

BIOSTRATIGRAPHIC AND PALEOZOOGEOGRAPHIC REVIEW OF THE UPPER APTIAN-ALBIAN OSTRACODS OF RIACHUELO FORMATION, SERGIPE- ALAGOAS BASIN, NORTHEASTERN BRAZIL

LUCAS SILVEIRA ANTONIETTO, DERMEVAL APARECIDO DO CARMO

Laboratory of Micropaleontology, Institute of Geosciences, University of Brasilia, Darcy Ribeiro Campus, 70919-970,
Brasilia, DF, Brazil. antoniettols@gmail.com

MARTA CLAUDIA VIVIERS

PETROBRAS-CENPES/DIVEX, Cidade Universitária, Quadra 7, Ilha do Fundão, 21949-900, Rio de Janeiro, RJ, Brazil.
mcviviers@petrobras.com.br

RODRIGO RODRIGUES ADÔRNO

Serviço Geológico do Brasil, DEGEO/DIPALE-CPRM/REPO, Avenida Lauro Sodré, 2561, CEP. 76801-58, Porto Velho,
Rondônia, Brazil. rodrigo.adorno@cprm.gov.br

ABSTRACT – A biostratigraphic and paleozoogeographic revision of upper Aptian-Albian ostracods of the Riachuelo Formation, in the Sergipe-Alagoas Basin, Brazil, was conducted. The studied material comprised 336 samples from several outcrops, along with well cores drilled by Petróleo Brasileiro S.A. (PETROBRAS). After taxonomic analysis, including the description of *Reticulocosta edrianae* n. sp., a new biozonation scheme was obtained for the Albian interval of that formation, and the paleozoogeographic affinities of the Brazil-Central West Africa province were reviewed through comparison with results published in the current literature. Several changes were made to the previously established ostracod zones. A new code for the *Aracajuia benderi* Zone (OSE-1), MSA-0, was created, with impact in all of its subzones. The names of the *Pattersoncypris* ex. gr. *angulata* (OSE-1.1), ‘*Patellacythere*’ sp. GA E 27 (OSE-1.3) and *Veenia guianensis* (OSE-1.4) subzones were changed to *Harbinia sinuata*? (MSA-0.1), *Praebythoceratina amsittenensis* (MSA-0.3) and *Reticulocosta edrianae* (MSA-0.4), respectively. The *Sergipella viviersae* Subzone (OSE-1.2) had its code changed for MSA-0.2; also, a stratotype was established for it, and its lower limit repositioned in time (from early Albian to upper Aptian). The *Metacytheropteron* aff. *Metacytheropteron* sp. GA C 24 Subzone (OSE-1.5) was renamed MSA-0.5. The uppermost Albian *Aracajuia antiqua* Latest Occurrence Interval Zone (MSA-1) is herein proposed, following the reclassification of specimens of the Subzone *Aracajuia benderi* (OSE-1.6) from this species to *Aracajuia antiqua*. Paleozoogeographic analyses showed some faunal interchange with Tethyan provinces, beginning in the early Albian, at both specific and generic levels. Limited northward marine influxes across the Walvis Ridge were also observed during this age, while larger scale southward migrations occurred in the early Cenomanian. The presence of Brachycytherinae species in the Brazil-Central West Africa province as early as the Aptian indicates a new zoogeographic origin for this subfamily, while explaining the occurrence of the group in both the Austral realm and part of the Tethyan realm during the Albian.

Key words: Early Cretaceous, South Proto-Atlantic Ocean, marine ostracods, MSA-1 Zone, province interchange.

RESUMO – Uma revisão bioestratigráfica e paleozoogeográfica dos ostracodes do Aptiano superior-Albiano da Formação Riachuelo, bacia de Sergipe-Alagoas, Brasil, foi proposto no presente trabalho. O material estudado compreendeu 336 amostras de vários afloramentos, juntamente com testemunhos de poços perfurados pela Petróleo Brasileiro S.A. (PETROBRAS). Após a análise taxonômica, incluindo a descrição de *Reticulocosta edrianae* sp. nov., um novo zoneamento bioestratigráfico foi obtido para a formação, e as afinidades paleozoogeográficas da província Brasil-África Central Ocidental (incluindo a bacia de Sergipe-Alagoas) foram revistas por meio da comparação com resultados publicados na literatura existente. Várias mudanças foram feitas nas biozonas previamente estabelecidas com base em ostracodes. O código da Zona *Aracajuia benderi* (OSE-1) foi alterado para MSA-0. As subzonas *Pattersoncypris* ex. gr. *angulata*, (OSE-1.1) ‘*Patellacythere*’ sp. GA E 27 (OSE-1.3) e *Veenia guianensis* (OSE-1.4) tiveram seus nomes e espécies guia alterados respectivamente para *Harbinia sinuata* (MSA-0.1), *Praebythoceratina amsittenensis* (MSA-0.3) e *Reticulocosta edrianae* (MSA-0.4), respectivamente. A subzona *Sergipella viviersae* (OSE-1.2) teve seu código alterado para MAS-0.2, e um novo estratótipo foi proposto para a mesma. A Subzona *Metacytheropteron* aff. *Metacytheropteron* sp. GA C 24 (OSE-1.5) foi renomeada como MSA-0.5. A Zona Diferencial Superior *Aracajuia antiqua* (MSA-1), do Albiano terminal, é aqui proposta, uma vez que espécimes tidos como fósseis guia para a Subzona *Aracajuia benderi* (OSE-1.6) são aqui identificados como pertencendo à espécie *Aracajuia antiqua*. Análises paleozoogeográficas evidenciaram intercâmbio de

faunas da Província Brasil-África Central Ocidental com províncias Tetianas a partir do Albiano, tanto em nível de espécie quanto de gênero. Influxos marinhos limitados para o norte através da Cordilheira de Walvis também foram observados durante esta idade, enquanto migração de maior intensidade em direção ao sul ocorreu no Eocenomaniano. A presença de espécies de Brachycytherinae na Província Brasil-Central África Ocidental a partir do Aptiano indica uma nova origem zoogeográfica para esta subfamília, ao mesmo tempo em que explica a ocorrência do grupo tanto em regiões austrais quanto tetianas durante o Albiano.

Palavras-chave: Eocretáceo, Proto-Oceano Atlântico Sul, ostracodes marinhos, Zona MSA-1, intercâmbio faunístico.

INTRODUCTION

The present work is a biostratigraphic and paleozoogeographic revision of the upper Aptian-Albian ostracods of the Riachuelo Formation, in the Sergipe-Alagoas Basin, northeastern Brazil. Its main objectives are to upgrade the biostratigraphic framework based on ostracods for the Albian of the basin and to re-evaluate the correlations between the ostracod biozones and those based on planktic and benthic foraminifera and cephalopods. At the same time, we also seek to determine the relationships between the “Brazil-Central West Africa” biological province proposed by Tambareau (1982) with its counterparts worldwide, through comparison with previous works addressing the same issue.

The Sergipe-Alagoas Basin is a marginal basin located in northeastern Brazil (9-11°30'S/37-35°30'W). Its onshore 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 to the northeast (Maragogi high) and the Jacuípe basin to the southwest (Itapuã fault) (Figure 1). It has been the subject of several studies, mainly due to the amount of data acquired from efforts such as well and outcrop sampling, investigations of seismic lines and gravimetric and magnetic surveys. Most of these studies have focused on the oil- and gas-producing strata of the basin, *i.e.*, the Carmópolis oil field (Late Jurassic-Aptian) and the Calumbi Formation (Santonian-Cenozoic) (Marques, 1965; Souza-Lima *et al.*, 2002; Campos Neto *et al.*, 2007; Graddi *et al.*, 2007).

