The genus *Congestheriella* Kobayashi, 1954 ("Conchostraca", Diplostraca, Afrograptioidea): redescription and new combination to *Isaura olsoni* Bock from Venezuela and a new species from Argentina (Upper Jurassic)

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ABSTRACT

The genus *Congestheriella* Kobayashi (Afrograptioidea-Afrograptidae) was erected to *Estheriella lualabensis* Leriche from the Lualaba Series (Upper Jurassic, Kimmeridgian) from the Congo Democratic Republic (Africa). Until now, *Congestheriella* was reported from Central Africa and with some doubt from the northeast of Brazil (Lower Cretaceous, Souza Formation). In this work, based on new material, the genus *Congestheriella* is emended. The species *Isaura olsoni* Bock, 1953 from the La Quinta Formation (Upper Jurassic) from Venezuela is assigned to this genus, as *Congestheriella olsoni* nov. comb. Also, *Congestheriella rauhuti* sp. nov. from the Puesto Almada Member of the Cañadón Asfalto Formation (Upper Jurassic) from Argentina is described. Other South American species could be related with the new ones, as *Graptoestheriella brasiliensis* (Oliveira), *G. fernandoi* Cardoso, *Graptoestheriella* sp. and *Estheriina*? *costai* (Cardoso) from the Upper Jurassic to Lower Cretaceous from different Brazilian basins. The new species is compared with the type species. According with its stratigraphic distribution and age, *Congestheriella* is considered as a potential biomarker for the Upper Jurassic-Lower Cretaceous sedimentary succesions from western Gondwana. Its paleogeographic distribution allows us to propose a biogeographic province including northern South America and Central Africa. Also, different alternative migration routes are proposed for the dispersion across central Africa, northern South America and Patagonia. A hypotethical evolutionary scheme for the Afrograptidae is presented.

KEY WORDS: *Congestheriella*. Conchostracans. Jurassic. South America. Systematics.

RESUMEN

El género *Congestheriella* Kobayashi (Afrograptioidea-Afrograptidae) fue definido para la especie *Estheriella lualabensis* Leriche proveniente de la Serie de Lualaba (Jurásico Superior, Kimmeridgiano) de la República Democrática del Congo (África). Hasta el presente, *Congestheriella* se había encontrado en el registro fósil de África central y, con alguna duda, del nordeste de Brasil (Cretácico Inferior, Formación Souza). En este trabajo, la diagnosis del género *Congestheriella* es enmendada, sobre la base de nuevo material identificado. La especie *Isaura olsoni* Bock 1953 proveniente de la Formación La Quinta (Jurásico Superior) de Venezuela es asignada a este género, como *Congestheriella olsoni* nov. comb. También, se describe *Congestheriella rauhuti* sp. nov. del Miembro Puesto Almada de la Formación Cañadón Asfalto (Jurásico Medio a Superior). Otras especies sudamericanas pueden ser relacionadas a la nueva especie descrita, a saber *Graptoestheriella brasiliensis* Oliveira, *G. fernandoi* Cardoso, *Graptoestheriella* sp. y *Estheriina*? *costai* Cardoso del Jurásico Superior–Cretácico Inferior provenientes de diferentes cuencas brasileñas. La nueva especie es comparada con la especie tipo. De acuerdo con su distribución estratigráfica y edad, el género *Congestheriella* es considerado como un potencial fósil indicador para las sucesiones del Jurásico Superior-Cretácico Inferior del oeste de Gondwana. Debido a su distribución paleogeográfica, se propone una provincia biogeográfica que incluye el norte de América del Sur y África central. También, se proponen diferentes rutas alternativas para su dispersión a través de África central, norte de América del Sur y Patagonia. Se presenta un esquema hipotético sobre la evolución de los Afrograptidae.

PALABRAS CLAVE: *Congestheriella*. Conchostracos. Jurásico. Sudamérica. Sistemática.

INTRODUCTION

The genus *Congestheriella* was erected by Kobayashi (1954) for the species *Estheriella lualabensis* Leriche (1913) from the Lualaba Series (Upper Jurassic, Kimmeridgian) from the Democratic Republic of Congo (Africa). Marlière (1948), Defretin (1957) and Defretin-LeFranc (1967) reassigned it to the genus *Estheriella* Weiss and *Bairdestheria-Estheriella* Defretin respectively, and Tasch (1987) erected the subgenus *Estheriella* (*Lioestheriata*) to include the species *E. lualabensis*. Defretin-LeFranc (1967) regarded *Congestheriella lualabensis* (Leriche) as a guide fossil from Lualaba Series, that allows to assigned it to the base of the Kimmeridgian. Chen & Shen (1985) included *Congestheriella* into the family Afrograptidae, which was defined by Novojilov (1957), and recently revised by Gallego & Caldas (2001) and Shen (2003). The other genera included in this family are *Afrograpta*, *Camerunograpta* and *Graptoestheriella*. The last two were synonymized (erroneously cited in Gallego & Martins-Neto 2006) by Chen & Shen (1985) and Shen (2003). Gallego & Caldas (2001) proposed to maintain the validity of both genera as independent taxonomic entities, due to their morphologic differences (carapace outline, umbo position and the number of radial ribs). The Afrograptidae is a problematic and bizarre extinct conchostracan family, but it is more interesting for their restricted distribution both paleogeographically (Central Africa and South America) and stratigraphically (upper Upper Jurassic-Kimmeridgian to lower Lower Cretaceous-Cenomanian).

Until now, *Congestheriella* was only reported from Central Africa and (as *lualabensis*) from northeastern Brazil (Lower Cretaceous, Souza Formation) by Carvalho (1993, 1996b). In this paper, based on new material, the genus *Congestheriella* is emended. The species *Isaura olsoni* Bock (1953) from the La Quinta Formation (Upper Jurassic) from Venezuela (Fig. 1) is assigned to this genus and the new species *Congestheriella rauhuti* sp. nov. from the Puesto Almada Member of the Cañadón Asfalto Formation (Upper Jurassic) from Argentina (Fig. 2) is described.

