen. nov. Species of *Gabonorygma* gen. nov. so far include *G. brotzeni* (Christensen, 1965), from the Kimmeridgian–early Tithonian of Denmark, and the presently described *G. sergipana* gen. et sp. nov. *Pattersoncypris?* sp. 1 in Piovesan *et al.* (2013) is also a species to be included in *Gabonorygma* gen. nov., if properly reviewed. *Cytherideinarum* gen. et sp. nov. 2 in Oertli *et al.* (1961), from the Valanginian–Barremian of Denmark, also belongs to this new genus, although it is not officially described; *Cytherideinarum* itself cannot be accepted as a valid generic name, as it never received a proper diagnosis. Despite the small number of classified taxa, their number could be considerably larger, since *Gabonorygma* gen. nov. represents what is in general the most neglected carapace morphology among ostracods, namely, a small, rounded, smooth, mostly featureless general layout.

Gabonorygma sergipana gen. et sp. nov.

urn:lsid:zoobank.org:act:185D3B61-6920-4DFA-89CA-260C37B43608

Fig. 7I–R

“*Asciocythere*” GA E 26 – Grosdidier 1979: 8, fig. 58a–c.

Ovocytheridea aff. *reniformis* van den Bold, 1964 – Viviers *et al.* 2000: 425, figs 14.3–14.4.

Pattersoncypris? sp. 1 – Piovesan *et al.* 2013: 244, fig. 4.3a–b.

Diagnosis

A species of *Gabonorygma* gen. nov. distinguished by the following features: carapace with greatest height at the antero-central region and greatest width at the centro-posterior region, round, slightly infra-curved posterior end and weakly developed inner margin, not visible in the oral region, where the selvage bends inwards expressively.

Etymology

From Sergipe State, Brazil, where the species was described.

Type material

Holotype

BRAZIL: ♀, carapace, stored dry in a micropaleontological slide (CP-698).

Allotype

BRAZIL: ♂, carapace, stored as the holotype (CP-699).

Paratypes

BRAZIL: ♀, carapace (CP-700), ♀, carapace (CP-701), ♀, valve (CP-702) and ♂, carapace (CP-703); stored as the holotype.

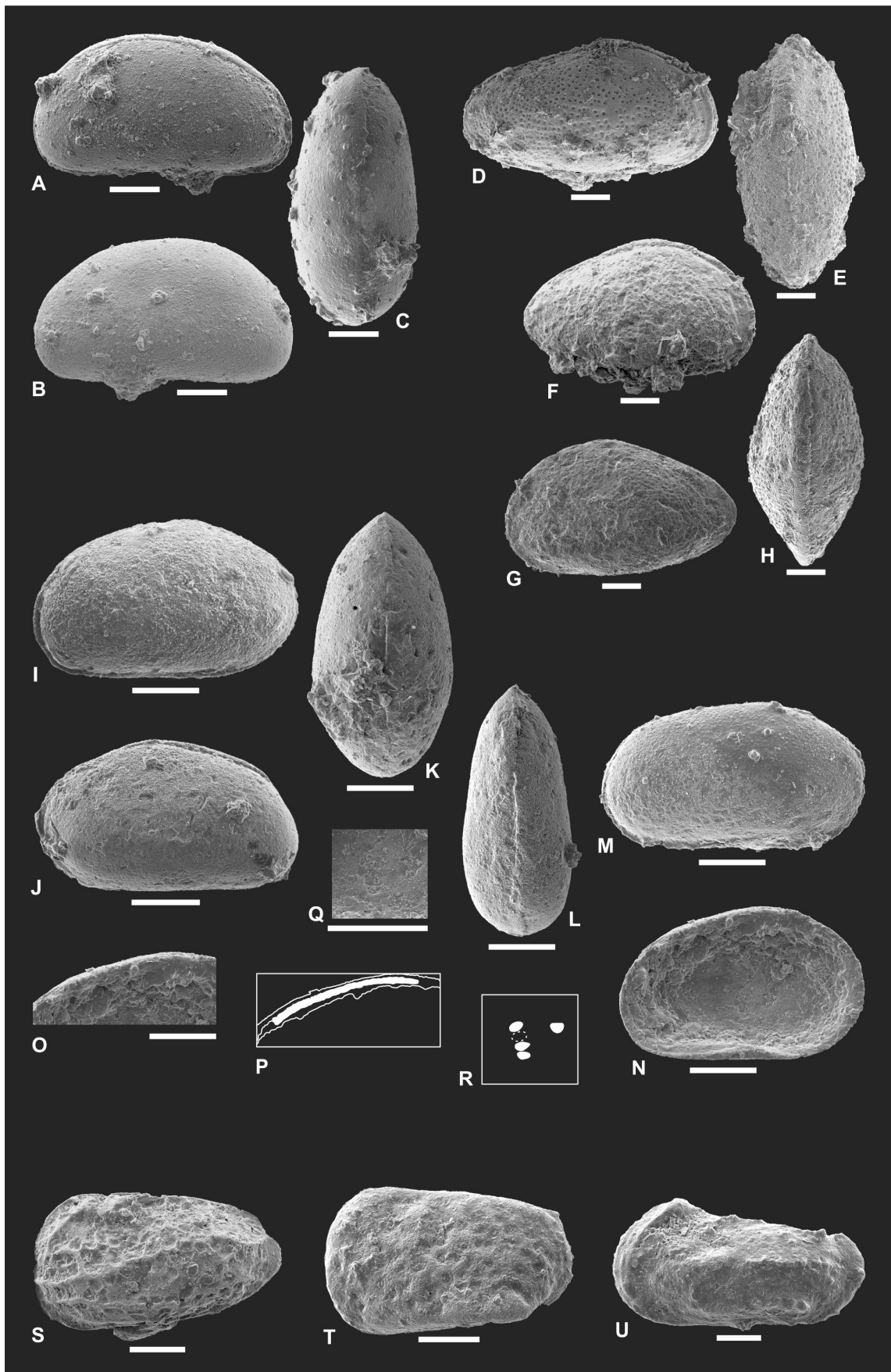
Other material examined

BRAZIL: 1-US-1 well, Laranjeiras Municipality, Sergipe State (depths of 399, 450, 1011, 1020 and 1080 m); 7-CP-252 well, Santo Amaro das Brotas Municipality, Sergipe State (depth of 512.7 m); Fazenda Santa Bárbara outcrop, Rosário do Catete Municipality, Sergipe State (sample MP-1419), approximate coordinates 10°39' S, 37°01' W; Penha outcrop, Riachuelo Municipality, Sergipe State (samples MP-1450 to MP-1452 and MP-1459), approximate coordinates 10°42' S, 37°13' W; Porto dos Barcos 3 outcrop, Riachuelo Municipality, Sergipe State (samples MP-1460, MP-1461, MP-1463, MP-1465 and MP-1468 to MP-1472), approximate coordinates 10°43' S, 37°10' W; São José 1 outcrop, Riachuelo Municipality, Sergipe State (samples MP-1550 to MP-1565), approximate coordinates 10°44' S, 37°13' W.

Type locality and *stratum*

Sample MP-1472, Porto dos Barcos 3 outcrop, Riachuelo Municipality, Sergipe State, Brazil, approximate coordinates: 10°43' S, 37°10' W; Riachuelo Formation, Sergipe-Alagoas Basin, middle Albian, *Aracajuia benderi* zone (MSA-0), *Praebythoceratina amsittenensis* subzone (MSA-0.3).