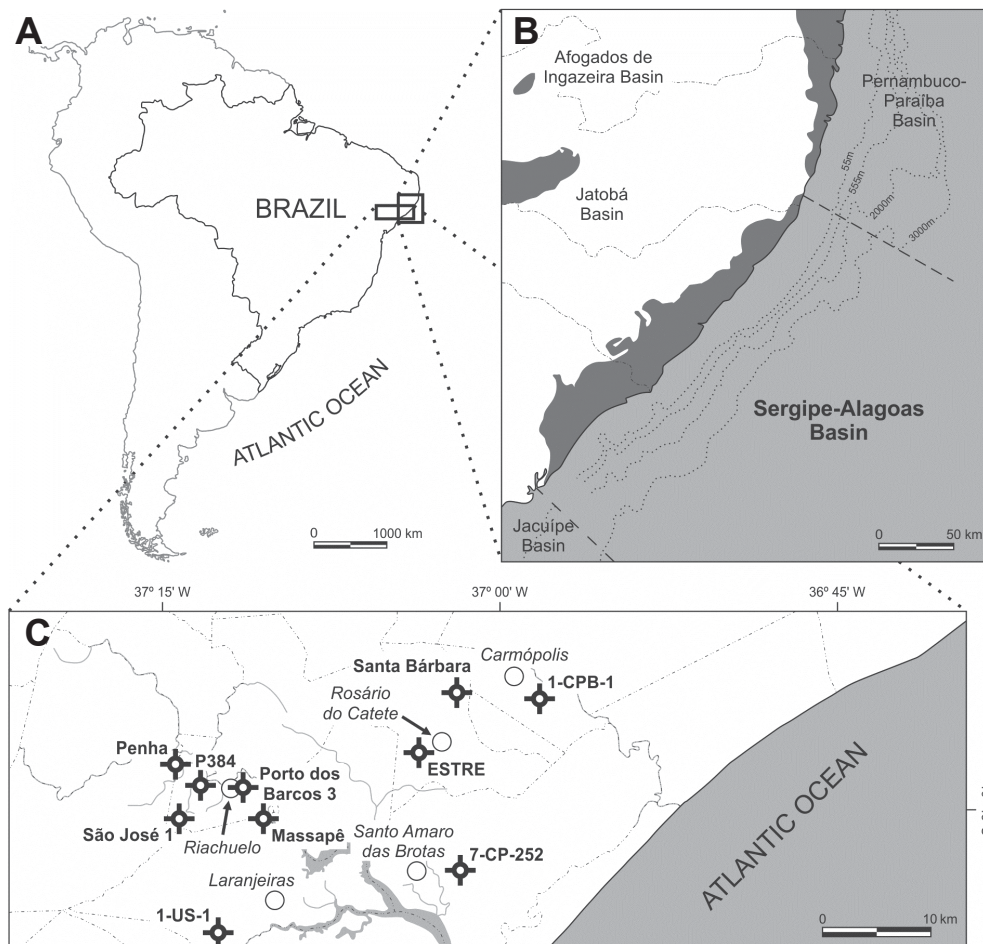
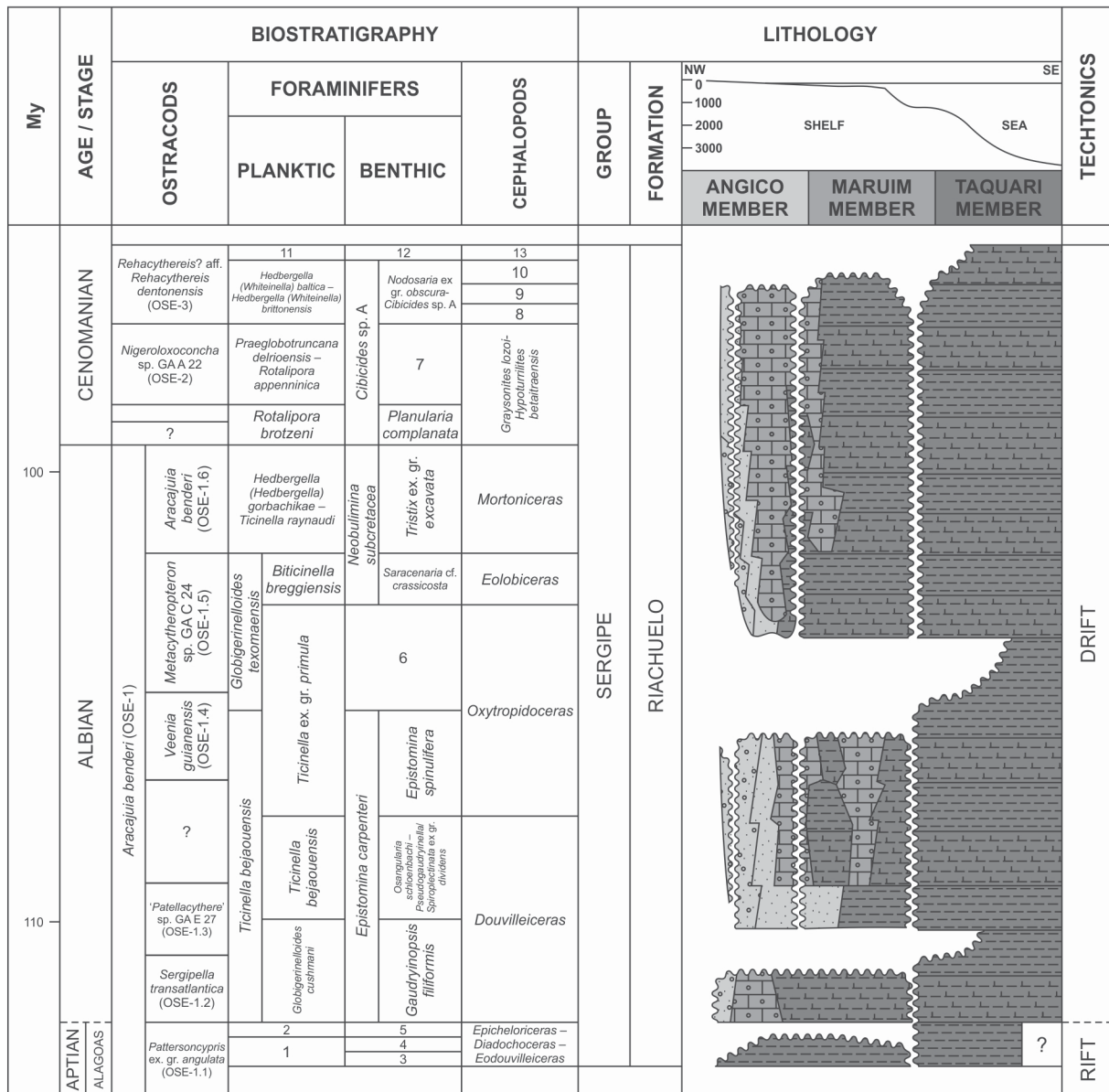


Figure 1. Location of the Sergipe-Alagoas Basin in South America (A) and Brazil (B), along with the outcrops and wells studied in the present work (C).

Since the first studies on ostracods from the Sergipe-Alagoas basin conducted in the 1960s (Krömmelbein, 1962, 1964), the Riachuelo Formation has been at the heart of important discoveries. Viviers *et al.* (2000) established the first ostracod-based biostratigraphy of the basin (Figure 2), integrating it with previous cephalopod and foraminifer data (Koutsoukos & Bengtson, 1993) and, in this process, identifying several new species in the aforementioned formation. Do Carmo *et al.* (2008, 2012), Propat & Colin (2012) and Antonietto *et al.* (2013) presented subsequent taxonomic updates of some species.

STUDY AREA

The Sergipe-Alagoas basin was originally described by Schaller (1969) as a single basin. However, a later stratigraphic revision by Feijó (1994) considered two separate basins, the Sergipe basin and the Alagoas Basin, separated by the Japoatã-Penedo high. Campos Neto *et al.* (2007) recently dismissed the Japoatã-Penedo high as a divisor between them, as it is not observable throughout the entire basin. It is noteworthy that the sedimentary deposits and tectonic style in the basin vary in the states of Sergipe



- 1- *Globigerinelloides barri* – *Hedbergella* (*Hedbergella*) *gorbachikae*
- 2- *Globigerinelloides* ex gr. *maridaliensis* – *Hedbergella* (*Hedbergella*) *similis*
- 3- *Lingulogavelinella ciryi* – *Lingulonodosaria nodosaria* – *Marginulina* ex gr. *aequivoca*
- 4- *Ammobaculites* cf. *coprolithiformis* – *Buccicrenata hedbergi* – *Haplophragmium luecke*
- 5- *Lenticulina* ex gr. *subangulata* – *Lenticulina* ex gr. *nodosa*
- 6- *Gavelinella berthelini* – *Gavelinella plummerae* – *Gavelinella reussi plexus* – *Gaudryinopsis* cf. *gradata*

- 7- *Lingulogavelinella* (?) cf. *thalmanniformis* – *Spiroculina cretacea*
- 8- *Acompsoceras spathi* – *Duvenganceras*
- 9- *Acanthoceras jukesbrowni* – *Eucalycoceras pentagonum*
- 10- *Pseudocalycoceras harpax* – *Thomelites* aff. *sornayi*
- 11- *Hedbergella* (*Whiteinella*) *aprica* – *Globigerinelloides bentonensis*
- 12- *Gabonita levis* – *Discammina* sp. A
- 13- *Euomphaloceras septemseriatum*

Figure 2. Biostratigraphy of the Albian and early Cenomanian sections of the Sergipe-Alagoas Basin, Brazil, based in ostracodes, foraminifers and cephalopods (modified from Koutsoukos & Bengtson, 1993; Viviers *et al.*, 2000).

and Alagoas, and they are therefore still considered to be separate sub-basins.