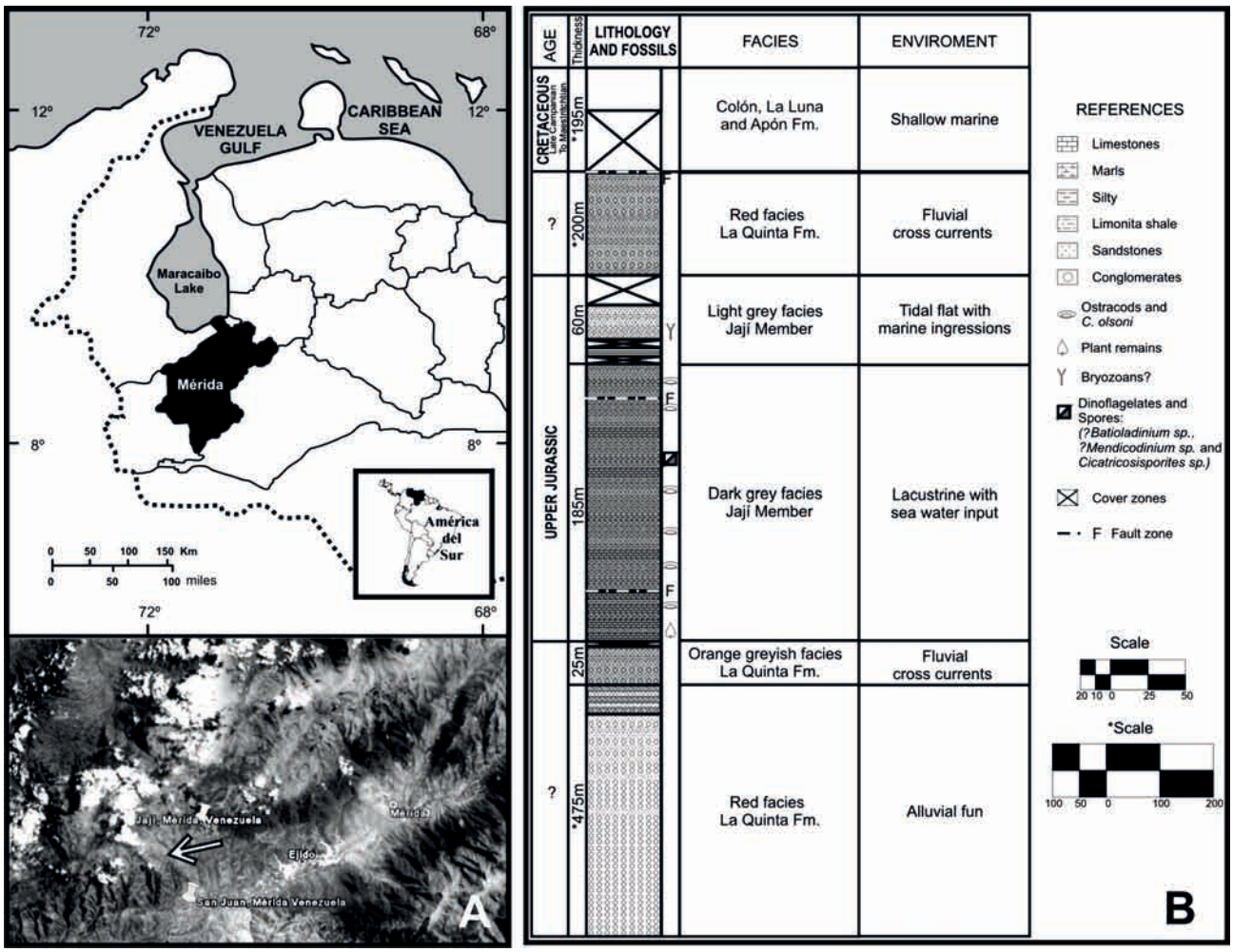

Figure 1. A. Geographic location of the fossiliferous locality of La Quinta Formation (Mérida State, Venezuela). **B.** Schematic section of the La Quinta Formation (Mérida State, Venezuela).

COMMENTS ON

Congestheriella lualabensis Leriche

Estheriella lualabensis Leriche is the type species of the genus *Congestheriella* Kobayashi (see Figs. 3 A-E). It was defined by Leriche (1913) for material that proceeded from the lower stage (Stanleyville) of the Lualaba Series (Democratic Republic of Congo, formerly Belgian Congo or Zaire). Later, this species was focussed by different authors: Raymond (1946), Marlière (1948), Kobayashi (1954), Defretin (1957), Defretin-LeFranc (1967), Chen & Shen (1985) and Tasch (1987). In the first half of the last century, the Stanleyville stage was dated as Triassic (Leriche 1932) and Permian (Marlière 1950). Posteriorly, Cahen and Lepersonne (1954) and Marlière (1955) recognised the Late Jurassic age of this unit, and Cahen (1983) established the age of the Stanleyville Group as ranging from the Upper Jurassic to the Lower Cretaceous (Mateer et al. 1992). The authors that treated the species *E. lualabensis*, used in general the original diagnosis and description of Leriche (1913), and only Marlière (1948) gave complementary descriptions and discussed the ornament variation within the population. Tasch (1987) defined a new