Fig. 7. [facing page] Ostracods of the Riachuelo Formation, Sergipe-Alagoas Basin, Albian, Brazil. – **A–C.** *Xestoleberis?* sp. 2; CP-697. **A.** Right lateral view. **B.** Left lateral view. **C.** Dorsal view. – **D–H.** *Apatocythere?* sp. 1. **D–E.** CP-763. **D.** Right lateral view. **E.** Dorsal view. **F–H.** CP-762. **F.** Right lateral view. **G.** Left lateral view. **H.** Dorsal view. – **I–R.** *Gabonorygma sergipana* gen. et sp. nov. **I.** CP-698, right lateral view. **J.** CP-700, left lateral view. **K.** CP-701, dorsal view. **L.** CP-703, dorsal view. **M.** CP-699, right lateral view. **N–R.** CP-702. **N.** Left internal view. **O.** Detail of the hinge. **P.** Interpretation of the hinge structures. **Q.** Detail of the central and anterior muscle scars. **R.** Interpretation of the central and anterior muscle scars. – **S.** *Aracajuia fragilis* (Piovesan & Nicolaidis, 2013) comb. nov.; CP-764, left lateral view. – **T.** *Microceratina?* sp. 1; CP-714, left lateral view. – **U.** *Algeriana?* sp. 1; CP-727, left lateral view. Scale bars = 100 µm.



Measurements

Holotype (CP-698): ♀, carapace: length = 0.40 mm, height = 0.23 mm, width = 0.21 mm.
Allotype (CP-699): ♂, carapace: length = 0.40 mm, height = 0.22 mm, width = 0.17 mm.
Paratype (CP-700): ♀, carapace: length = 0.38 mm, height = 0.22 mm, width = 0.20 mm.
Paratype (CP-701): ♀, carapace: length = 0.40 mm, height = 0.23 mm, width = 0.21 mm.
Paratype (CP-702): ♀, left valve: length = 0.37 mm, height = 0.22 mm.
Paratype (CP-703): ♂, carapace: length = 0.38 mm, height = 0.20 mm, width = 0.17 mm.

Description

In lateral view, sub-rounded to sub-rectangular carapace, with greatest height at antero-central and greatest length at central regions. Left valve larger than the right, slightly overlapping it at ventral margin and posterior end. Round anterior end, becoming slightly rectilinear close to dorsal margin, forming an obtuse cardinal angle. Round, slightly infra-curved posterior end; obtuse posterior cardinal angle. Slightly rectilinear to concave dorsal margin. Rectilinear ventral margin. Smooth overall ornamentation. In dorsal view, elliptical, with greatest width at centro-posterior region. In internal view, adont hinge, composed of smooth bar in left valve. Weakly developed inner lamella, not visible in oral region, where valve margin bends inwards expressively. Selvage visible through entire free margin. Central muscle scar group consisting of at least three elliptical central scars oriented in its greatest axis from antero-ventral to postero-dorsal margins and an elliptical frontal scar. Weak sexual dimorphism: females more sub-rounded and wider in dorsal view, males more sub-rectangular and narrower.

Remarks

Gabonorygma sergipana gen. et sp. nov. can be separated from *Gabonorygma brotzeni* by the more rounded shape of its posterior end, the more anterior position of its greatest height and the more central position of its greatest width. Specimens in Grosdidier *et al.* (1979), Piovesan *et al.* (2013) and Viviers *et al.* (2000) also belong to the new species.

Paleoecology and distribution

Gabonorygma sergipana gen. et sp. nov. is a marine, shelf species occurring in the following localities and stages: Madiéla Formation, Gabon Basin, Gabon, lower–middle Albian (Grosdidier 1979). Angico (Viviers *et al.* 2000) and Taquari (present work) Members, Riachuelo Formation, Sergipe-Alagoas Basin, uppermost Aptian–Albian, *Aracajuia benderi* (MSA-0) and *Aracajuia antiqua* (MSA-1) zones, Brazil.

Family Progonocytheridae Sylvester-Bradley, 1948
Subfamily Progonocytherinae Sylvester-Bradley, 1948
Tribe Majungaellini Krömmelbein, 1974

Neocythere Mertens, 1956

Neocythere? aff. *pseudovanveeni* Gründel, 1966
Fig. 8A–B

?*Neocythere pseudovanveeni* Gründel, 1966: 33, figs 6.1–6.2.

Neocythere (n. subgen.?) *pseudovanveeni* – ?Gründel 1967: 638, figs 2.14–2.15.

Neocythere GA B 21 – Grosdidier 1979: 8, fig. 38a–c.

Perissocytheridea? sp. 1 – Piovesan *et al.* 2013: 240, fig. 5.4a–b.

New material examined

BRAZIL: 1-CPB-1 well, Carmópolis Municipality, Sergipe State (depth of 222 m); Massapê outcrop, Riachuelo Municipality, Sergipe State (samples MP-1514, MP-1515, MP-1517 to MP-1522, MP-1534, MP-1538, MP-1541, MP-1543, and MP-1545 to MP-1547), approximate coordinates 10°06' S, 37°10' W.

Type locality and age

Camin 3/55 well, Germany; upper Albian.

Measurements

Homeotype (CP-705): right valve: length = 0.48 mm, height = 0.30 mm.

Homeotype (CP-706): left valve: length = 0.49 mm, height = 0.28 mm.

Remarks

The suprageneric diagnosis follows Gründel (1977) and Liebau (2005), while the specific diagnosis is based on Gründel (1966). Although the present species and *Neocythere? pseudovanveeni* Gründel, 1966 are similar in size and general layout, the style of ornamentation and lack of distinctive morphological traits, i.e., the dorsal marginal flange and the pair of ventral ribs, leave the attribution to the former uncertain. Specimens identified as *Neocythere* GA B 21 in Grosdidier (1979) and *Perissocytheridea?* sp. 1 in Piovesan *et al.* (2013) also belong to *Neocythere?* aff. *pseudovanveeni*.

Paleoecology and distribution

Neocythere? aff. *pseudovanveeni* is a marine, shelf species occurring in the following localities and stages: Germany, upper Albian–lower Cenomanian (Gründel 1966, 1967); Madiéla Formation, Gabon Basin, Gabon, upper Albian–Cenomanian (Grosdidier 1979); Guarujá Formation, Santos Basin, lower–middle Albian (Piovesan *et al.* 2013); and in the present work, Maruim Member, Riachuelo Formation, Sergipe-Alagoas Basin, uppermost Albian, *Aracajuia antiqua* zone (MSA-1), Brazil.

Neocythere (Physocythere) tenuis Kaye, 1965

Fig. 8C–D

Neocythere (Physocythere) tenuis Kaye, 1965: 245, figs 6.14–6.17.

Neocythere (Physocythere) tenuis – Neale 1978: 352, fig. 10.10.

Neocythere sp. GA B 21 – Viviers *et al.* 2000: 427, figs 15.20–15.22.

New material examined

BRAZIL: Estre outcrop, Rosário do Catete Municipality, Sergipe State (samples MP-1423, MP-1426 and MP-1429), approximate coordinates 10°41' S, 37°02' W.

Type locality and stratum

Henfield, Sussex, England; lower Gault Formation, *Hoplites dentatus* zone, *Anahoplites intermedius* subzone, middle Albian.

Measurements

Homeotype (CP-707): right valve: length = 0.43 mm, height = 0.25 mm.

Homeotype (CP-708): left valve: length = 0.44 mm, height = 0.24 mm.

Remarks

The specific diagnosis follows Kaye (1965). *Neocythere (Physocythere) tenuis* Kaye, 1965 is the same species identified by Viviers *et al.* (2000) as *Neocythere* sp. GA B 21 from Grosdidier (1979). However, the species in the latter work is, actually, *Neocythere?* aff. *pseudovanveeni* (Gründel 1966).

Paleoecology and distribution

Neocythere (Physocythere) tenuis is a marine, shelf species occurring in the following localities and stages: England, middle Albian (Kaye 1965; Neale 1978); Açú Formation, Potiguar Basin, upper Albian–lower Cenomanian; Maruim Member (Viviers *et al.* 2000); and in the present work, Taquari Member, Riachuelo Formation, Sergipe-Alagoas Basin, middle Albian, *Aracajuia benderi* zone (MSA-0), *Praebythoceratina amsittenensis* subzone (MSA-0.3), Brazil.

Superfamily Cytheroidea Baird, 1850

Family Cytheridae Baird, 1850

Subfamily Schizocytherinae Mandelstam, 1960

Tribe Schizocytherini Mandelstam, 1960

Aracajuia Krömmelbein, 1967

Aracajuia antiqua (Rosenfeld & Raab, 1983) comb. nov.