The basin consists of 23 formations, which are correlatable to the evolutionary stages of the formation and the expansion of the South Atlantic Ocean: syncline, pre-rift, rift, gulf and drift (Ponte & Asmus, 1976; Feijó, 1994). In the beginning of the drift phase, initially restricted marine deposits evolved into open sea environments. The early Albian-late Cenomanian Riachuelo Formation was established during this phase, due to a transgression that allowed the sedimentation of openly marine sediments. There are three members of this formation: at the basin margins and grabens, deltaic fans were formed, and the coarse sediments they carried constitute the Angico Member. In lower sedimentation areas, the Maruim Member dominates, with carbonate ramps and dolomitized oolite/oncolite banks deposited under fluctuating sea level conditions. The Taquari Member, on the other hand, corresponds to calcareous mudstone and shale from lagoonal and slope environments. Two third-order sequences are observed in the formation, which are characterized by a highly organic clay basal interval and retrogradational stacking and are interpreted as transgressive systems. A third sequence, with predominantly calcareous deposits and a progradational pattern, is interpreted as a highstand system (Campos Neto *et al.*, 2007).

Regional settings

The material studied in the present work comprised 147 samples collected from outcrops of the Riachuelo Formation, in the State of Sergipe, Brazil, plus 189 samples from cores drilled by Petróleo Brasileiro S.A. (PETROBRAS) (Figures 1, 3), totaling 336 samples (Table 1). The UTM quadrant reference for coordinates is 24L, in the SAD69 default system. The majority of the outcrops (ESTRE, Fazenda Santa Bárbara, Porto dos Barcos 3, Penha, São José 1 and P384) is composed of alternate strata of the Taquari and Angico members. The Maruim Member is only present in the upper part of the Massapê outcrop. No lithology or GPS coordinates were provided by PETROBRAS for wells 1-CPB-1, 7-CP-252 and

1-US-1; however, these wells were previously illustrated in maps by Viviers *et al.* (2000).

Point ESTRE (713561 N, 8816808 E) in the Municipality of Rosário do Catete begins with marly mudstones that are rich in phytofossils, followed by interbedded carbonate/clay levels. Bioturbated creamy shales with abundant impregnations and fossil-rich siliceous concretions on the top make up the next strata. Immediately above it lie creamy-to-gray carbonate mudstones that are abundant in phytofossils, especially from angiosperms. In the same municipality, the Fazenda Santa Bárbara outcrop occurs (716635 N, 8821887 E), which is considered to be the type section of the Taquari Member of the Riachuelo Formation (Schaller, 1969). The analyzed section comprises reddish calciferous mudstones, with a fossil record consisting of gastropod shells (Family Turritellidae Loven, 1847) as well as possible brachiopods.

The Porto dos Barcos 3 location is situated in the municipality of Riachuelo (699059 N, 8814030 E). From the base to the top, this slightly saprolitic sequence shows levels of creamy calcareous siltstone, followed by alternating creamy and gray calciferous siltstones. Upward, there is a layer of gray-to-yellowish mudstones that become very fossiliferous near the top. Over this mudstone, creamy calciferous siltstones are observed, and the outcrop ends with creamy micaceous mudstones. The fossil record of the outcrop includes echinoderm spines, gastropods and bivalves. Point Penha (692726 N, 8812604 W), also located in Riachuelo, presents a sequence of yellow, calcareous fine sandstones with levels of brachiopod-coquina and sparse phytofossils at its base. This sequence is followed by gray calciferous shales, laminated calcareous siltstones and laminated fine sandstones. Abundant occurrences of bivalves and echinoids are also recorded in these strata.

In the same municipality, the São José 1 outcrop (693824 N, 8811279 W) presents the most complex lithology among the sampled sites. Basal siltstones with calcareous impregnations are superposed with yellow silty fine sandstones and calciferous yellow siltstones with limestone levels. After a non-observable interval, massive yellow sandstones are recorded, followed

Table 1. Sampled depths analyzed by well in the present work.

Well	Sampled depth (m)
1-CPB-1	198, 222, 345.5, 348, 348.5, 35, 354.5, 355.5, 356.5, 358.5, 359.5, 360.5, 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, 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, 581.35

by limestones with abundant bivalves, cephalopods and bioturbations. Towards the top, marl levels with varying amounts of limestone occur, and above them, there are very fossiliferous solid limestones, immediately under a non-rhythmic intercalation of creamy laminated siltstone marls and mudstones, rich in turrilid gastropods. The section ends with the deposition of creamy-to-yellowish, medium-to-thinly laminated calcareous sandstones, with many phytofossils.

Locality P384 (695625 N, 8814175 E), also in Riachuelo Formation, comprises, from the base to the top, creamy calciferous laminated mudstones with bioturbation levels, rich in brachiopods, bivalves and phytoclasts; interbedded yellowish calciferous siltstones and creamy sandstones; and creamy calciferous laminated mudstones. The whole section is abundant in turrilid shells. Point Massapê (700764 N, 881233 L), located at the homonymous village in Riachuelo, is the only section addressed in the present work identified as part of the Maruim Member. The lithology of this extensive outcrop begins with yellow-creamy laminated calciferous and micaceous siltstones. Over these siltstones, fine-to-very fine yellowish calciferous/micaceous sandstones occur. These are followed by (in this order) intercalations of yellow-to-creamy siltstones and mudstones; gray greywacke with dark impregnations; and, finally, interposed levels of oolitic calcarenites and yellow sandstones with smoky quartz grains, sparse ooids and bioturbations.

MATERIAL AND METHODS

One hundred forty-seven samples collected during fieldwork were listed, prepared and packaged according to the methodology developed by the Laboratory of Micropaleontology of the University of Brasilia (LabMicro-UnB), Brazil. Sixty grams of each sample was prepared, and the remainder was packed in double plastic bags with catalogue-record sheets. The sample contents separated for preparation were treated as follows: first, they were treated with a solution containing 30% hydrogen peroxide (H_2O_2), with the aim of fragmenting rock particles. Ethanol at 92 GL was added to interrupt this reaction, after which separation of grains by size was performed, 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.

The carapaces and valves of several species were studied at LabMicro-UnB and the Smithsonian National Museum of Natural History (NMNH), Washington D.C., United States. The analysis of the additional 189 previously processed samples from PETROBRAS was conducted at the “Centro de Pesquisas Leopoldo Américo Miguez de Mello” (CENPES), Rio de Janeiro, Brazil. After taxonomic analysis of the ostracods present in the samples, a new biozonation scheme for the Albian of the Sergipe-Alagoas Basin was obtained. The ostracods were also used to revise the paleozoogeographic affinities of the Sergipe-Alagoas basin with other basins during the Albian-early Cenomanian through comparison with previous results from the current literature on this topic.

RESULTS AND DISCUSSION

The revision of the ostracod biostratigraphy of the Riachuelo Formation’s Albian strata demonstrates the necessity of the present changes in range and nomenclature of the zones and subzones established by Viviers *et al.* (2000). New information was added to the Aptian-Albian ostracod zones, in order to improve application and resolution of the analyzed units. In accordance to the “Código Brasileiro de Nomenclatura Estratigráfica” (Murphy & Salvador, 1999), a new code name for these units, “MSA” (“Marinho de Sergipe-Alagoas”), was established in substitution for the original “OSE”. A new interval zone was also formalized in the uppermost Albian of the Riachuelo Formation.

Some specimens identified as *Veenia guianensis* by Viviers *et al.* (2000) were guide fossils to one of the subzones of the Albian of the Riachuelo Formation. However, they belong in fact to an entirely new species, *Reticulocosta edrianae* n. sp., which is herein described. A paleozoogeographic revision is also performed in this work, expanding on the correlations with paleozoogeographic provinces in the northern and southern regions along the Proto-Atlantic Ocean.

Systematic paleontology

The suprafamiliar classification used here follows Liebau (2005), while the taxonomy of lower ranks was based on Gründel (1974). The morphological terminology is the same from 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). Type materials were housed at the research collection of the Museum of Geosciences, University of Brasilia (UnB), under the prefix CP (“Coleção de Pesquisa”).

Subclass OSTRACODA Latreille, 1802
 Superorder PODOCOPOMORPHA Kozur, 1972
 Order PODOCOPIDA Sars, 1866
 Suborder CYTHEROCOPINA Gründel, 1967
 Infraorder NOMOCYTHERININA Liebau, 1991
 Superfamily TRACHYLEBERIDOIDEA Sylvester-Bradley, 1948
 Family CYTHERETTIDAE Triebel, 1952
 Subfamily PALAEOCYTHERIDEINAE Ljubimova, 1955
 Tribe CYTHERETTINI Triebel, 1952

Reticulocosta Gründel, 1974

Type species. *Reticulocosta ornatoreticulata* Reymont, 1963, by subsequent designation of Gründel (1974).

Reticulocosta edrianae n. sp.
 (Figures 4A-L)

2000 *Veenia guianensis* Swain. Viviers, Koutsoukos, Silva-Telles Jr. & Bengtson, p. 413, fig. 22.10.