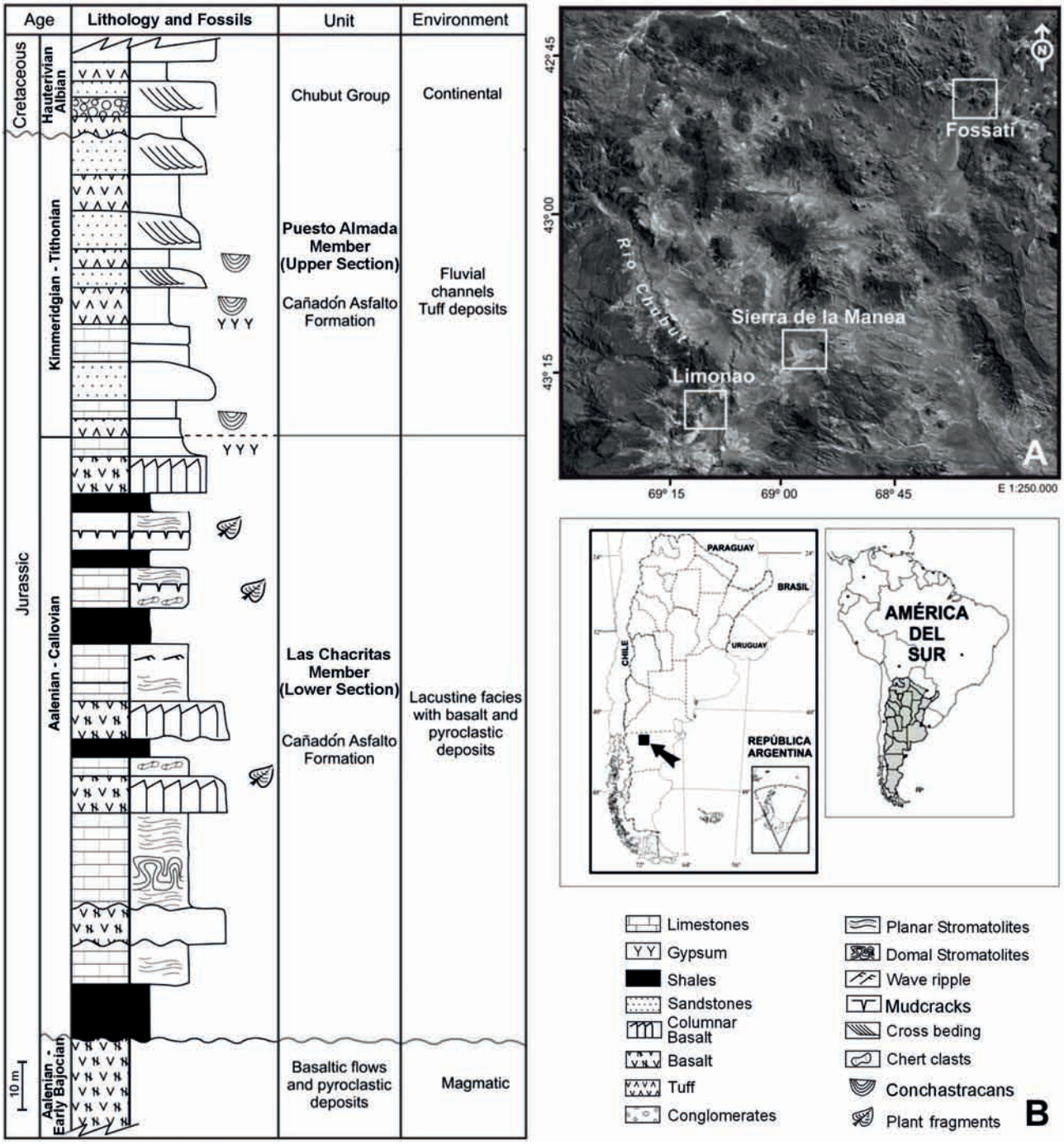

Figure 2. A. Geographic location of the fossiliferous localities from the Puesto Almada Member of the Cañadón Asfalto Formation (Chubut Province, Argentina). **B.** Schematic profile of the Cañadón Asfalto Formation (Chubut Province, Argentina).