Fig. 8G–I

Amphicytherura antiqua Rosenfeld & Raab, 1983: 96, figs 2.1–2.2.

New material examined

BRAZIL: 1-US-1 well, Laranjeiras Municipality, Sergipe State (depths of 480, 510, 555 and 1140 m); Massapê outcrop, Riachuelo Municipality, Sergipe State (samples MP-1515 to MP-1522, MP-1530, MP-1534, MP-1538, MP-1540 to MP-1543, MP-1546 and MP-1547), approximate coordinates 10°06' S, 37°10' W.

Type locality and stratum

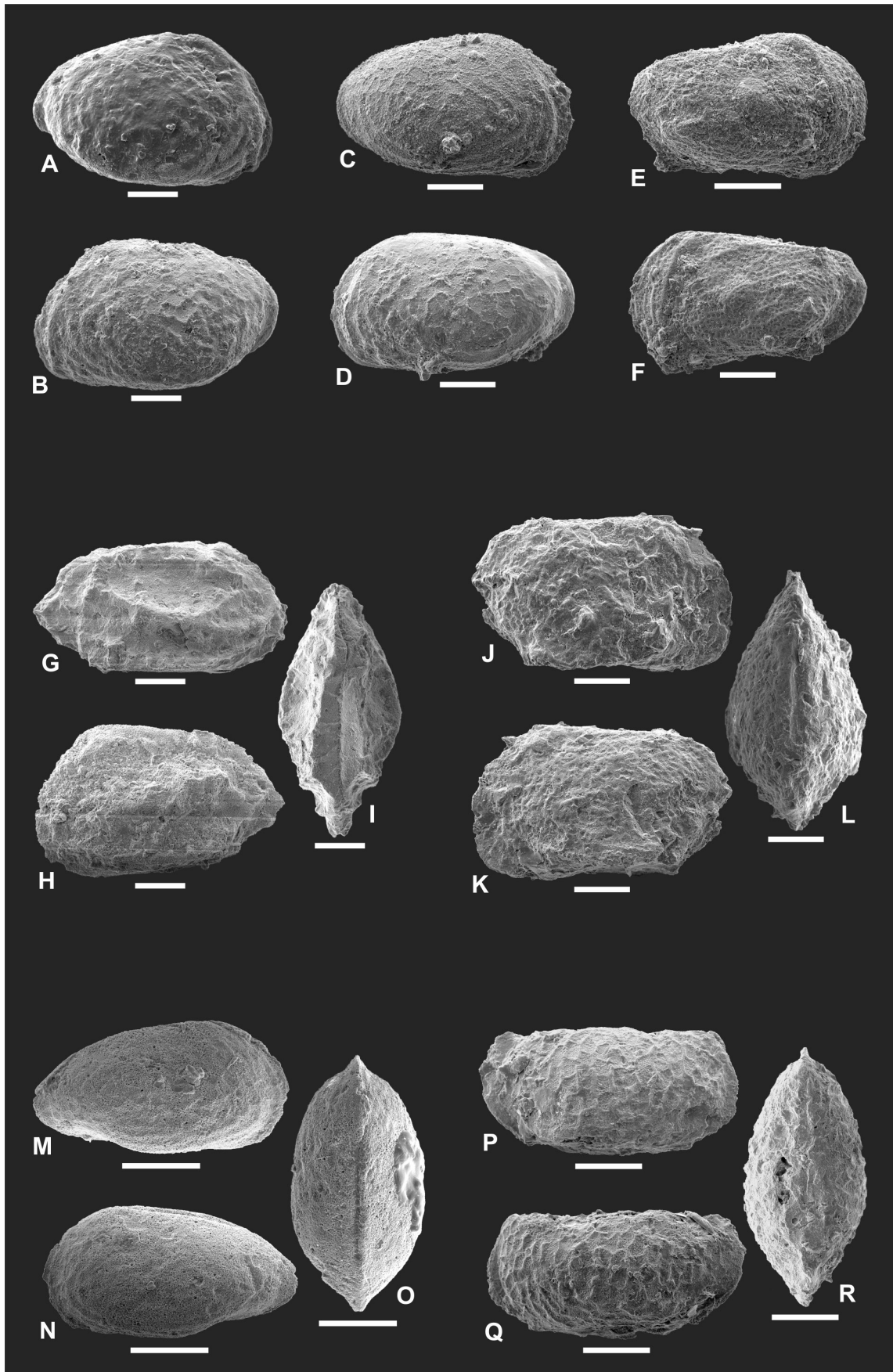
Kokhav-3 well, at a depth of 1454 m, Israel; Telamim Formation, Levantine Basin, Aptian.

Measurements

Homeotype (CP-709): ♀, left valve: length = 0.51 mm, height = 0.32 mm.

Homeotype (CP-710): ♂, carapace: length = 0.50 mm, height = 0.26 mm, width = 0.24 mm.

Fig. 8. [facing page] Ostracods of the Riachuelo Formation, Sergipe-Alagoas Basin, Albian, Brazil. – **A–B.** *Neocythere?* aff. *pseudovanveeni* (Gründel, 1966). **A.** CP-705, right lateral view. **B.** CP-706, left lateral view. – **C–D.** *Neocythere (Physocythere) tenuis* Kaye, 1965. **C.** CP-707, right lateral view. **D.** CP-708, left lateral view. – **E–F.** *Quasihermanites?* sp. 1. **E.** CP-766, right lateral view. **F.** CP-715, left lateral view. – **G–I.** *Aracajuia antiqua* (Rosenfeld & Raab, 1983) comb. nov. **G, I.** CP-709. **G.** Right lateral view. **I.** Dorsal view. **H.** CP-710, left lateral view. – **J–L.** *Eocytheropteron* sp. 1; CP-765. **J.** Right lateral view. **K.** Left lateral view. **L.** Dorsal view. – **M–O.** *Metacytheropteron* aff. *minuta* (Swain, 1976); CP 712. **M.** Right lateral view. **N.** Left lateral view. **O.** Dorsal view. – **P–R.** *Microceratina azazoulensis* Andreu & Colin, 2005; CP-713. **P.** Right lateral view. **Q.** Left lateral view. **R.** Dorsal view. Scale bars = 100 µm.



Remarks

The diagnosis follows Antonietto *et al.* (2013) for the generic and Rosenfeld & Raab (1983) for the specific level.

Paleoecology and distribution

Aracajuia antiqua (Rosenfeld & Raab, 1983) comb. nov. is a marine, shelf species occurring in the following localities and stages: Telamim and Talme Yafe Formations, Levantine Basin, Israel, Aptian–Albian (Rosenfeld & Raab 1983); and in the present work, Maruim Member, Riachuelo Formation, Sergipe-Alagoas Basin, Brazil, uppermost Albian, *Aracajuia antiqua* zone (MSA-1).

Aracajuia benderi Krömmelbein, 1967

Fig. 6V

Aracajuia benderi Krömmelbein, 1967: 529, figs 1, 2a–b, 3, 4a–c.

Aracajuia benderi – Musacchio & Simeoni 2008: 252, fig. 8. — Antonietto *et al.* 2013: 7, fig. 6a–r.

Ostracoda sp. B – Krömmelbein 1966: 121, fig. 2a–c.

Amphicytherura aff. *benderi* – ?Viviers *et al.* 2000: 427, figs 16.4–16.6.

Amphicytherura benderi – Viviers *et al.* 2000: 413, figs 16.1–16.3.

Amphicytherura sp. P3 – Viviers *et al.* 2000: 411, figs 16.11–16.14.

Amphicytherura sp. P4 – ?Viviers *et al.* 2000: 411, figs 16.15–16.17.