2000 *Veenia* sp. P1. Viviers, Koutsoukos, Silva-Telles Jr. & Bengtson, p. 410, figs. 23.3, 23.4.

Etymology. Latinized form of “Edriana”, first name of Edriana Araújo de Lima. The name of this species is a tribute to her.

Holotype. Female carapace (CP-716).

Alotype. Male carapace (CP-717).

Paratypes. Female carapace (CP-718), female carapace (CP-719), female left valve (CP-720) and male right valve (CP-768).

Type locality and stage. Riachuelo Formation, Sergipe-Alagoas Basin, Riachuelo Municipality, Sergipe State, Brazil, approximate coordinates: 699059N, 8814030L (UTM 24L quadrant, SAD69 geodesic reference system), Porto dos Barcos 3 outcrop, Sample MP-1461. middle Albian, *Aracajuia benderi* Zone (MSA-0), *Praebythoceratina amsittenensis* Subzone (MSA-0.3).

Diagnosis. A species of *Reticulocosta* distinguished by the following features: carapace ornamentation consisting of three highly acuminate ridges, quite varied in thickness, at dorsal, central and ventral position. Secondary ornamentation includes rounded to foveolate reticulation in several degrees of extension, but always present at the centro-anterior region.

Description. In lateral view, subtriangular to sub-rectangular carapace, with greatest height at the antero-central and greatest length at the central regions. Left valve is larger than the right, overlapping it through the entire free margin, but more intensely at the antero-dorsal, antero-ventral and postero-dorsal margins. Round anterior end, becoming slightly rectilinear close to the dorsal margin, where an obtuse cardinal angle is formed. Round, supra-curved posterior end, becoming slightly rectilinear close to the dorsal margin, where they form an obtuse cardinal angle; a small caudal process is present. Rectilinear to slightly concave dorsal margin. Rounded ventral margin, with a mild concavity at the oral region. Ornamentation consisting of three highly acuminate ridges, quite varied in thickness, at dorsal, central and ventral position: the generally smooth, curved dorsal one runs from the postero-dorsal to the antero-dorsal region, projecting behind the dorsal margin; the lightly posteriorly nodulate and undulate central one runs from the postero-central to the central region, where it connects to the reticulate centro-anterior tubercle; and the lightly posteriorly nodulate and curved ventral one runs from the postero-ventral to the antero-ventral region. Two riblets also occur, one originating from the eye tubercle and running along the anterior end, right below it, and the other, irregularly shaped, runs along the ventro-central area, partially covering the ventral margin. Additionally, a series of teeth radiates from the anterior and posterior ends. Secondary ornamentation includes rounded to foveolate reticulation in several degrees of extension, but always present at the centro-anterior region; Well-developed rounded eye tubercle. In dorsal view, elliptical, with greatest width at the centro-posterior region; a flat surface is formed between the anterior and posterior cardinal angles and the dorsal ridges. In internal

view, Paramphidont hinge, composed of an elliptical, four-lobed tooth in the right valve, followed by an anterior round socket, a smooth bar and a posterior, also four-lobed tooth; elements in the left valve are complementary. Well-developed inner lamella, not visible in the oral region, where the valve margin bends inwards expressively. Selva is not visible at the postero-ventral and postero-central regions. Central muscle scars group consisting of a slightly concave set of four adductor scars, the second from dorsum to venter subdivided in two, and two elliptical frontal scars. Strong sexual dimorphism: females are shorter and more oblong in dorsal view than males; thicker ridges and less reticulate ornamentation in females than males. Interspecific variation observed as follows: degree of reticulation in the carapace lateral surface varying from widespread to concentrate along its central region, and height/length ratios of the specimens resulting in sturdier or more elongate forms.

Dimensions. CP-716 (holotype), length 0.54 mm, height 0.33 mm, width 0.27 mm; CP-717 (alotype), length 0.57 mm, height 0.31 mm, width 0.26 mm; CP-718 (paratype), length 0.52 mm, 0.32 mm, width 0.29 mm; CP-719 (paratype), length 0.52 mm, height 0.31 mm, width 0.28 mm; CP-720 (paratype), length 0.55 mm, height 0.33 mm; CP-768 (paratype), length 0.56 mm, height 0.28 mm.

Occurrence. ESTRE outcrop, samples MP-1423 and MP-1424; Fazenda Santa Bárbara outcrop, samples MP-1419 and MP-1420; P384 outcrop, samples MP-1496, MP-1497, MP-1499, MP-1506 and MP-1509 to MP-1513; Porto dos Barcos 3 outcrop, samples MP-1460 to MP-1466, MP-1468 to MP-1472, MP-1474 to MP-1477, MP-1481 and MP-1482.

Remarks. *Reticulocosta edrianae* n. sp. is similar to *Reticulocosta tarfayensis* (Reyment, 1978), even presenting some degree of intraspecific variation on the reticulate ornamentation, like the latter (see Reyment, 1978; Andreu-Boussut, 1991; Majoran, 1991). Even so, the aforementioned species, plus *Reticulocosta vitiliginosa* (Apostolescu, 1961), differ from the present species by its overall lesser presence of reticulation and sharper ridges, when compared to them (see Apostolescu, 1961). In addition, *R. edrianae* n. sp. has its occurrence restricted to the Lower Cretaceous (Albian), while the others are Upper Cretaceous species (upper Cenomanian-Santonian).

Biostratigraphy

According to Viviers *et al.* (2000), the Albian Stage in the Sergipe-Alagoas basin originally comprised one zone, *Amphycytherura benderi*, or OSE-1, later renamed *Aracajuia benderi* by Antonietto *et al.* (2013). This zone was subdivided into six subzones from bottom to top: *Pattersoncypris* ex. gr. *angulate*, OSE-1.1; *Sergipella transatlantica*, OSE-1.2, renamed as *Sergipella viviersae* Do Carmo *et al.*, 2012 by Do Carmo *et al.* (2012); ‘*Patellacythere*’ sp. GA E 27, OSE-1.3; *Veenia guianensis* Swain, 1976, OSE-1.4; *Metacytheropteron* aff. *M.* sp. GA C 24, OSE-1.5; and *Amphycytherura benderi*, OSE-1.6 – also *Aracajuia benderi*, after Antonietto *et al.* (2013). Between subzones OSE-1.3 and OSE-1.4, there was an interval where no zonation based on ostracods could be established,

although a transition is observable in the planktic (ending of *Ticinella bejaouensis* Zone, *Ticinella bejaouensis* Subzone) and benthic (ending of *Epistomina carpenteri* Zone, *Osangularia schloenbachi-Pseudogaudryinella/Spiroplectinata* ex gr. *dividens* Subzone) foraminiferal faunas as well as between cephalopods (ending of *Douvilleicerias* Zone) (Figure 2).

At the present revision of the upper Aptian-Albian stratigraphy of the basin, several changes were made in previously established ostracod zones and subzones, based on the correlation of outcrops and wells analyzed (Figure 5). The OSE-1 Zone and its subzones, OSE-1.1, OSE-1.2, OSE-1.3 and OSE-1.4, are renamed and redescribed below, while OSE-1.5 had only its name changed (MSA-0.5). An entirely new zone, MSA-1, is created in the uppermost Albian of the Riachuelo Formation, substituting the form OSE-1.6 Subzone.

***Aracajuia benderi* Range Zone (MSA-0)**

Definition. Stratigraphic interval corresponding to the local range of *Aracajuia benderi* Krömmelbein, 1967.

Characterization. From the base to the top, the following subzones are recognized: the *Harbinia sinuata?* (Krömmelbein & Weber, 1971) (MSA-0.1), *Sergipella viviersae* (MSA-0.2), *Praebythoceratina amsittenensis* Andreu-Boussut, 1991 (MSA-0.3), *Reticulocosta edrianae* (MSA-0.4) and *Metacytheropteron* aff. *M.* sp. GA C 24 (MSA-0.5).

Stage. Upper Aptian-upper Albian.

Stratotype. 1-US-1 well, between depths of 690 and 1161m, Municipality of Laranjeiras, Sergipe State, Brazil.

Observations. A detailed discussion on the Zone MSA-0 (formerly OSE-1) can be found in Viviers *et al.* (2000). A stratotype, established in core sections of the 1-US-1 well, is also proposed for MSA-0 for the first time. Although the zone is not entirely represented in this well (it lacks MSA-0.1, MSA-0.3 and MSA-0.4 subzones), this is the most complete section of MSA-0 so far analyzed.

***Harbinia sinuata?* Range Subzone (MSA-0.1)**

Definition. Stratigraphic interval corresponding to the local range of *Harbinia sinuata?*

Characterization. Interval containing a characteristic association of *Harbinia sinuata?*, *Aracajuia benderi*, *Sergipella viviersae* and *Dicrorygma?* sp. 1.