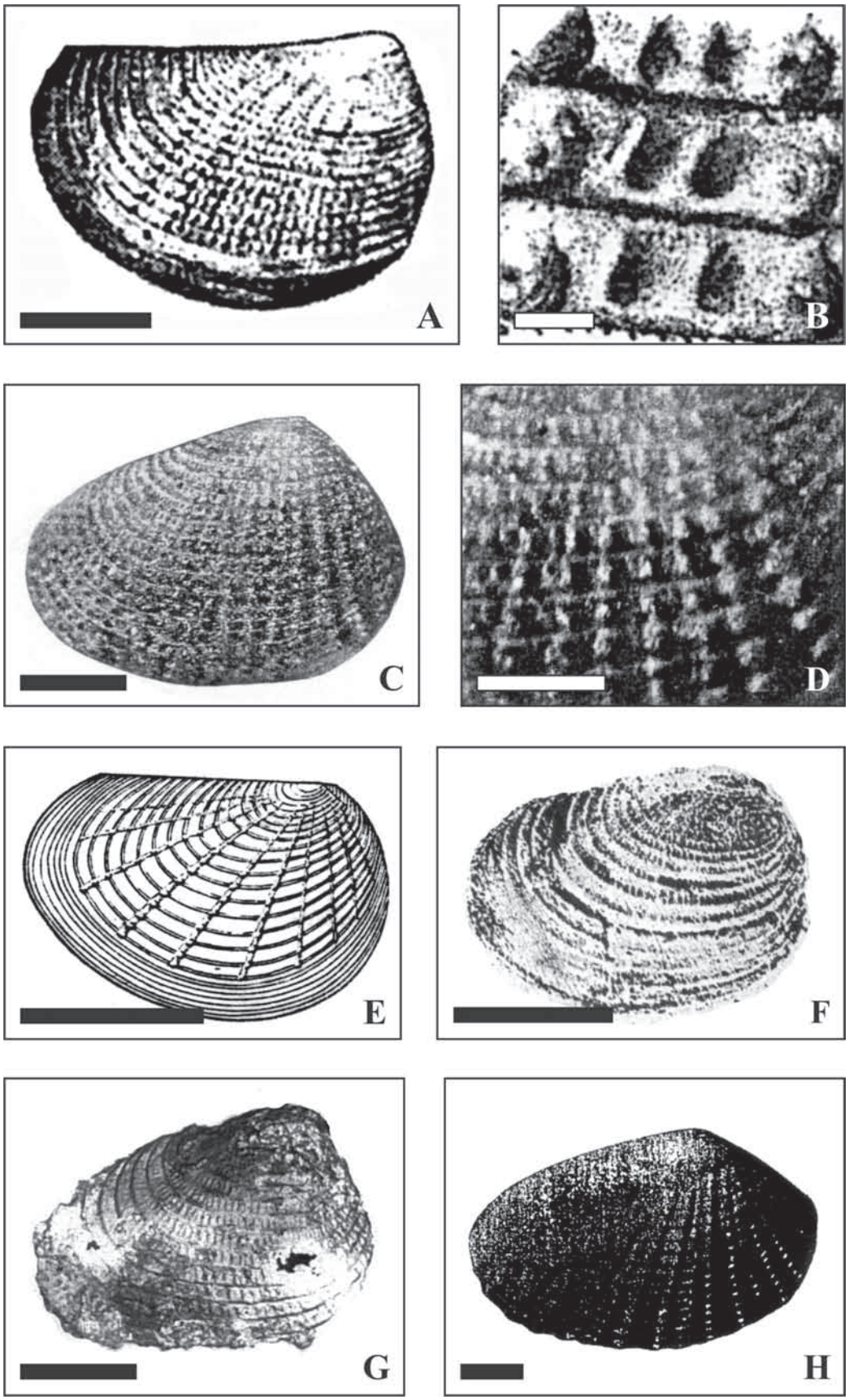

Figure 3. A-E. *Congestheriella lualabensis* Leriche. **A-B.** Carapace with ovate outline and detail of the interrupted radial ribs, both modified from Defretin (1957). **C-D.** Carapace with subtriangular outline and detailed of the ornament pattern, both modified from Marlière (1948). **E.** Carapace with ovate outline, modified from Defretin (1967). **F.** *Congestheriella olsoni* (Bock) comb.nov., ovate carapace, modified from Bock (1953). **G.** *Congestheriella* sp., modified from Carvalho (1996a). **H.** *Graptoestheriella fernandoi* Cardoso, modified from Carvalho (1996b). Scale bars= 1 mm (A, C, E, F, G, H), 0.1 mm (B), 0.5 mm (D).

subgenus *Estheriella* (*Lioestheriata*) based, on the interrupted radial ribs, that do not reach the ventral margin and the presence of the "lioestherid-type" ornamentation in the ventral growth bands. However, this subgenus is according the rules of the ICZN an objective junior synonym of the nominated subgenus *Congestheriella*, because the type species of a genus must belong to the nominated subgenus *Congestheriella* (*Congestheriella*) and not to another subgenus, if several subgenera are distinguished. Marlière (1948) presented the best photographs (Plate V, Figs. 1-4) that reflect clearly the morphologic features of this species, showing similarities with and differences from the species described here (see Figs. 3C-D). Nevertheless, other line drawings as those presented by Defretin (1957, Pl. 18, figs. 7, 8; 1967, Fig. 9), Raymond (1946, Pl. 3, Fig. 6) and others modified from them, show exaggerated features as the stronger radial ribs and their lower number, that do not reflect the real morphologic characteristics of this species (see Fig. 3E). When compared the species described here with the excelent photographs provided by Marlière (1948), those features allow us to propose an emended diagnosis to include the new South American specimens.

GEOLOGICAL SETTING

a) La Quinta Formation

The name La Quinta Formation was published by Kündig (1938) to designate predominantly red-colored nonmarine, clastic beds of Early Mesozoic age. It had long been observed in Venezuela and Colombia. La Quinta Formation has an extensive but somewhat irregular distribution in the Venezuelian Andes, and has been recognized in limited areas, on the east flank of the Sierra de Perijá (Fig. 1.A). The type section of the La Quinta Formation is exposed (2,300 meters thick) along a road that leads to the town of Seburuco, 7 km distant (Táchira state). The beds are resting with strong angular unconformity on phyllites (epi-schists) referred to the Mucuchachí Formation. The section shown in Fig. 1.B corresponds to the exposure of the km 86 (from Mérida city) of the route San Juan-Jají, Mérida state (northern flank of the Andean Cordillera, Venezuela). The La Quinta type section was divided by Kündig (1938) into: **a)** a lower conglomeratic portion (400 m). These levels correspond to both "Red facies" and "Orange-greyish facies" and are interpreted as results of an alluvial fan and braided river deposits, **b)** a middle predominantly shaly portion (500 m), the first 245 m correspond to the Jají Member interpreted as lacustrine deposits and **c)** an upper sandy portion (1,300 m), that corresponds to the upper "Red facies", interpreted as braided river deposits. In the locality studied here these levels are overlain by the marine deposits of three different units (Colón, La Luna and Apón formations), and separated by a fault and a covered section (Fig. 1.B). The paleontological content (*sensu* Schubert 1997) included fish remains (?*Lepidotus*), conchostracans (*Isaura olsoni* Bock and *Howellites colombianus* Bock), ostracods (*Cypridea valdensis* Sowerby), palynomorphs and plant remains (Bock 1953, Schubert et al. 1979, Benedetto & Odreman 1977). Bock (1953) mentioned that *Isaura olsoni* Bock, "… were found, in blackish, laminated shale, believed to be of Rhaetic age or slightly younger…" and occurred associated with "*Cypridea valdensis* Sowerby, known from the North German Wealden formation". In the samples studied here, *C. olsoni* also occurred together with ostracods that closely resemble the specimens of *C. valdensi*s (Ballent, pers. comm., 2007) figured by Jones (1862, Pl. V, figs. 26, 28 and 30). The age of this sequence is not conclusive. The paleontologic contents indicate a Jurassic age, and the paleomagnetic studies show a Triassic remanent paleomagnetism from the basal ash deposits. Based on the palynomorph assemblage listed by Schubert (1997), Prámparo (pers. comm., 2007) suggests a Late Triassic to Early Jurassic age. Radiometric studies bring different ages ranging from the Late Triassic (229 Ma ± 15 Ma), Middle Jurassic (174 Ma) Late Jurassic (146 Ma ± 7 Ma; 149 Ma ± 10 Ma; 155 Ma ± 5 Ma, 156 Ma, 160 Ma) to Early Cretaceous (122.5 Ma ± 7.7 Ma; 140 Ma) many of them for the same basal ash deposit. Finally, all of these data suggest a Late Triassic? to Early Jurassic age (*sensu* Schubert 1997), but the presence of *Lepidotus*, *Cypridea valdensis* and *Congestheriella,* allow us to extend it probably to the Late Jurassic.