New material examined

BRAZIL: 1-US-1 well, Laranjeiras Municipality, Sergipe State (depths of 690, 711, 720, 726, 741, 831 and 1161 m); 7-CP-252 well, Santo Amaro das Brotas Municipality, Sergipe State (depth of 493 m); Estre outcrop, Rosário do Catete Municipality, Sergipe State (sample MP-1423), approximate coordinates 10°41' S, 37°02' W; Fazenda Santa Bárbara outcrop, Rosário do Catete Municipality, Sergipe State (samples MP-1419, MP-1420), approximate coordinates 10°39' S, 37°01' W; P384 outcrop, Riachuelo Municipality, Sergipe State (samples MP-1496, MP-1497, MP-1500, MP-1504 and MP-1506 to MP-1513), approximate coordinates 10°43' S, 37°12' W; Penha outcrop, Riachuelo Municipality, Sergipe State (samples MP-1449 to MP-1453 and MP-1455 to MP-1457), approximate coordinates 10°42' S, 37°13' W; Porto dos Barcos 3 outcrop, Riachuelo Municipality, Sergipe State (samples MP-1460 to MP-1466, MP-1468 to MP-1472, MP-1474 to MP-1477, MP-1481 and MP-1482), approximate coordinates 10°43' S, 37°10' W; São José 1 outcrop, Riachuelo Municipality, Sergipe State (samples MP-1550 to MP-1561, MP-1563 to MP-1578, MP-1680 and MP-1694 to MP-1698), approximate coordinates 10°44' S, 37°13' W.

Type locality and *stratum*

Divina Pastora Municipality, Sergipe State, Brazil; Riachuelo Formation, Sergipe-Alagoas Basin, Albian.

Measurements

Homeotype (CP-711): ♀, carapace: length = 0.43 mm, height = 0.24 mm, width = 0.20 mm.

Remarks

The diagnosis follows Antonietto *et al.* (2013).

Paleoecology and distribution

Aracajuia benderi Krömmelbein, 1967 is a marine, shelf species occurring in the following localities and stages: Madiéla Formation, Gabon Basin, Upper Aptian–lower Albian, Gabon (Krömmelbein 1966; Bertels 1977); Potiguar Basin, Açú Formation, middle Albian (Viviers *et al.* 2000); and Angico Member, Riachuelo Formation, Sergipe-Alagoas Basin, uppermost Aptian–upper Albian, *Aracajuia benderi* zone (MSA-0) (Krömmelbein 1967; Bertels 1977; Viviers *et al.* 2000; Musacchio & Simeoni 2008; Antonietto *et al.* 2013); in the present work, in addition to the Angico Member, it was also found in the Taquari Member, Brazil.

Aracajuia fragilis (Piovesan & Nicolaidis, 2013) comb. nov.

Fig. 7S

Amphicytherura fragilis Piovesan & Nicolaidis, 2013: 247, fig. 4.7a–d.

New material examined

BRAZIL: Estre outcrop, Rosário do Catete Municipality, Sergipe State (samples MP-1424 to MP-1431), approximate coordinates 10°41' S, 37°02' W.

Type locality and stratum

PAB-15 well at a depth of 1029 m, Espírito Santo State, Brazil; São Mateus Formation, Espírito Santo Basin, Albian.

Measurements

Homeotype (CP-764): ♀, left valve: length = 0.45 mm, height = 0.24 mm.

Remarks

The diagnosis follows Piovesan *et al.* (2013). After a major review of the genera *Amphicytherura* and *Aracajuia* by Antonietto *et al.* (2013), the species has been transferred to the latter.

Paleoecology and distribution

Aracajuia fragilis (Piovesan & Nicolaidis, 2013) comb. nov. is a transitional to marine (shelf) species occurring in the following localities and stages: São Mateus Formation, Espírito Santo Basin, Albian (Piovesan *et al.* 2013); and in the present work, Taquari Member, Riachuelo Formation, Sergipe-Alagoas Basin, middle Albian, *Aracajuia benderi* zone (MSA-0), *Reticulocosta edrianae* subzone (MSA-0.4), Brazil.

Family Cytheruridae Müller, 1894
Subfamily Cytherurinae Müller, 1894
Tribe Eocytheropterini Mandelstam, 1960

Eocytheropteron Alexander, 1933

Eocytheropteron sp. 1

Fig. 8J–L

Material examined

BRAZIL: 1-US-1 well, Laranjeiras Municipality, Sergipe State (depths of 996 and 1080 m); Massapê outcrop, Riachuelo Municipality, Sergipe State (samples MP-1515, MP-1516, MP-1518, MP-1519, MP-1521, MP-1540, MP-1542, MP-1545 and MP-1547), approximate coordinates 10°06' S, 37°10' W.

Measurements

Hypotype (CP-765): carapace: length = 0.47 mm, height = 0.27 mm, width = 0.21 mm.

Hypotype (CP-767): left valve: length = 0.43 mm, height = 0.23 mm.

Remarks

The generic diagnosis follows Alexander (1933) and the suprageneric diagnosis follows Gründel (1976). Due to the paucity of well-preserved specimens, *Eocytheropteron* sp. 1 cannot be properly described.

Paleoecology and distribution

Eocytheropteron sp. 1 is a marine, shelf species occurring in the Angico, Maruim and Taquari Members, Riachuelo Formation, Sergipe-Alagoas Basin, Brazil, uppermost Aptian–Albian, *Aracajuia benderi* (MSA-0) – *Sergipella viviersae* subzone (MSA-0.2) – and *Aracajuia antiqua* (MSA-1) zones.

Metacytheropteron Oertli, 1957

Metacytheropteron aff. *minuta* (Swain, 1976)

Fig. 8M–O

?*Majungaella minuta* Swain, 1976: 747, figs 1.19–1.21, 1.23.

Eocytheropteron? sp. – ?Swain 1976: 745, fig. 2.14.

Metacytheropteron GA B 14 – Grosdidier 1979: 8, fig. 40a–c.

Metacytheropteron aff. sp. GA C 26 – Viviers *et al.* 2000: 414, fig. 15.9.

New material examined

BRAZIL: São José 1 outcrop, Riachuelo Municipality, Sergipe State (sample MP-1557), approximate coordinates 10°44' S, 37°13' W.

Measurements

Hypotype (CP-712): carapace: length = 0.33 mm, height = 0.17 mm, width = 0.16 mm.

Remarks

The generic diagnosis follows Oertli (1957) and the suprageneric diagnosis follows Gründel (1976). The reclassification of *Metacytheropteron minuta* (Swain, 1976) has been suggested by several previous works, including Babinot & Colin (1988) and Piovesan *et al.* (2012), so the present authors have opted to perform it. The figured specimen possibly belongs to this species, although it differs significantly in the dorsal overlap (strong in *Metacytheropteron minuta*). Still, it is co-specific with the ones identified as *Metacytheropteron* GA B 14 by Grosdidier (1979) and *Metacytheropteron* aff. sp. GA C 26 by Viviers *et al.* (2000).

Paleoecology and distribution

Metacytheropteron aff. *minuta* (Swain, 1976) is a marine, shelf species occurring in the following localities and stages: Madiéla Formation, Gabon Basin, Gabon, Albian (Grosdidier 1979); and Maruim Member, Riachuelo Formation, Sergipe-Alagoas Basin, Brazil, upper Albian, *Aracajuia benderi* zone (MSA-0), *Metacytheropteron* sp. aff. sp. GA C 24 subzone (MSA-0.5) (Viviers *et al.* 2000); in the present work, expanded to the Angico Member, upper Aptian–lower Albian, *Sergipella viviersae* subzone (MSA-0.2).

Subfamily Eucytherurinae Puri, 1974 *emend.* Maddocks & Steineck, 1987

Microceratina Swanson, 1980

Microceratina azazoulensis Andreu & Colin, 2005

Fig. 8P–R

Microceratina azazoulensis Andreu & Colin, 2005: 21, figs 2.2–2.8.

Chapmanicythereis? sp. 1 – ?Hart & Critenden 1985: 228, fig. 9d.

Pseudomonoceratina sp. 1 – Andreu-Boussut 1991: 502, fig. 42.3.

Pseudomonoceratina sp. 3 – Andreu-Boussut 1991: 503, figs 42.5–42.6.

Microceratina sp. – Babinot *et al.* 2009: 7, figs 1.23, 1.23a.