Stratotype. 7-CP-252 well, between depths of 478.45 and 484.4m, Municipality of Santo Amaro das Brotas, Sergipe State, Brazil.

Stage. Upper Aptian.

Observations. A detailed discussion on the MSA-0.1 Subzone (formerly OSE-1.1) can be found in Viviers *et al.* (2000). This subzone was established using *Pattersonocypris* ex. gr. *angulata* (Krömmelbein & Weber, 1971) as its fossil guide. However, *Harbinia sinuata?* (Krömmelbein & Weber, 1971) is more abundant in the studied samples (including the reviewed well material), which justifies its preference as a marker for the interval. A stratotype is also proposed for the subzone for the first time. Additionally, several species from Viviers *et al.* (2000), such as *Ovocytheridea?* aff. *Ovocytheridea?* sp. GA D 6, *Pattersonocypris* ex. gr. *angulata*, *Conchoecia?* sp. Se1 were not observed in the present study.

***Sergipella viviersae* Latest Occurrence Interval Subzone (MSA-0.2)**

Definition. Lower and upper boundaries of the subzone defined by the last occurrences of *Harbinia sinuata?* and *Sergipella viviersae*, respectively.

Characterization. Other species observed in this zone include *Cytherella besrinensis* (Bischoff, 1964), *Cytherelloidea btaterensis* Bischoff, 1964, *Bairdoppilata pseudoseptentrionalis* Mertens, 1956, *Cetacella* sp. 1, *Paracypris eniotmetos* Nicolaidis & Piovesan, 2013, *Harbinia crepata* Do Carmo *et al.*, 2013, *Liasina* sp. 1, *Praebythoceratina amsittenensis*, *Praebythoceratina* sp. 1, *Praebythoceratina reducta* (Gründel, 1964), *Patellacythere shimonensis* (Rosenfeld & Raab, 1983), *Xestoleberis?* sp. 1, *Xestoleberis?* sp. 2, *Dico*, *Aracajuia antiqua* (Rosenfeld & Raab, 1983), *Aracajuia benderi*, *Eocytheropteron* sp. 1, *Metacytheropteron* aff. *M.* sp. GA C 24 and *Metacytheropteron minuta?* (Swain, 1976).

Stratotype. 1-CPB-1 well, between depths of 348 and 354.5 m, Municipality of Carmópolis, Sergipe State, Brazil.

Stage. Uppermost Aptian-lowermost Albian.

Observations. A detailed discussion on the MSA-0.2 Subzone (formerly OSE-1.2) can be found in Viviers *et al.* (2000). The present work formalizes the taxonomic changes made to this subzone by Do Carmo *et al.* (2012), while proposing a stratotype for it. Originally, this subzone was restricted to the Taquari Member; however, present data show it also occurs in the Angico Member. The occurrence of *Harbinia crepata*, a characteristic species of the Aptian of Brazil (Do Carmo *et al.*, 2013), at the lowest portion of MSA-0.2, associated with other Aptian species (*Cytherella besrineensis*, *Cytherelloidea btaterensis*, *Patellacythere shimonensis* and *Aracajuia benderi*) led to repositioning the lower limit of this subzone from the lower Albian to the uppermost Aptian. *Conchoecia?* sp. Se1 was not observed in the present work.

***Praebythoceratina amsittenensis* Latest Occurrence Interval Subzone (MSA-0.3)**

Definition. Lower and upper boundaries of the subzone defined by the last occurrences of *Sergipella viviersae* and *Praebythoceratina amsittenensis*, respectively.

Characterization. The ostracod assemblage of the subzone also comprises *Cytherella besrinensis*, *Cytherelloidea btaterensis*, *Bairdoppilata pseudoseptentrionalis*, *Robsoniella falklandensis* Dingle, 1984, *Paracypris eniotmetos*, *Praebythoceratina amsittenensis*, *Patellacythere parva?* Weaver, 1982, *Xestoleberis?* sp. 2, *Apatocythere?* sp. 1, *Dicrorygma?* sp. 1, *Neocythere tenuis*, *Aracajuia benderi*, *Microceratina azazolensis* Andreu & Colin, 2005, *Microceratina?* sp. 1, *Reticulocosta edrianae*, *Algeriana?* sp. 1 and *Quasihermanites?* sp. 1. Among species from Viviers *et al.* (2000) not observed in the MSA-0.3 Zone in the present revision are *Cytherella* sp. Se4, *Liasina* sp. 1, *Venia guianensis* (Swain, 1976), *Sergipella* aff. *S. transatlantica* Krömmelbein, 1967, *Cetacella* aff. *C.* sp. GA D 24 and *Metacytheropteron* aff. *M.* sp. GA C 24.

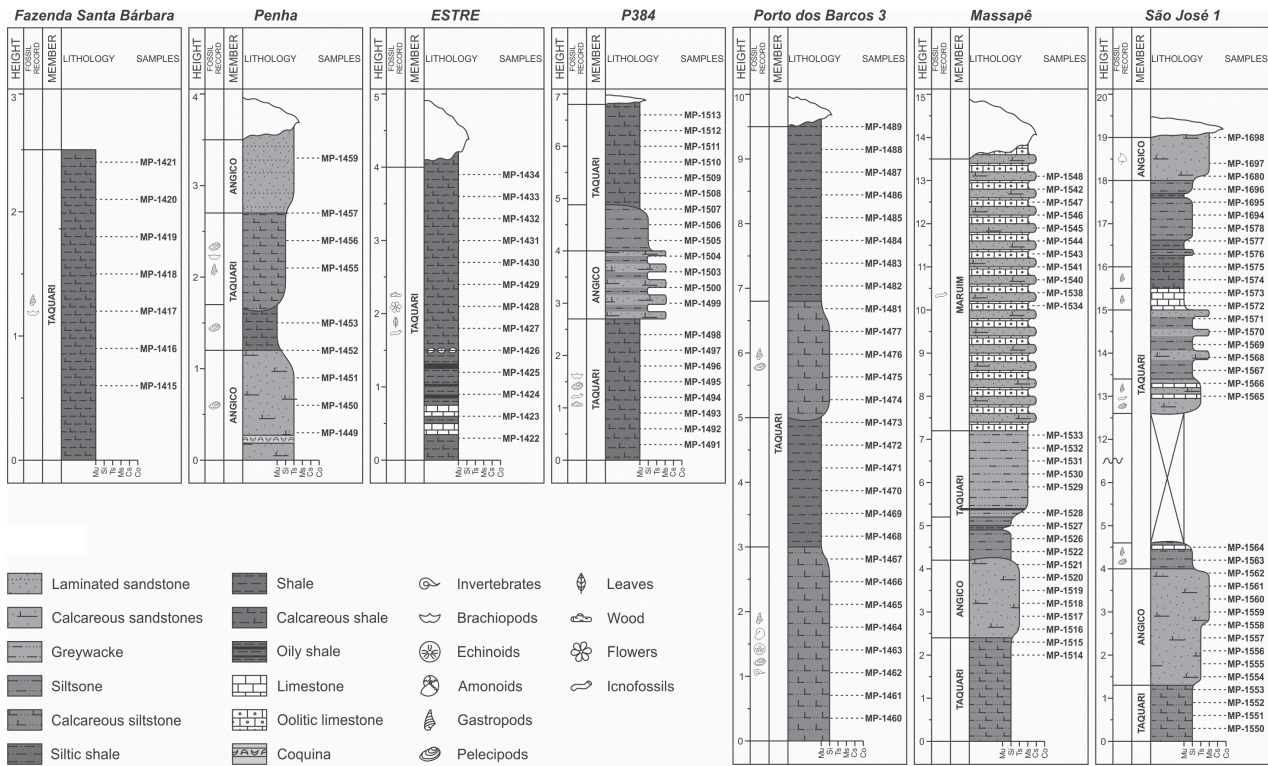


Figure 3. Lithology of sampled Riachuelo Formation outcrops in the Sergipe-Alagoas basin, Brazil. The samples are numbered from MP-1421 to MP-1698. **Abbreviations:** MP, Micropaleontological collection of the “Museu de Geociências” of the “Universidade de Brasília”.

Stratotype. 1-CPB-1 well, between depths of 345.5 and 348 m, Municipality of Carmópolis, Sergipe State, Brazil.

Stage. Lower-middle Albian.

Observations. The species which originally named the MSA-0.3 (formerly OSE-1.3) subzone, ‘*Patellacythere*’ sp. GA E 27, was found to actually belong to a group of species in the Family Bythocytheridae Sars, 1926. The figured specimen in Viviers *et al.* (2000) was reclassified as *Patellacythere shimonensis*, a species restricted to MSA-0.2 subzone, and most of the material assigned to this species in fact belonged to another taxon, *Praebythoceratina amsittenensis*. This was particularly true for specimens occurring after the end of MSA-0.2. Therefore, *Praebythoceratina amsittenensis* is considered to be the true MSA-0.3 marker. A detailed discussion on this subzone can be found in Viviers *et al.* (2000). The MSA-0.3 subzone was originally restricted to the Angico Member of the Riachuelo Formation; its occurrence is herein expanded to the Taquari Member. Species not observed in the present work include *Cytherella* sp. Se4, *Liasina* sp. 1, *Veenia guianensis*, *Sergipella* aff. *S. transatlantica*, *Cetacella* aff. *C. sp. G D 24* and *Metacytheropteron* aff. *M. sp. GA C 24*.