b) Cañadon Asfalto Formation

During the Mesozoic (Lower Jurassic to Upper Cretaceous) and as a consequence of the break-up of Gondwana, marine and continental sedimentary sequences, as well as, volcanic episodes associated to a magmatic arc, are developed in Patagonia, Argentina (Chubut Province, Fig. 2A). During the Middle Jurassic began an important effusive cycle. This volcano-sedimentary sequence was named Lonco Trapial Formation (Lesta & Ferello 1972). Silva Nieto (1998) obtained a radiometric age (K/Ar) of 173 Ma (Aalenian) for this unit. The Mesozoic deposition continued with an important continental lacustrine-fluviodeltaic sedimentation, basaltic flows and pyroclastic intercalations, corresponding to the Cañadón Asfalto Formation (Stipanicic et al. 1968), assigned by different authors to the Callovian-Oxfordian (Silva Nieto et al. 2002), Callovian-?Kimmeridgian (Figari & Courtade 1993) and Bajocian-early Bathonian to Kimmeridgian (Volkheimer et al. 2008). It rests, with angular unconformity, on the volcano-sedimentary sequence of the Early Middle Jurassic Lonco Trapial Formation and is covered by the Cañadón Calcáreo Formation or, with angular unconformity, by the Middle to Late Cretaceous Chubut Group. The sedimentation of the Cañadón Asfalto Formation is related with the development of pull-apart basins within the sinuosities of the transcurrent faults of the mega-lineament of Gastre (Silva Nieto et al. 2002, Lizuain & Silva Nieto 2005). They were filled with lacustrine and fluvial sediments. The lacustrine systems were affected by climatic variables, reflected by alternating periods of contraction and expansion of the bodies of water (Cabaleri & Armella 1999). The Cañadón Asfalto Formation was divided in two stratigraphic sections: Las Chacritas Member (lower section) and Puesto Almada Member (upper section) (Silva Nieto et al. 2003, Cabaleri et al. 2008) (Fig. 2.B). The Las Chacritas Member is represented by lacus-

trine sedimentites, principally limestones, interbedded with pyroclastic deposits and basaltic rocks. The lacustrine facies are mainly planar stromatolitic limestones that sometimes alternate with black chert stromatolites, algal stromatolitic boundstones, intraformational conglomerates and black bituminous shales. The Puesto Almada Member, mostly siliciclastic, represents fluvial systems prograding towards the lacustrine deposits. This Member consists of sandstones, fine to coarse tuffaceous and calcareous sandstones with horizontal, ripple and trough lamination, and matrixsupported conglomerates, with clasts of tuffs, limestones and algal limestones, with intercalations of basalts and pyroclastic rocks. The paleontological content of this unit includes: palynomorphs and megaflora; ostracods, conchostracans, and bivalved molluscs; fishes, amphibians, turtles, squamates, crocodiles, dinosaurs, pterosaurs and mammals. The age of this unit ranges between the Middle Jurassic and the Upper Jurassic, also Rauhut (2006) mentioned unpublished radiometric data referred to the Tithonian (Cabaleri et al. in press). Salani (2007) reported a new radiometric age (170 ± 4.4 Ma, Aalenian) from a basalt that correspond to the basal levels of the Cañadón Asfalto Formation, from the Cañadón Los Loros in the north of the Cerro Cóndor village (Chubut province). Figari & Courtade (1993) on biostratigraphic evidence, suggest an Early Cretaceous age and Volkheimer et al. (2008), based on palynologic and palynofacial studies, indicate a Middle Jurassic (Bajocian to early Bathonian) age for the lower part of the Cañadón Asfalto Formation at the cañadón Lahuincó locality.

MATERIAL AND METHODS

The material described in this paper was collected by MH (*C. olsoni* from Venezuela) in a field trip during 2002 and by OFG and NC (*C. rauhuti* from Argentina) in a different field trip during 2002.

The taxonomy adopted here follows mainly that of Chen & Shen (1985) and Shen (2003). The measurement abbreviations correspond to Tasch (1987).

The repository and institutional abbreviations used here are: **ANSP:** Invertebrate Paleontology type collection (Malacology, Invertebrate Paleontology and General Invertebrates, Department of Malacology, Academy of Natural Sciences, Philadelphia (USA). **MPEF-PI**: Paleoinvertebrates Collection, Museo Paleontológico Egidio Feruglio, Trelew, Chubut (Argentina) **CTES-PZ**: Paleozoological Collection, Facultad de Ciencias Exactas, Naturales y Agrimensura, Universidad Nacional del Nordeste, Corrientes (Argentina) and **UNPSJB-PI:** Departamento de Geología, Universidad Nacional de la Patagonia San Juan Bosco, Comodoro Rivadavia, Chubut (Argentina).

SEM studies were carried out with a JEOL JSM-5800-LV Scanning Microscope (of the SECyT-UNNE, Corrientes, Argentina) and photographs provide more detailed microscopic evidence on the morphologic characteristics of the conchostracan species described here.

SYSTEMATIC PALEONTOLOGY

Order: Diplostraca Gerstaecker 1866

Remarks: The name Conchostraca is commonly used in fossil and extant literature. Recently, however, molecular and morphological analyses point out that the 'Conchostraca' is not a monophyletic group and has no taxonomic meaning. It is therefore abandoned as a taxonomic unit (Fryer 1987, Olesen 1998, Stenderup et al. 2006). Martin & Davis (2001) divided the order Diplostraca into four suborders: Laevicaudata, Spinicaudata, Cyclestherida and Cladocera. Two extinct groups should be added in the Order Diplostraca. They are Leaiida and Estheriellina Shen 2003 (Shen et al. 2006, Shen & Huang 2008). So in this paper, the term "clam shrimp" is useful for those of fossil and extant laevicaudatans, spinicaudatans, leaiids and estherielliids (Shen, pers. comm. 2008). Neverthelss, the name "conchostracan" due to its extensive and frequent usage, also in the technical and non-specialized literature,is recommended to employ it to avoid general uncertainty.