Material examined

BRAZIL: Massapê outcrop, Riachuelo Municipality, Sergipe State (sample MP-1520), approximate coordinates 10°06' S, 37°10' W; Porto dos Barcos 3 outcrop, Riachuelo Municipality, Sergipe State (samples MP-1460 and MP-1470), approximate coordinates 10°43' S, 37°10' W.

Type locality and stratum

Tarhzoute (9°44'50" W, 30°34'50.3" N), Morocco; Aït Lamine Formation; Azazoul Basin, middle–upper Cenomanian.

Measurements

Hypotype (CP-713): carapace: length = 0.39 mm, height = 0.18 mm, width = 0.19 mm.

Remarks

The diagnosis follows Colin *et al.* (2005). Additionally, *Microceratina* sp. in Babinot *et al.* (2009) is included in the synonymic list of *Microceratina azazoulensis* Andreu & Colin, 2005. *Chapmanicythereis?* sp. 1 in Hart & Critenden (1985) is also tentatively herein considered co-specific, as the figured specimen presents the same general shape, but not the ornamentation, which could be due to taphonomic processes.

Paleoecology and distribution

Microceratina azazoulensis Andreu & Colin, 2005 is a marine, shelf to neritic species occurring in the following localities and stages: Andranomaimbo Formation, Madagascar, lower Cenomanian (Babinot *et al.* 2009); Aït Lamine Formation, Azazoul Basin, Morocco, middle–upper Cenomanian (Andreu Boussut 1991; Colin *et al.* 2005); and in the present work, Taquari Member, Riachuelo Formation, Sergipe Alagoas Basin, Brazil, middle–uppermost Albian, *Aracajuia benderi* (MSA-0) – *Praebythoceratina amsittenensis* subzone (MSA-0.3) – and *Aracajuia antiqua* (MSA-1) zones.

Microceratina? sp. 1

Fig. 7T

Material examined

BRAZIL: Porto dos Barcos 3 outcrop, Riachuelo Municipality, Sergipe State (sample MP-1470), approximate coordinates 10°43' S, 37°10' W.

Measurements

Hypotype (CP-714): left valve: length = 0.41 mm, height = 0.24 mm.

Remarks

Microceratina? sp. 1 vaguely resembles other species of *Microceratina* in Colin *et al.* (2005) in general shape (which is incomplete in the present specimen). Its ornamentation, however, bears no resemblance to any of the aforementioned, and for this reason it is only tentatively placed in this genus.

Paleoecology and distribution

Microceratina? sp. 1 is a marine, outer shelf species occurring in the Taquari Member, Riachuelo Formation, Sergipe-Alagoas Basin, Brazil, middle Albian, *Aracajuia benderi* zone (MSA-0), *Praebythoceratina amsittenensis* subzone (MSA-0.3).

Superfamily Trachyleberidoidea Sylvester-Bradley, 1948

Family Cytherettidae Triebel, 1952

Subfamily Cytherettinae Triebel, 1952

Tribe Protocytherini Ljubimova, 1955

Veenia Butler & Jones, 1957

Veenia guianensis Swain, 1976

Fig. 9B–D

Veenia guianensis Swain, 1976: 748, pl. 1, fig. 22, pl. 3, figs 1a–b, 3.2–3.5, 3.10.

Veenia guianensis – Viviers *et al.* 2000: 437, figs 23.1–23.2.

Veenia (*Protoveenia*) cf. *florentinensis* Damotte, 1961 – Andreu-Boussut 1991: 677, figs 49.5–49.8.

Veenia aff. sp. GA D 16 – Viviers *et al.* 2000: 414, fig. 22.11.

New material examined

BRAZIL: Massapê outcrop, Riachuelo Municipality, Sergipe State (samples MP-1545 and MP-1546), approximate coordinates 10°06' S, 37°10' W.

Type locality and stratum

Leg 14, 144 well, core no. 6, section no. 1, at 58–64 cm depth, Guyana; upper Aptian–Cenomanian.

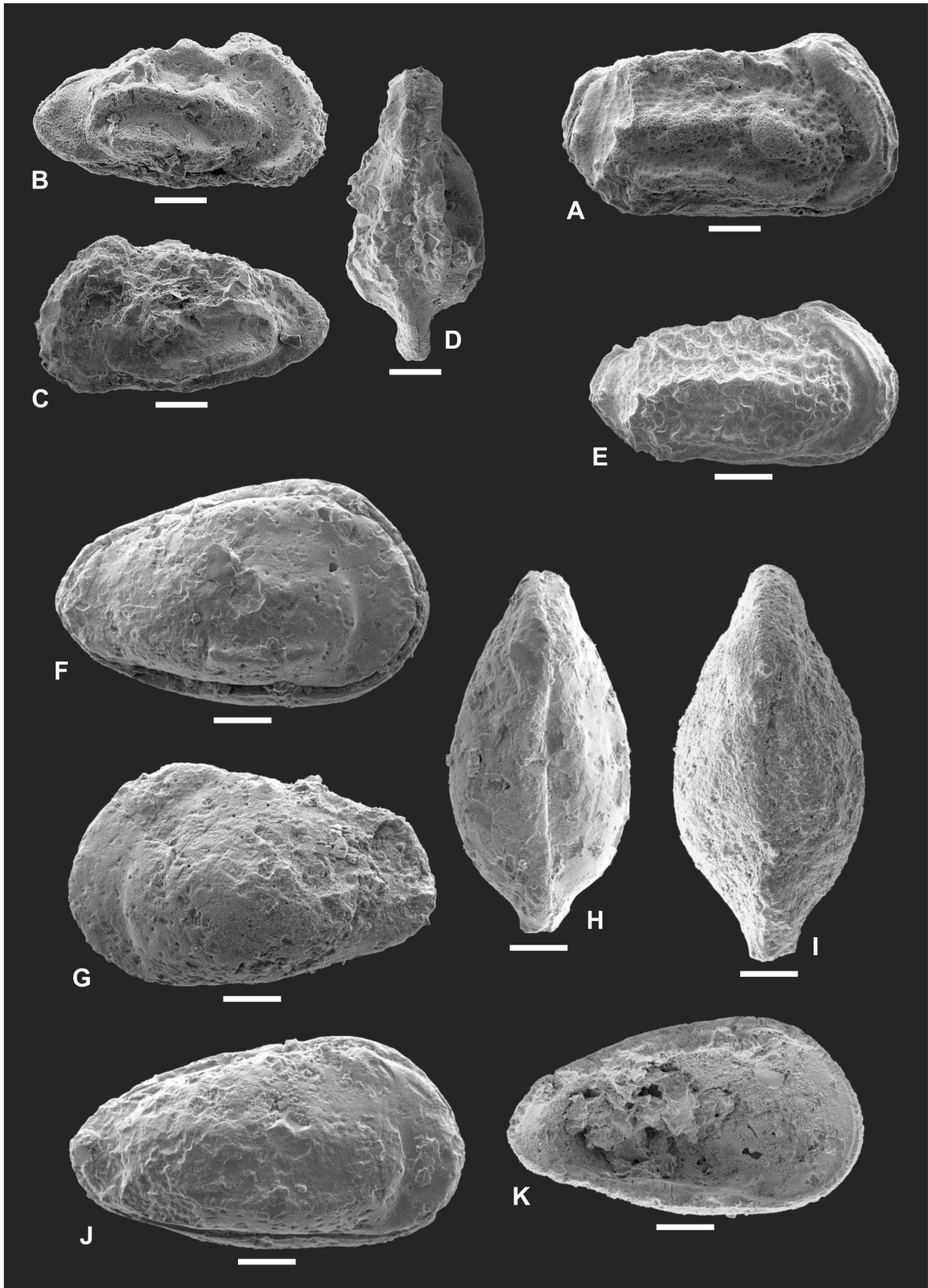
Measurements

Hypotype (CP-732): carapace: length = 0.57 mm, height = 0.30 mm, width = 0.27 mm.

Remarks

The diagnosis follows Swain (1976). *Veenia* (*Protoveenia*) cf. *florentinensis* Damotte, 1961 in Andreu-Boussut (1991) is in fact *Veenia guianensis*, just as part of the specimens identified as *Veenia guianensis* and *Veenia* aff. sp. GA D 16 in Viviers *et al.* (2000).