***Reticulocosta edrianae* Latest Occurrence Interval Subzone (MSA-0.4)**

Definition. Lower and upper boundaries of the subzone defined by the last occurrences of *Praebythoceratina amsittenensis* and *Reticulocosta edrianae*, respectively.

Characterization. This subzone fauna also includes *Cytherella icknieldensis?*, *Paracypris eniotmetos*, *Neocythere tenuis*, *Aracajuia benderi* and *Aracajuia fragilis* (Piovesan & Nicolaidis, 2013).

Stratotype. Porto dos Barcos 3 outcrop (699059 N, 8814030 E, 24L UTM quadrant reference, SAD69 default system), between 6.7 and 7m high from the outcrop base, Municipality of Riachuelo, Sergipe State, Brazil.

Stage. Middle Albian.

Observations. The specimens identified by Viviers *et al.* (2000) as *Veenia guianensis*, the fossil guide for MSA-0.4 (formerly OSE-1.4), belong to *Reticulocosta edrianae* leading to the renaming of this subzone. Nevertheless, *Veenia guianensis* was also found in the present material, though not associated with *R. edrianae*. Between subzones MSA-0.3 and MSA-0.4, Viviers *et al.* (2000) observed an absence of any clear biozone marking species, and the interval between these subzones was left open for biozonation. The present work established the contact between the two zones, although it was not possible to determine when in time it occurred. Therefore, the authors chose to maintain along the top limits of MSA-0.3, *Ticinella bejaouaensis* Zone (A12) of planktic foraminifera and *Douvilleiceras* Zone of ammonites. A detailed discussion on this subzone can be found in Viviers *et al.* (2000). Originally, there was no information about which members of the Riachuelo Formation MSA-0.4 was present at; therefore, according to our results, it is restricted to the Angico and Taquari members. *Ovocytheridea?* sp. Se1 was not observed in the present study.

***Aracajuia antiqua* Latest Occurrence Interval Zone (MSA-1)**

Definition. Lower boundary of the zone defined by the last occurrences of *Aracajuia benderi* and *Metacytheropteron* aff. *M. sp. GA C 24*, while the upper boundary is defined by the last occurrence of *Aracajuia antiqua*.

Characterization. The MSA-1 Zone spans areas nearby the Massapê outcrop and the 1-US-1 well, between the towns of Riachuelo and Laranjeiras, Sergipe State, Brazil. It is observable in Massapê in all members of the Riachuelo Formation. Its thickness varies between 11 (Massapê outcrop) and almost 300m (1-US-1 well). Other taxa present in this zone include *Cytherella besrinensis*, *Cytherelloidea btaterensis*, *Bairdoppilata comanchensis* (Alexander, 1929), *Bairdoppilata* sp. 1, *Bairdoppilata* sp. 2, *Cetacella* sp. 1, *Paracypris eniotmetos*, *Xestoleberis?* sp. 1, *Dicrorygma?* sp. 1, *Neocythere pseudovanveeni* (Gründel, 1966), *Eocytheropteron?* sp. 1, *Microceratina azazoulensis*, *Veenia guianensis* and *Brachycythere* sp. 1.

Stratotype. 1-US-1 well, between depths of 480 and 681 m, Municipality of Laranjeiras, Sergipe State, Brazil.

Stage. Uppermost Albian.

Observations. Specimens previously considered to be *Aracajuia benderi* in the OSE-1.6 Subzone, at the top of MSA-

0 Zone (Viviers *et al.*, 2000), were reclassified as *Aracajuia antiqua*, creating an entirely new zone in the latest Albian of the Riachuelo Formation, the *Aracajuia antiqua* Latest Occurrence Interval Zone, after its guiding species, and coded as MSA-1. Although its lower limit is established based in two species, *Aracajuia benderi* and *Metacytheropteron* aff. *M. sp. GA C 24*, these two disappear from the fossil record within a slightly different interval between them. Viviers *et al.* (2000) did not discuss the distribution of this zone along the Riachuelo Formation; according to present results, it is observable at all members of that formation.

Paleozoogeography

Original attempts to establish relationships based on the composition of taxa between the upper Aptian-Albian ostracodefaunas of the Riachuelo Formation and coeval lithologic units from western Africa indicated great similarity between the latter units and the Madiéla Formation in the Gabon basin, Gabon (Krömmelbein, 1966, 1975; Krömmelbein & Wenger, 1966; Bertels, 1977; Grosdidier, 1979; Koutsoukos & Silva-Telles Jr., 1993). Tambareau (1982) even suggested the existence of a “Central Brazil-West Africa” biological province. This correlation was later expanded by Koutsoukos & Dias-

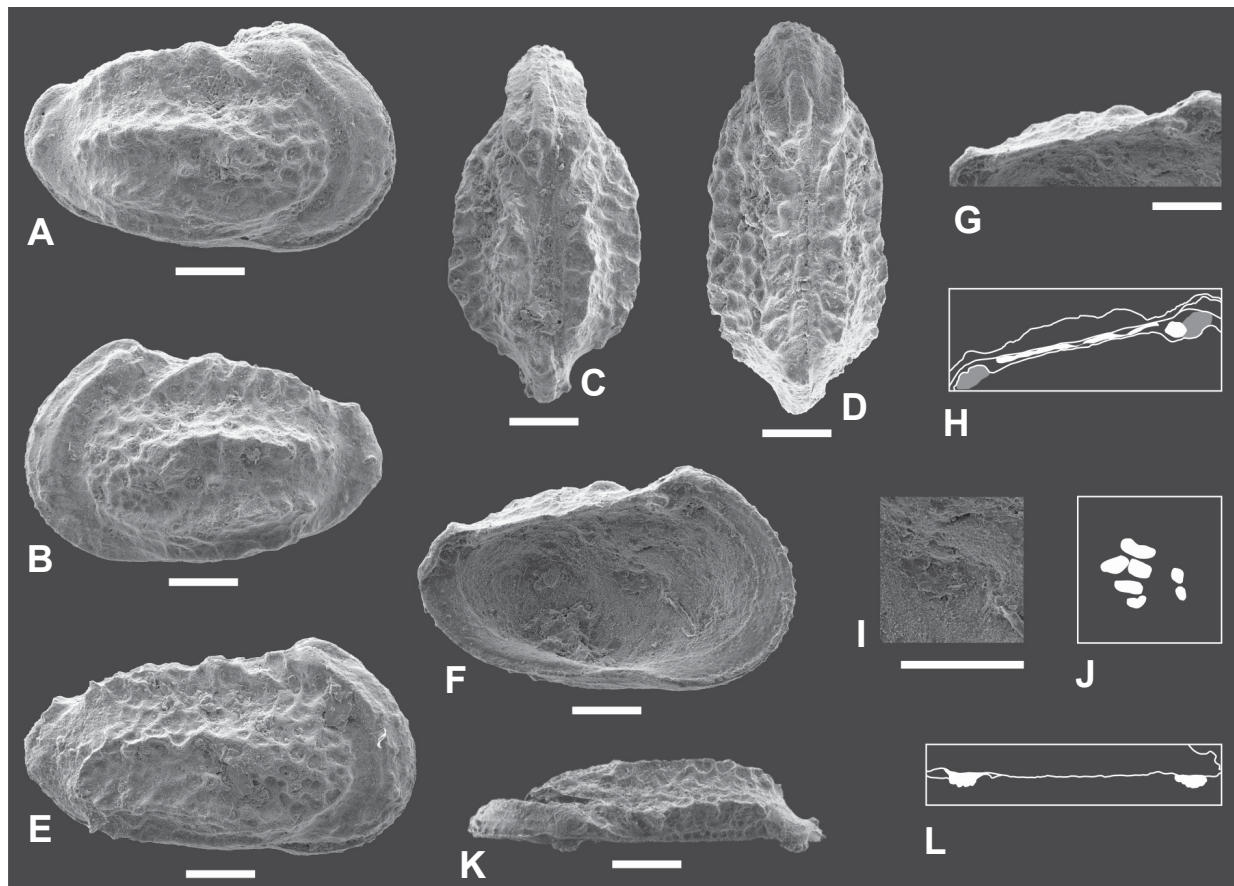


Figure 4. *Reticulocosta edrianae* n. sp., Riachuelo Formation, Sergipe-Alagoas Basin, Middle Albian, Brazil. **A**, CP-716, holotype, female carapace, right lateral view. **B**, CP-718, paratype, female carapace, left lateral view. **C**, CP-719, paratype, female carapace, dorsal view. **D, E**, CP-717, alotype, male carapace; **D**, dorsal view; **E**, right lateral view. **F-J**, CP-720, paratype, female left valve; **F**, internal view; **G**, detail of the hinge line; **H**, interpretation of the hinge line structures; **I**, detail of the central and anterior muscle scars; **J**, interpretation of the central and anterior muscle scars. **K, L**, CP-768, paratype, male right valve; **K**, dorsal view; **L**, interpretation of the hinge line structures. Scale bars = 100 µm.