Suborder: Estheriellina Shen 2003

Superfamily: Afrograptioidea Novojilov 1958
(*sensu* Shen 2003)

Family: Afrograptidae Novojilov 1958
(*sensu* Shen 2003)

GENUS: ***Congestheriella*** Kobayashi 1954

Type species: *Congestheriella lualabensis* Leriche 1913: p. 3, pls. I-II .

Diagnosis (emend): Strongly convex small carapace, ovate in outline; umbo inset anteriorly, raised above dorsal margin; dorsal margin straight or slightly concavate, inclined posteriorly; posterodorsal angle obtuse; anterior margin less convex than the posterior one; greatest height at the anterior region; carapace surface with strong nodose radial ribs or with weak radial lirae, both interrupted by the growth lines, with 0.1 to 0.5 mm width or narrow to wide lirae ranging from 0.01 to 0.04 mm width (20 to 30 lirae per milimeter); growth bands ornamented by parallel radial lirae between the radial ribs, smooth in the striated forms and with serrated growth lines in both forms, growth lines 14 to 19 in number. Age: Upper Jurassic – Lower Cretaceous. South America, Africa.

Discussion: The similarities shared by the African and South American forms allow us to assign them to the genus *Congestheriella* Kobayashi and to propose the present emended diagnosis. They are the general outline, the strong convexity of the carapace, the striated pattern of the ornamentation and the serrated growth lines.

Congestheriella olsoni Bock nov. comb.

Figure 3F; Plate I, figure B; Plate II, figures A-B

1953 *Isaura olsoni* Bock: p. 69, pl. 12, figs. 1-6

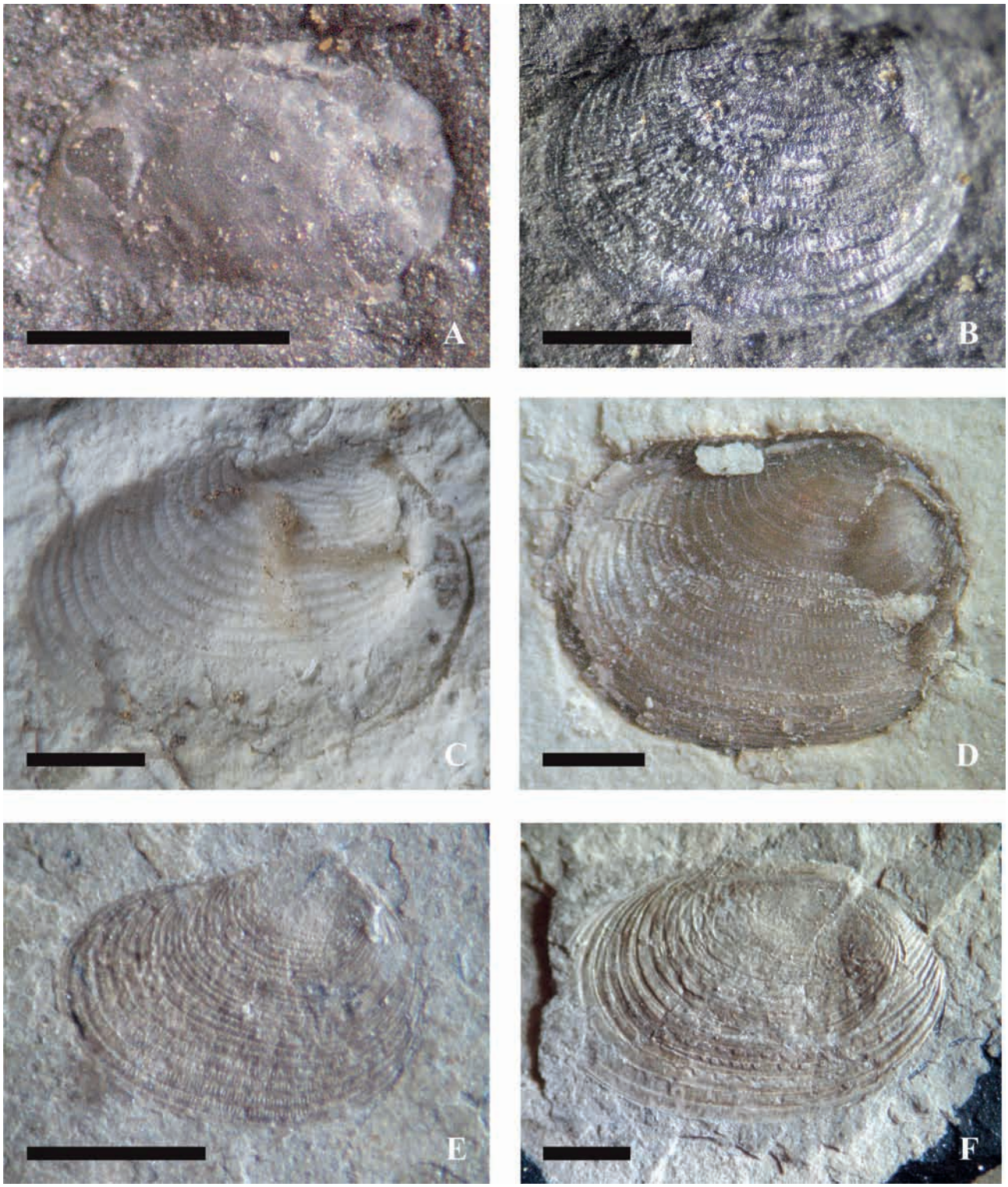

Plate I. A. *Cypridea valdensis* Sowerby. **B.** *Congestheriella olsoni* (Bock) comb.nov., additional material CTES-PZ 7384. **C-E.** *Congestheriella rauhuti* sp. nov., C. paratype CTES-PZ 7386a, D. holotype MPEF-PI 1170, E. paratype UNPSJB-PI 293. **F.** *Cyzicus* (*Lioestheria*) sp. 1 (from Vallati 1986), material UNPSJB-PI 301. Scale bars= 1 mm.