Fig. 9. [facing page] Ostracods of the Riachuelo Formation, Sergipe-Alagoas Basin, Albian, Brazil. – **A.** *Sergipella viviersae* Do Carmo *et al.*, 2012; CP-728, right lateral view. – **B–D.** *Veenia guianensis* Swain, 1976; CP-732. **B.** Right lateral view. **C.** Left lateral view. **D.** Dorsal view. – **E.** *Reticulocosta edrianae* Antonietto *et al.*, 2015; CP-800, right lateral view. – **F–K.** *Brachycythere smithsoniana* sp. nov. **F.** CP-721, right lateral view. **G.** CP-723, left lateral view. **H.** CP-724, dorsal view. **I.** CP-726, dorsal view. **J.** CP-722, right lateral view. **K.** CP-725, left internal view. Scale bars = 100 µm.



Paleoecology and distribution

Veenia guianensis is a marine, shelf species occurring in the following localities and stages: Guiana, upper Aptian–Cenomanian (Swain 1976); Jbel El Hajer and El Jir Formations and Azazoul Basin, Morocco, Albian (Andreu-Boussut 1991); Ponta do Mel Formation, Potiguar Basin, middle–upper Albian (Viviers *et al.* 2000); and in the present work, Maruim Member, Riachuelo Formation, Sergipe-Alagoas Basin, uppermost Albian, *Aracajuia antiqua* zone (MSA-1), Brazil.

Subfamily Palaeocytherideinae Ljubimova, 1955
Tribe Cytherettini Triebel, 1952

Reticulocosta Gründel, 1974

Reticulocosta edrianae Antonietto *et al.*, 2015
Fig. 9E

Reticulocosta edrianae Antonietto *et al.*, 2015: 361, fig. 4a–l.

Veenia guianensis Swain, 1976 – Viviers *et al.* 2000: 413, fig. 22.10.

Veenia sp. P1 – Viviers *et al.* 2000: 410, figs 23.3–23.4.

Material examined

BRAZIL: Estre outcrop, Rosário do Catete Municipality, Sergipe State (samples MP-1423 and MP-1424), approximate coordinates 10°41' S, 37°02' W; Fazenda Santa Bárbara outcrop, Rosário do Catete Municipality, Sergipe State (samples MP-1419 and MP-1420), approximate coordinates 10°39' S, 37°01' W; P384 outcrop, Riachuelo Municipality, Sergipe State (samples MP-1496, MP-1497, MP-1499, MP-1506 and MP-1509 to MP-1513), approximate coordinates 10°43' S, 37°12' W; Porto dos Barcos 3 outcrop, Riachuelo Municipality, Sergipe State (samples MP-1460 to MP-1466, MP-1468 to MP-1472, MP-1474 to MP-1477, MP-1481 and MP-1482), approximate coordinates 10°43' S, 37°10' W.

Type locality and *stratum*

Sample MP-1461, Porto dos Barcos 3 outcrop, Riachuelo Municipality, Sergipe State, Brazil, approximate coordinates: 10°43' S, 37°10' W; Riachuelo Formation, Sergipe-Alagoas Basin, middle Albian, *Aracajuia benderi* zone (MSA-0), *Praebythoceratina amsittenensis* subzone (MSA-0.3) (Antonietto *et al.* 2015).

Measurements

Homotype (CP-800): ♂, carapace: length = 0.50 mm, height = 0.30 mm, width = 0.28 mm.

Remarks

The diagnosis follows Antonietto *et al.* (2015).

Paleoecology and distribution

Reticulocosta edrianae Antonietto *et al.*, 2015 is a marine, shelf species occurring in the following localities and stages: Açú Formation, Potiguar Basin, middle Albian; and Maruim (Viviers *et al.* 2000) and Taquari (Antonietto *et al.* 2015) Members, Riachuelo Formation, Sergipe-Alagoas Basin, middle Albian, *Aracajuia benderi* zone (MSA-0), *Praebythoceratina amsittenensis* (MSA-0.3) and *Reticulocosta edrianae* (MSA-0.4) subzones, Brazil.

Family Trachyleberididae Sylvester-Bradley, 1948
Subfamily Brachycytherinae Puri, 1954

Brachycythere Alexander, 1933 *emend.* Puckett 2002

Brachycythere smithsoniana sp. nov.

[urn:lsid:zoobank.org:act:92A99BD1-9BB2-457D-8329-8CA4E3ADC881](https://doi.org/10.21203/rs.3.rs-1000000/v1)

Fig. 9F–K

“*Veenia*” GAD 34 – Grosdidier 1979: 8, fig. 28a–c.

Diagnosis

A species of *Brachycythere* distinguished by the following features: in lateral view, subtriangular to sub-elliptical carapace, with greatest height at the antero-central and greatest length at the central regions. Left valve is larger than the right, overlapping it markedly through the entire free margin, except at the postero-ventral margin, where the overlap is modest. Ornamentation differing from left to right valves: in the right one, it consists of three weakly distinguishable smooth ribs at dorsal, central and centro-ventral positions; the left one is entirely smooth.

Etymology

Named for the Smithsonian Institution, the organization to which the National Museum of Natural History of Washington, D.C. belongs, where an important part of this work was carried out.

Type material

Holotype

BRAZIL: ♀, carapace, stored dry in a micropaleontological slide (CP-721).

Allotype

BRAZIL: ♂, carapace, stored as the holotype (CP-722).

Paratypes

BRAZIL: ♀, carapace (CP-723), ♀, carapace (CP-724), ♂, valve (CP-725) and ♂, carapace (CP-726); stored as the holotype.

Other material examined

BRAZIL: Massapê outcrop, Riachuelo Municipality, Sergipe State (samples MP-1514, MP-1516 to MP-1520, MP-1522, MP-1542, MP-1543 and MP-1545 to MP-1547), approximate coordinates 10°06' S, 37°10' W.

Type locality and *stratum*

Sample MP-1515, Massapê outcrop, Riachuelo Municipality, Sergipe State, Brazil, approximate coordinates: 10°06' S, 37°10' W; Riachuelo Formation, Sergipe-Alagoas Basin, uppermost Albian, *Aracajuia antiqua* zone (MSA-1).

Measurements

Holotype (CP-721): ♀, carapace: length = 0.65 mm, height = 0.39 mm, width = 0.28 mm.

Allotype (CP-722): ♂, carapace: length = 0.66 mm, height = 0.35 mm, width = 0.31 mm.

Paratype (CP-723): ♀, carapace: length = 0.64 mm, height = 0.39 mm, width = 0.31 mm.

Paratype (CP-724): ♀, carapace: length = 0.63 mm, height = 0.37 mm, width = 0.30 mm.

Paratype (CP-725): possible ♀, left valve: length = 0.62 mm, height = 0.35 mm.

Paratype (CP-726): ♂, carapace: length = 0.69 mm, height = 0.38 mm, width = 0.33 mm.

Description

In lateral view, subtriangular carapace, with greatest height at antero-central and greatest length at central regions. Left valve larger than right valve, overlapping it pronouncedly through entire free margin, except at postero-ventral margin, where overlap is discrete. Round anterior end, becoming more rectilinear close to dorsal margin, where a slightly obtuse cardinal angle is formed. Lightly pointed posterior end, forming small caudal process, rectilinear below and above its rounded, more extreme point; with dorsal margin it forms an obtuse cardinal angle. Rectilinear to slightly concave dorsal margin. Rounded ventral margin, with slightly conspicuous concavity at oral region at left valve. Ornamentation differing from left to right valves: in right one three weakly distinguishable smooth ribs at dorsal, central and centro-ventral position: the generally curved dorsal one runs from centro-posterior to antero-dorsal region, slightly projecting behind dorsal margin at antero-dorsal region; central one runs from postero-central to central region; lightly curved ventral one runs from postero-ventral to antero-ventral region. Left valve entirely smooth. Flattened anterior and posterior regions. Weakly developed elliptical eye tubercle. In dorsal view, elliptical, with greatest width at centro-posterior region; pointed anterior and posterior ends. In internal view, holamphidont hinge, composed in left valve of frontal rounded socket and smaller, rounded bilobate tooth, a central smooth bar and a posterior elliptical, elongate socket. Well-developed inner lamella, not visible in oral region, where valve margin bends inwards expressively. Selvage not visible at postero-ventral and postero-central regions. Mild sexual dimorphism: females shorter in dorsal view and more rounded in lateral view than males, presenting more valve overlap through carapace margins than males.