Britto (1987) and Piovesan *et al.* (2013), who observed the co-occurrence of ostracod species and genera of the Riachuelo Formation in other Brazilian shore units, such as the northeasternmost Potiguar and the southeastern Campos and Santos basins.

Dias-Brito (2000), based on the occurrence of pithonellids (calcspheres), established the notion of the “Megatethys”, or the “Mid Cretaceous Tethyan Realm”. According to this concept, the global distribution of pithonellids defined a realm occupying both hemispheres, approximately between latitudes 40°N and 40°S, in the Albian-Turonian time interval. This Megatethys Ocean reached its maximum extension in the late Albian, when warm water reached temperate regions and initially tropical organisms made brief incursions into high-latitude areas. The southern limit of this Tethyan arm was coincident with the Walvis Ridge, an effective topographic barrier at that time.

The first evidence of faunal similarity between the Riachuelo Formation and strata outside of the central South Atlantic Ocean was provided by Colin & Andreu (1990), who were working with halocypridid ostracods. These authors found the formations in eastern Brazil and western Africa to be strongly correlated with those from the North Atlantic Ocean, from areas such as the Agadir basin in Morocco, southern England (Kaye, 1965), the Jura Mountains in

Switzerland (Charollais *et al.*, 1977), the Persian Gulf and Israel (Rosenfeld & Raab, 1983). This observation was partly confirmed by Piovesan *et al.* (2013), following a review by Andreu (2002), who identified some genera distributed along the Brazilian coast (including the Sergipe-Alagoas Basin) and lithologic units in Morocco.

Reyment (1980) and Dingle (1999) studied the role of the proto-Walvis ridge as a geographical barrier between the central and southernmost Atlantic ostracodefaunas during the Berriasian-Santonian. After a taxonomic study of several Cretaceous stages of the Sergipe-Alagoas Basin, Viviers *et al.* (2000) summarized the relationships of the Riachuelo Formation with strata in several Early-Late Cretaceous realms along the Proto-Atlantic Ocean. These correlations were made based in part on the chronologic and geographic distributions of the ostracod genera *Conchoecia* Dana, 1849, *Amphicytherura* Butler & Jones, 1957 and *Venia* Butler & Jones, 1957. A significant faunal renewal was recorded approximately in the middle Cenomanian, with the first appearance in the basin of genera such as *Brachycythere* Alexander, 1933 and *Paracypris* Sars, 1866.

Present results corroborate previous assumptions herein summarized about the paleogeography of the Riachuelo Formation ostracods, both at specific and generic levels. Although the majority of the species identified are

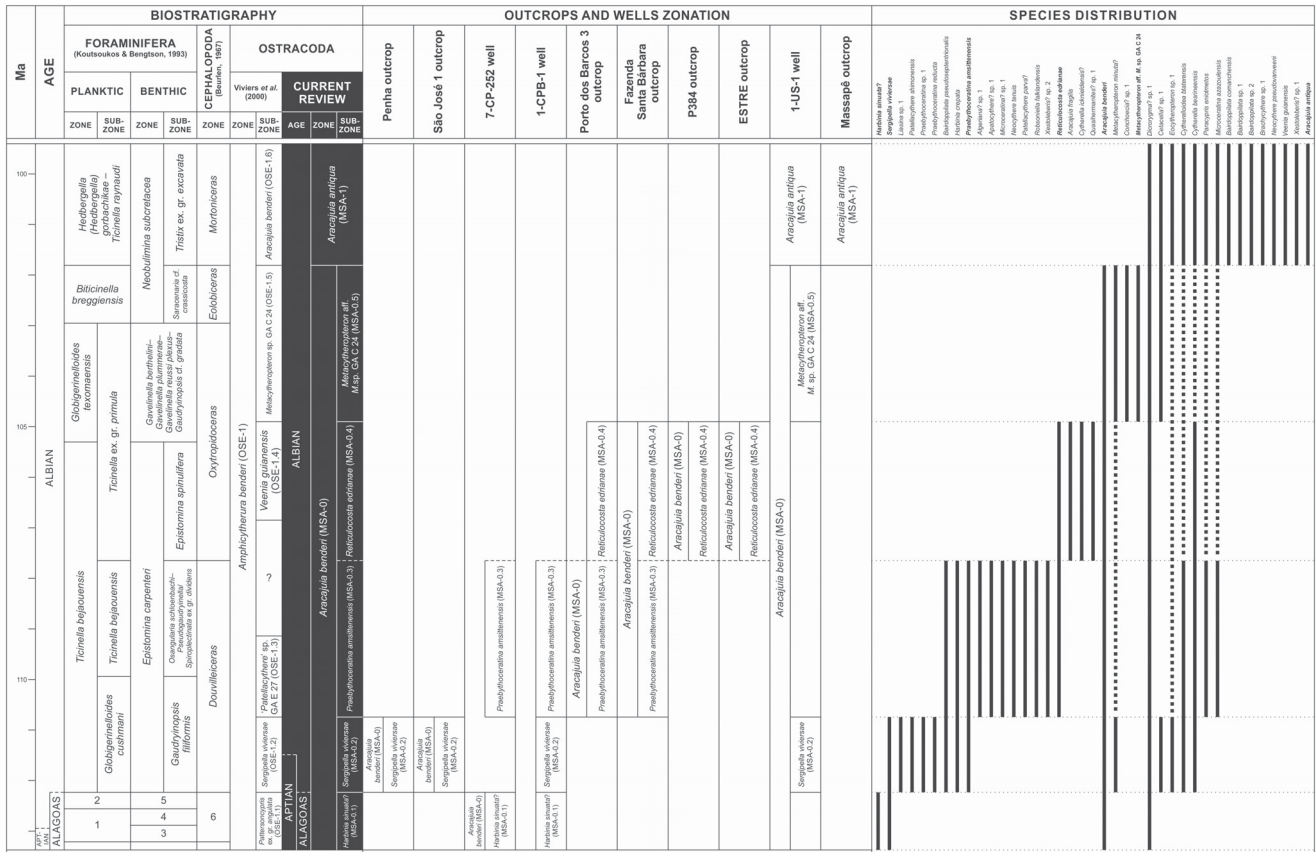


Figure 5. Reviewed ostracod biostratigraphy of the Sergipe-Alagoas basin, along with the temporal distribution of its late Aptian-Albian ostracod species. Names of species in bold indicate fossil guides to each biozone.

endemic to this province, some interchange is observed with Tethyan faunas beginning in the early Albian (Figure 6). Species such as *Veenia guianensis* and *Bairdoppilata comanchensis* are shared with North-Central American shores (*Veenia guianensis* is also found in Africa), while *Conchoecia?* sp. 1, *Cytherella besrinensis*, *Cytherelloidea btaterensis*, *Praebythoceratina amsittenensis*, *Patellacythere shimonensis* and *Aracajuia antiqua* appear in both Brazil-Central West Africa and the Levantine region in the Middle East (Israel and Lebanon). *Bairdoppilata pseudoseptentrionalis*, *Praebythoceratina reducta*, *Neocythere pseudovanveeni* and *Neocythere tenuis* co-occur in the Riachuelo Formation and some of the southern-to-western European basins in England, France and Germany. Two species shared with realms south of the Walvis Ridge, *Microceratina azazoulensis* and *Robsoniella falklandensis*, probably originated in Brazil-Central West Africa, where they surged in the middle Albian. These species reached the former regions during the Cenomanian.

The exchange of genera between the provinces appears to follow the same pattern observed at the specific level. Genera such as *Cytherella* Jones, 1849, *Cytherelloidea* Alexander, 1929, *Bairdoppilata* Coryell *et al.*, 1935, *Paracypris*, *Bythoceratina* Hornibrook, 1952 and *Patellacythere* Gründel & Kozur, 1971 are both geographically and chronologically cosmopolitan. However, some other genera present a more limited distribution, at least during the Early Cretaceous, and seem to indicate,

through their origins, greater paleozoogeographical proximity with the Tethysyan realm, such as *Dicrorygma* Poag, 1962 (see also Christensen, 1965), *Neocythere* Mertens, 1956, *Veenia* Butler & Jones, 1957, *Reticulocosta* Gründel, 1974, *Robsoniella* Kuznetsova, 1956 (see also Gramm & Kuznetsova, 1970) and *Microceratina* Swanson, 1980 (see also Colin *et al.*, 2005). *Sergipella* Krömmelbein, 1967 is the only endemic genus of the region, according to the occurrences summarized in Do Carmo *et al.* (2012).