1954 *Euestheria olsoni* Bock, Kobayashi: p. 107, 163

1977 *Cyzicus* (*Euestheria*) aff. *C.* (*E.*) *olsoni* Bock, Rivas & Benedetto: p. 21

1987 *Cyzicus (Lioestheria) olsoni* Bock, Tasch: p. 117

Holotype. ANSP 64902 (ex-200108 from Bock 1953).

Paratypes. ANSP 65583, 64903 and 31191 (ex-200109 to 200111 from Bock 1953).

Additional material. CTES-PZ 7287 (MEB1), 7384.

Type locality. Near Mérida, Venezuela (after Bock 1953).

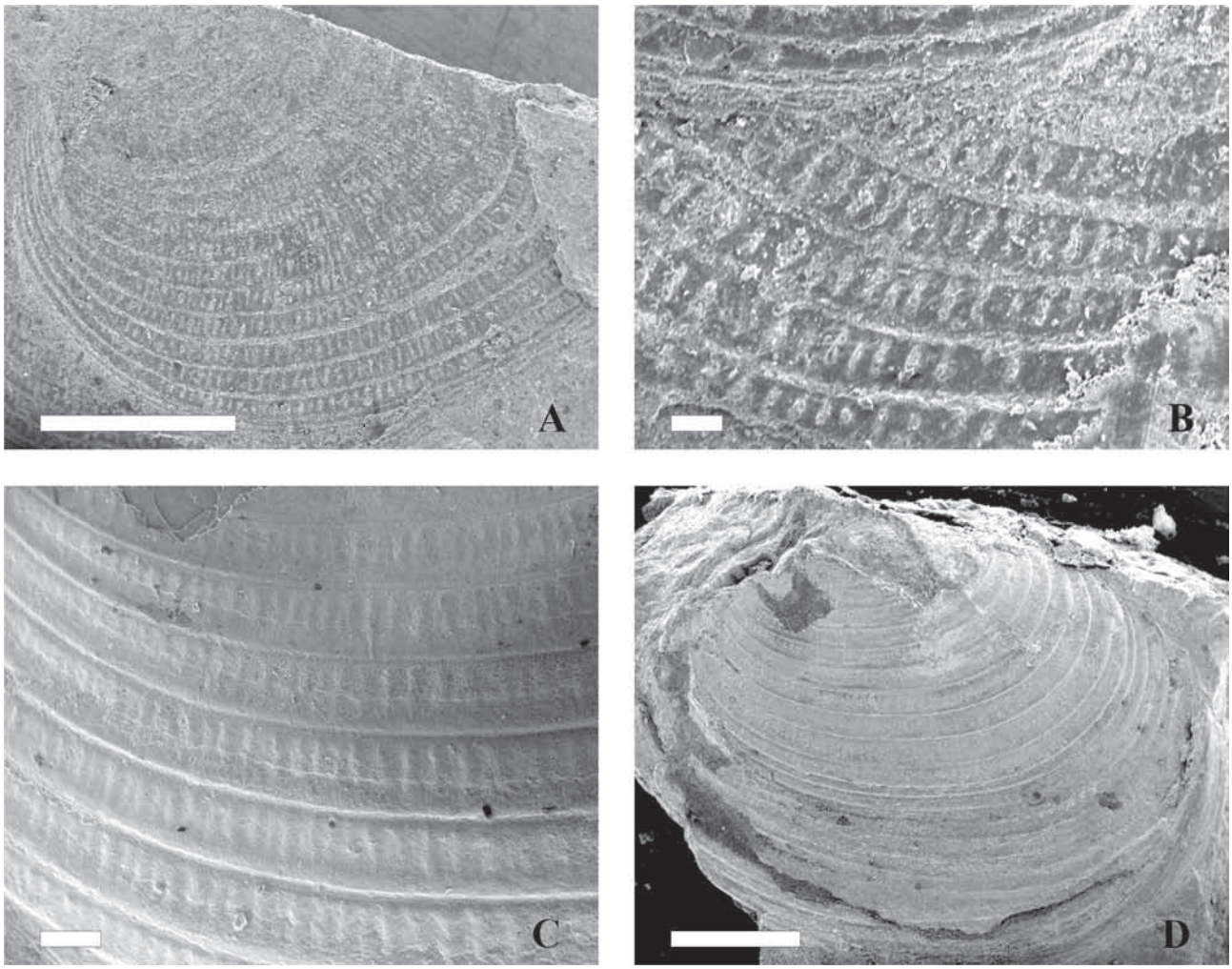

Plate II. SEM microphotographs**, A-B.** *Congestheriella olsoni* (Bock) comb.nov., additional material CTES-PZ 7287. **C-D.** *Congestheriella rauhuti* sp. nov., paratype CTES-PZ 7389. Scale bars= 1 mm (A, D), 0.1 mm (B, C).

Other locality. Km 86 (from Mérida city) of the route San Juan-Jají, Mérida state (northern flank of the Andean Cordillera, Venezuela).

Occurence. Jají Member (grey facies), La Quinta Formation, Upper Triassic? to Lower Jurassic (probably Upper Jurassic, Tithonian).

Diagnosis: (modified from Bock 1953) carapace valve with oval, elliptic to subrectangular outline, with straight dorsal margin, convex umbonal region, hinge line straight, less or equal than half of length, surface curvature prominently convex strongest into umbonal zone, umbo inset in the first quarter, rised above dorsal margin, growth bands ornamented by around 50 weak radial interrupted lirae, with 0.01 to 0.04 mm width.

Description: Carapace valve with 18 to 20 growth lines, lenght 1.5 to 2.9 mm, height 1.3 to 2.2 mm, ratio 0.76 to 0.86, (for more details see Bock 1953).