Remarks

The suprageneric diagnosis follows Puckett (2002). *Brachycythere smithsoniana* sp. nov. presents the very distinctive feature among species of *Brachycythere* of having differences in ornamentation between its left and right valves as following: the right valve presents three weakly distinguishable ribs in dorsal, central and ventral positions, while the left is smooth. *Brachycythere asymmetrica* Puckett, 1994 also has dissimilar ornamentation between its left and right valves, but in a different pattern: in this species, only a ventral rib is present and this in both valves, although developed in varied levels from left to right; it is also distinct between male and females of the species (Puckett 1994). “*Veenia*” GAD 34 in Grosdidier (1979) is co-specific to *Brachycythere smithsoniana* sp. nov.

Paleoecology and distribution

Brachycythere smithsoniana sp. nov. is a marine, shelf species occurring in the following localities and stages: Madiéla Formation, Gabon Basin, Gabon, upper Aptian–middle Albian (Grosdidier 1979); and in the present work, Angico, Maruim and Taquari Members, Riachuelo Formation, Sergipe-Alagoas Basin, Brazil, uppermost Albian, *Aracajuia antiqua* zone (MSA-1).

Subfamily Trachyleberidinae Sylvester-Bradley, 1948

Algeriana Majoran, 1989

Algeriana? sp. 1

Fig. 7U

Material examined

BRAZIL: Fazenda Santa Bárbara outcrop, Rosário do Catete Municipality, Sergipe State (sample MP-1419), approximate coordinates 10°39' S, 37°01' W.

Measurements

Hypotype (CP-727): left valve: length = 0.57 mm, height = 0.28 mm.

Remarks

The generic diagnosis partially follows Majoran (1989). The main difference between the present specimen and previously described nominal species of *Algeriana* is the presence in the former of an additional anterior sub-marginal ridge originating in the eye tubercle. Due to the restricted number of specimens, it is not possible to make any further comments on the taxonomic placement of *Algeriana?* sp. 1.

Paleoecology and distribution

Algeriana? sp. 1 is a marine, shelf species occurring in the Taquari Member, Riachuelo Formation, Sergipe-Alagoas Basin, Brazil, middle Albian, *Aracajuia benderi* zone (MSA-0), *Praebythoceratina amsittenensis* subzone (MSA-0.3).

Quasihermanites Gründel, 1964

Quasihermanites? sp. 1

Fig. 8E–F

Material examined

BRAZIL: Estre outcrop, Rosário do Catete Municipality, Sergipe State (samples MP-1423 and MP-1424), approximate coordinates 10°41' S, 37°02' W.

Measurements

Hypotype (CP-715): left valve: length = 0.43 mm, height = 0.25 mm.

Hypotype (CP-766): right valve: length = 0.38 mm, height = 0.23 mm.

Remarks

The generic diagnosis follows Gründel (1964) and the suprageneric diagnosis follows Gründel (1966). The figured specimens are apparently less ornamented than other species of *Quasihermanites* Gründel, 1964, especially with regard to its characteristic lateral ribs (Kuznetsova 1961; Gründel 1964; Donze 1965; Pokorný 1973; Colin 1974; Babinot *et al.* 1985a; Babinot & Colin 2011). The probable reason for that would be diagenesis, similar to that observed in the type material of *Quasihermanites spiralus* Schudack & Schudack, 2000 (Schudack & Schudack 2000). Therefore, the present authors classify it questionably as *Quasihermanites*.

Paleoecology and distribution

Quasihermanites? sp. 1 is a marine, shelf species occurring in the Taquari Member, Riachuelo Formation, Sergipe-Alagoas Basin, Brazil, middle Albian, *Aracajuia benderi* zone (MSA-0), *Praebythoceratina amsittenensis* subzone (MSA-0.3).

Sergipella Krömmelbein, 1967 *emend.* Do Carmo *et al.* 2012

Sergipella viviersae Do Carmo *et al.*, 2012

Fig. 9A

Sergipella viviersae Do Carmo *et al.*, 2012: 10, figs 2.1–2.7.

Sergipella transatlantica Krömmelbein, 1967. – Viviers *et al.* 2000: 437, figs 23.12–23.13.

Sergipella aff. *viviersae* – Piovesan *et al.* 2013: 249, fig. 5.9a–b.

New material examined

BRAZIL: 1-CPB-1 well, Carmópolis Municipality, Sergipe State (depths of 348, 348.5 and 364.5 m); 1-US-1 well, Laranjeiras Municipality, Sergipe State (depths of 951, 1146 and 1200 m); Penha outcrop, Riachuelo Municipality, Sergipe State (samples MP-1449 to MP-1453, MP-1456, MP-1457 and MP-1459), approximate coordinates 10°42' S, 37°13' W; São José 1 outcrop, Riachuelo Municipality, Sergipe State (samples MP-1550 to MP-1576, MP-1578, MP-1680 and MP-1694 to MP-1698), approximate coordinates 10°44' S, 37°13' W.

Type locality and *stratum*

Sample MP-1157, São José 1 outcrop, Riachuelo Municipality, Sergipe State, Brazil, approximate coordinates: 10°44' S, 37°13' W; Riachuelo Formation, Sergipe-Alagoas Basin, lower Albian, *Aracajuia benderi* zone (MSA-0), *Sergipella viviersae* subzone (MSA-0.2).

Measurements

Homeotype (CP-728): ♂, carapace: length = 0.65 mm, height = 0.35 mm, width = 0.31 mm.

Remarks

The diagnosis follows Do Carmo *et al.* (2012).

Paleoecology and distribution

Sergipella viviersae Do Carmo *et al.*, 2012 is a transitional to marine (shelf) species occurring in the following localities and stages: São Mateus Formation, Espírito Santo Basin, Albian (Piovesan *et al.* 2013); and Riachuelo Formation, Sergipe-Alagoas Basin, upper Aptian–lower Albian, *Aracajuia benderi* zone (MSA-0), *Harbinia sinuata*? (MSA-0.1) and *Sergipella viviersae* (MSA-0.2) subzones (Viviers *et al.* 2000; Do Carmo *et al.* 2012); in the present work, restricted to the Angico and Taquari Member of the aforementioned formation, Brazil.