The genus *Aracajuia* Krömmelbein, 1967 originated in the Austral province during the Berriasian, prior to becoming very common in this realm during the Hauterivian. However, this genus showed its peak diversity and abundance at the end of the Early Cretaceous (Barremian-Albian), along the shores of Brazil-Central West Africa and the South Mediterranean, extending to the Middle East (Antonietto *et al.*, 2013). According to Dingle (1999), limited northward marine influxes across the Walvis Ridge are postulated for the middle Aptian age, while large-scale southward migrations of marine ostracods from the northern sector occurred in early Cenomanian and/or Turonian times. This observation is confirmed by the occurrences of *Aracajuia* in the early-late Albian of the Sergipe-Alagoas Basin.

Brachycythere appeared to have originated during the Albian, somewhere close to the limits of the North American and African regions of the Tethysian realm (Colin & Babinot, 1996; Puckett, 2002), although occurrences in India (Austral realm) have also been reported for the same

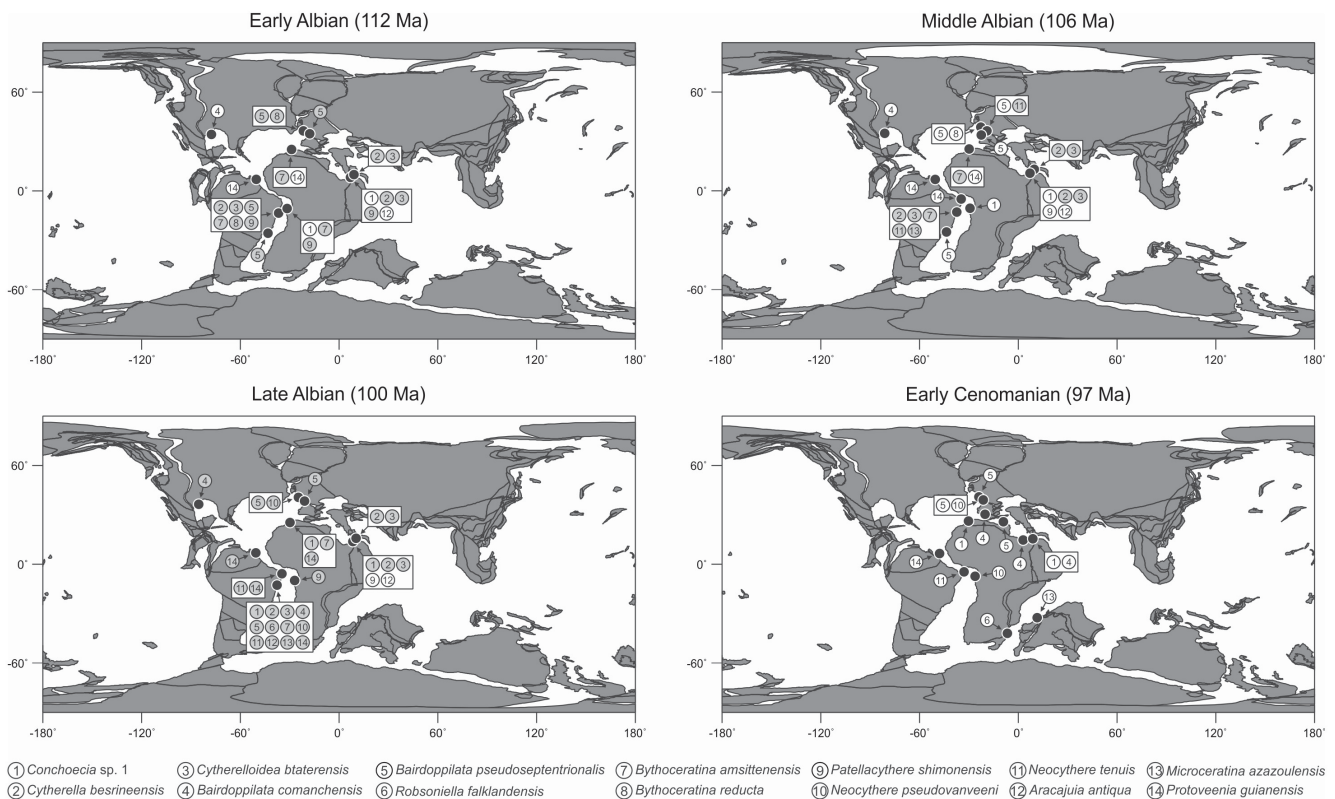


Figure 6. Paleozoogeography of species with occurrences in the Riachuelo Formation, Sergipe-Alagoas Basin, and coeval lithologies worldwide during the Albian and early Cenomanian. Paleomaps were adapted from ODSN (2011).

age (Andreu *et al.*, 2008). The presence of *Brachycythere* sp. 1 in the Brazil-Central West Africa province dates from the late Aptian (Grosdidier, 1979), much earlier than the previous earliest record for this region, *i.e.*, *Brachycythere sapucariensis* Krömmelbein, 1964 from the Cenomanian of several Brazilian and African basins (Viviers *et al.*, 2000). Therefore, it relocates the geographic origin of the Subfamily Brachycytherinae Puri, 1954 southwards, as it helps to explain the occurrence of the group in both the Austral realm and part of the Tethyan realm during the Albian.

CONCLUSIONS

The present revision of the ostracod biostratigraphy and paleozoogeography of the upper Aptian and Albian stages of the Riachuelo Formation resulted in the description of a new species, *Reticulocosta edrianae*. There were also changes in one previously established zone and its five subzones, along with the proposition of an entirely new zone, MSA-1, created in detriment of OSE-1.6 and based on *Aracajuia antiqua*. The Zone OSE-1, following the present stratigraphic revision, is renamed MSA-0. Its subzones currently being changed include formers OSE-1.1, now MSA-0.1 and defined by *Harbinia sinuata?*; OSE-1.2, renamed MSA-0.2 and with a newly designated stratotype; OSE-1.3, henceforth MSA-0.3 and marked by *Praebythoceratina amsittenensis*; OSE-1.4, now MSA-0.4, whose guide species was reclassified as *R. edrianae* n. sp., and its earlier limit was tentatively redefined as the end of OSE-1.3; and OSE-1.5, renamed MSA-0.5.

The present work also allowed a major expansion of the correlations with paleozoogeographic provinces along the Proto-Atlantic ocean. Although the majority of the species from the basin are endemic to the Brazil-Central West Africa province, some interchange is observed with Tethyan faunas, beginning in the early Albian, ranging from North-Central American shores to the Levantine region in the Middle East. Species shared with realms south of the Walvis ridge probably originated in Brazil-Central West Africa in the middle Albian and reached the former regions during the Cenomanian. The exchange of genera between the provinces appears to follow the same pattern observed at the specific level, except for the genus *Aracajuia*, which emigrated from the southernmost Proto-Atlantic during the Barremian, reaching the central Proto-Atlantic at the end of the Early Cretaceous. *Sergipella* is the only endemic genus of the region. The presence of Brachycytherine ostracods in Brazil-Central West Africa as early as the late Aptian relocates the geographic origin of this subfamily southwards, while also helping to explain the occurrences of the group in both the Austral realm and part of the Tethyan realm during the Albian.

ACKNOWLEDGEMENTS

The authors wish to thank the National Counsel of Technological and Scientific Development (CNPq), associated with the “Serviço de Compras Internacionais” of UnB, for the acquisition of our scanning electron microscope (SEM)

(Project no. 401.794/2010-5). We are also grateful to UnB for financial support to the visit to PETROBRAS. Thanks to CENPES for technical support with core sample slides (J.V. Queiroz Neto and J.L. Grillo) and SEM photography (R.S.M. Costa). Special thanks go to the “Agência Nacional do Petróleo, Gás Natural e Biocombustíveis”, PETROBRAS and the “Fundação de Empreendimentos Científicos e Tecnológicos” (FINATEC) for financial support to the field work in the Sergipe-Alagoas basin, through the OSTRAKi project (PETROBRAS/GEO-2007/03676). The first author L.S. Antonietto wishes to thank the Coordination for the Improvement of Higher Education Personnel (CAPES) for granting support that allowed the realization of most of the work in the Smithsonian NMNH from July 2013 to July 2014 (Process no. 3604-13-6), and the board of the Institute of Geosciences-UnB, for all cooperation throughout the process. Last, but not least, the first author thanks the NMNH Paleobiology Department staff members, G. Hunt and C.E. Sanford, for all of their help and great joyful moments during his stay at Washington, D.C., United States.

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Received in December, 2014; accepted in September, 2015.