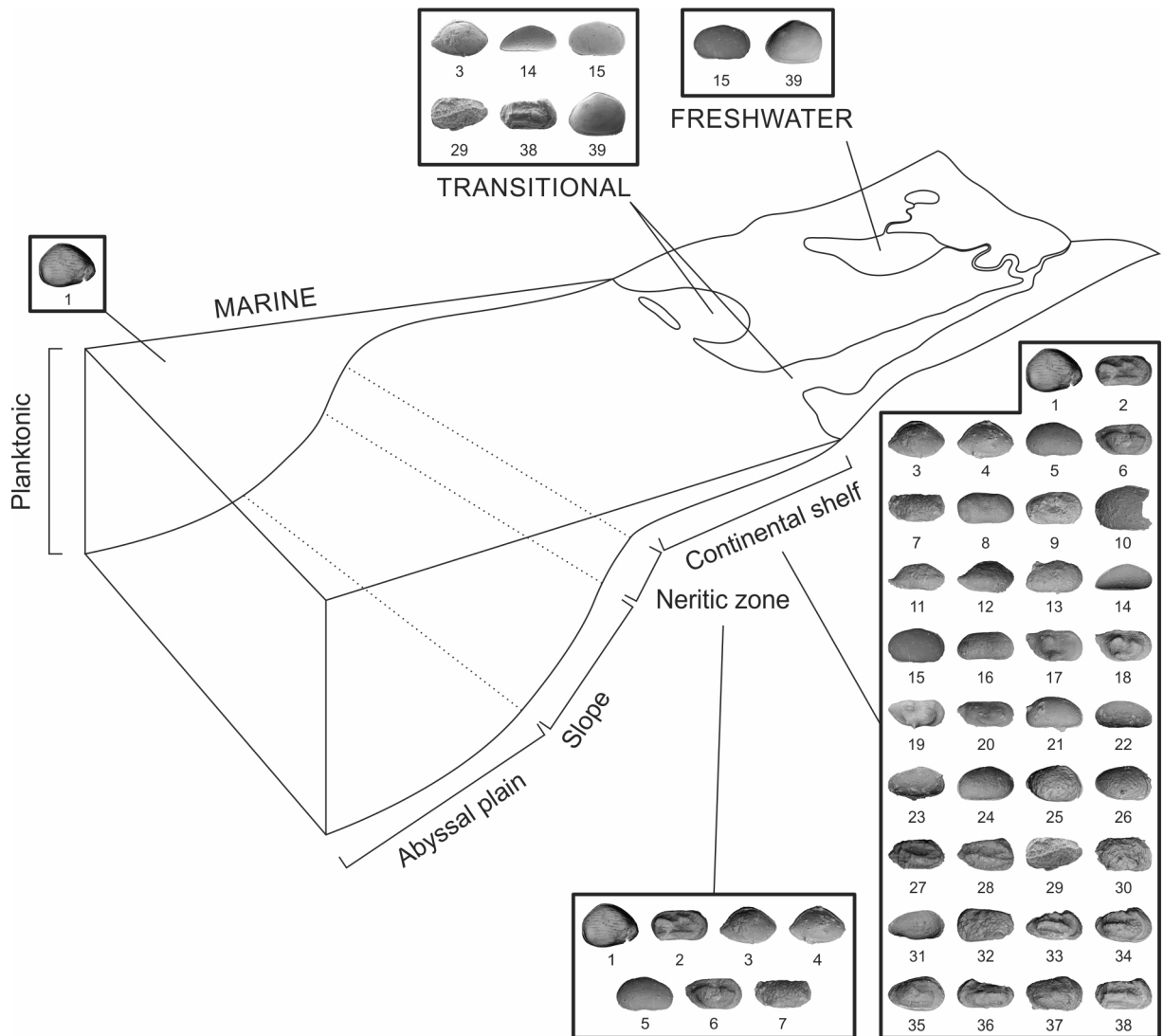
Discussion

Taxonomic summary

The present taxonomic study reviews the identification of the ostracod species found in the Angico, Taquari and Maruim Members of the Riachuelo Formation. Thirty-nine species of 25 genera in 16 families were found and the new taxa include a genus, *Gabonorygma* gen. nov., and three species: *Praebythoceratina deltalata* sp. nov., *Gabonorygma sergipana* gen. et sp. nov. and *Brachycythere smithsoniana* sp. nov. Other species in the present samples include *Conchoecia*? sp. 1, *Cytherella* sp. 1, *C. besrineensis* comb. nov., *Cytherelloidea* aff. *globosa*, *C. btaterensis*, *Bairdoppilata* sp. 1, *Bairdoppilata* sp. 2, *B. comanchensis* comb. nov., *B. pseudoseptentrionalis*, *Robsoniella falklandensis*, *Cetacella* sp. 1, *Paracypris eniotmetos*, *Harbinia sinuata*?, *H. crepata*, *Liasina* sp. 1, *Praebythoceratina amsittenensis* comb. nov., *P. trinodosa* comb. nov., *Patellacythere shimonensis* comb. nov., *Patellacythere* sp. 1, *Xestoleberis*? sp. 1, *Xestoleberis*? sp. 2, *Apatocythere*? sp. 1, *Neocythere*? aff. *pseudovanveeni*, *N. (Physocythere) tenuis*, *Aracajuia antiqua* comb. nov., *A. benderi*, *A. fragilis* comb. nov., *Eocytheropteron* sp. 1, *Metacytheropteron* aff. *minuta*, *Microceratina*? sp. 1, *M. azazoulensis*, *Venia guianensis*, *Algeriana*? sp. 1, *Quasihermanites*? sp. 1 and *Sergipella viviersae*.

Paleoecology

According to Campos Neto *et al.* (2007), the sediments of the Riachuelo Formation were deposited during the drift phase of the proto-South Atlantic Ocean. The sedimentary basin evolved from an initially transitional (local late Alagoas) to an initial shelf system (early Albian) and then gradually to more open sea habitats (late Albian–Cenomanian). This is evidenced by the temporal and spatial distributions of



- | | | | |
|---|--|--|---|
| 1- <i>Conchoecia?</i> sp. 1 | 11- <i>Bairdoppilata</i> sp. 1 | 21- <i>Xestoleberis?</i> sp. 1 | 31- <i>Metacytherofteron?</i> <i>minuta</i> |
| 2- <i>Cytherelloidea btaterensis</i> | 12- <i>Bairdoppilata</i> sp. 2 | 22- <i>Xestoleberis?</i> sp. 2 | 32- <i>Microceratina?</i> sp. 1 |
| 3- <i>Bairdoppilata comanchensis</i> | 13- <i>Cetacella</i> sp. 1 | 23- <i>Apatocythere?</i> sp. 1 | 33- <i>Veenia guianensis</i> |
| 4- <i>Bairdoppilata pseudoseptentrionalis</i> | 14- <i>Paracypris eniotmetos</i> | 24- <i>Gabonorygma sergipana</i> | 34- <i>Reticulocosta edrianae</i> |
| 5- <i>Robsoniella falklandensis</i> | 15- <i>Harbinia crepata</i> | 25- <i>Neocythere?</i> aff. <i>N.?</i> <i>pseudovanveeni</i> | 35- <i>Brachyocythere smithsoniana</i> |
| 6- <i>Patellacythere shimonensis</i> | 16- <i>Liasina</i> sp. 1 | 26- <i>Neocythere (Physocythere) tenuis</i> | 36- <i>Algeriana?</i> sp. 1 |
| 7- <i>Microceratina azazolensis</i> | 17- <i>Praebythoceratina deltalata</i> | 27- <i>Aracajuia antiqua</i> | 37- <i>Quasihermanites?</i> sp. 1 |
| 8- <i>Cytherella besineensis</i> | 18- <i>Praebythoceratina amsittenensis</i> | 28- <i>Aracajuia benderi</i> | 38- <i>Sergipella viviersae</i> |
| 9- <i>Cytherelloidea</i> aff. <i>C. globosa</i> | 19- <i>Praebythoceratina trinodosa</i> | 29- <i>Aracajuia fragilis</i> | 39- <i>Harbinia sinuata?</i> |
| 10- <i>Cytherella</i> sp. 1 | 20- <i>Patellacythere</i> sp. 1 | 30- <i>Eocytherofteron?</i> sp. 1 | |

Fig. 10. Paleoenvironmental distributions of the ostracod species from the upper Aptian–Albian of the Riachuelo Formation, Sergipe-Alagoas Basin, northeastern Brazil.

the Angico, Maruim and Taquari Members, which respectively represent inner shelf, reef and outer shelf shallow marine deposits (the Taquari Member also preserves lagoon and back reef environments).

Paleoecological data of the Albian species herein found (Fig. 10) endorse the lithological interpretations above, as 38 of the 39 identified species displayed shallow marine life habits, according to the literature. This is coincident with the paleoenvironments mainly observed in the Albian of the Riachuelo Formation. Seven species were also characteristic of moderately deep waters, and five were transitional (two of them even freshwater). However, our data are not perfectly congruent with data pertaining to the stratigraphic occurrence, because species living in the transitional zone do not necessarily occur in strata expected to be more transitional (MSA-0.1 and MSA-0.2 subzones). Moderately deep species are also equally found in both transitional and shallow marine to moderately deep marine strata (MSA-0.3, MSA-0.4 and MSA-0.5 subzones and MSA-1 zone). Therefore, further analysis of additional data is needed to elucidate the distribution of these species in late Aptian–Albian strata of the Riachuelo Formation.

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