Remarks: *Congestheriella olsoni* Bock nov. comb. was previously assigned to the genus *Isaura* by Bock (1953). The genus name *Isaura* erected by Joly in 1841, latter fell in discuss and was invalid, because it was preoccupied by Savigny in 1817, for an extant cnidarian (hexacoral). Kobayashi (1954) adscribe *olsoni* to the genus *Euestheria*. Rivas & Benedetto (1977) describe as *Cyzicus* (*Euestheria*) aff. *C.* (*E.*) *olsoni* Bock, new specimens (MPI 046) from the "Río Palmar" (confluence of the Caño Caliche with the Río Palmar, Sierra de Perijá, Zulia State, Venezuela), but the stratigraphic procedence was assigned to the Tinacoa Formation (Lower Jurassic). Rivas & Benedetto (1977) compared this material with other from the La Quinta Formation, and justified their doubtful assignation on the stronger ornamentation, more space that separated the lirae and the smaller size of the carapaces of the La Quinta specimens. Tasch (1987) assigned *Isaura olsoni* to the genus *Cyzicus* (*Lioestheria*) based on their ornamentation with strong radial striae. The new material collected by one of us (M.H.), allows to redescribe this species and assigned it to the genus *Congestheriella* Kobayashi. This new assignment is based on two diagnostic features, first, the strong convex carapace and the second their weak interrupted radial lirae ornamentation. This type of ornamentation is only registered in two conchostracan groups, the afrograptids (*Afrograpta Camerunograpta*, *Congestheriella* and *Graptoestheriella*)

and the estheriellids (now a doubtful conchostracan group *sensu* Jones & Chen 2000).

Congestheriella lualabensis Leriche differs from the new species in its more prominent umbo set anteriorly, dorsal margin straight and notably inclined posteriorly, radial striae between 5 to 11, strong nodes (0.13 mm width) formed where the striae are crossed by the growth lines, space between growth bands ornamented by small striae (0.04 mm width), serrated growth lines (absent in *C. olsoni*) and larger in general dimensions (L 1.60 to 3.78 mm, H 1.28 to 2.56 mm, H/L 0.67 to 0.80).

Congestheriella rauhuti sp. nov.

Plate I, figures C-E; Plate II, figures C-D

1986 *Cyzicus (Lioestheria)* sp. 1 (partim.), Vallati: ps. 34-35, pl. II, figs. 3-9

Diagnosis. Small carapace valve with ovate outline, cycladiform, straight dorsal margin, umbo inset anteriorly not rised above dorsal margin, posterior margin with more lenght and equal in size than the anterior margin, growth lines regularly spaced in all of the carapace, growth bands ornamented by around 40 weak interrupted radial lirae, with 0.04 to 0.10 mm width, serrated growth lines with 10 beads per 0.12 mm.

Etymology. In honour to Oliver Rauhut (Bayerische Staatssammlung für Paläontologie und Geologie, München, Germany).

Holotype. MPEF-PI 1170.

Paratypes. MPEF-PI 1171 to 1175, CTES-PZ 7385-7389, UNPSJB-PI 293, and 302 (from Vallati 1986).

Type locality. Sierra de la Manea, 43º8´38´´S / 68º5´11´´W (Cañadón Calcáreo-Cerro La Cicuta depocenter, Chubut Province, Argentina).

Other localities. Estancia Fossati, 42º48´04´´S / 68º50´11´´W (Fossati depocenter), Puesto Limonao, aprox. 43º11´09´´S / 69º08´08´´W (Cerro Condor-Taquetrén depocenter), Cerro Bayo (levels 202, 203, 204; 15 km NE from Cerro Condor *sensu* Vallati, 1986), Chubut Province, Argentina.

Occurrence. Puesto Almada Member of the Cañadón Asfalto Formation, Upper Jurassic.

Description. Small carapace valve with ovate outline, cycladiform, straight dorsal margin, umbo inset anteriorly not rised above dorsal margin, posterior margin with more length and equal in size than the anterior margin, 15 to 29 growth lines regularly spaced in all of the carapace, lenght 1.3 to 5.0 mm, height 0.93 to 3.70 mm, ratio H/L 0.64 to 0.81, growth bands ornamented by around 40 weak interrupted radial lirae, with 0.04 to 0.10 mm width, serrated growth lines with 10 radial beads per 0.12 mm.

Remarks. *Cyzicus (Lioestheria)* sp. 1 described by Vallati (1986, p. 34-35, pl. II, figs. 3-9.) is a synonym of the species described here (see Pl. I, fig. E). It was collected at a locality called Cerro Bayo (15 km NW of the Cerro Condor village, probably the same as Puesto Limonao) and stratigraphically from the Puesto Almada Member of the "Cañadón Asfalto Formation" (equivalent to the section with *Tharrias feruglioi* from Puesto Almada locality, *sensu* Vallati 1986). This author defined three morphotypes (A, B and C) based on some morphological differences, but remarks that all of them probably correspond to the same species. Both forms share the dimorphic outline, dimensions of the valve and the ornamentation pattern between the growth lines.

The new species resembles *Congestheriella lualabensis* Leriche in the strong convex carapace, umbo rised above dorsal margin and serrated growth lines, but differs in the smaller dimensions of the valve, the strong nodose radial ribs and the growth bands ornamented by parallel radial striae (between the radial ribs) in *C. lualabensis*.

C. olsoni Bock differs from *C. rauhuti* sp. nov. in the general outline, more convex carapace, umbo rised above dorsal margin, dorsal margin inclined posteriorly, 50 weak interrupted radial lirae and the absence of serrated growth lines.

SOUTH AMERICAN RECORDS AND THE PALAEOGEOGRAPHIC-EVOLUTIONARY IMPLICANCIES

These two records of "*Congestheriella*-type" conchostracans allow us to emend the diagnosis of the genus, including the weakly striated forms (non-ribbed) into this genus. Two morphological features are considered to evaluate the assignment to the genus *Congestheriella*. One is that the interrupted radial ribs do not reach both the dorsal (umbonal area) and the ventral margin. On the other hand, these ribs are less notorious in the anterior and posterior side of the carapace, as noted by Defretin (1957) and Tasch (1987). The second character is that the interrupted radial ribs are followed ventrally by weak radial striated ornamentation.

Other "*Congestheriella* type" conchostracans found in the South American Mesozoic record comprise:

a) *Estheriella lualabensis* Leriche recorded by Carvalho (1993) from the Souza Basin (Lower Cretaceous, Brazil). Comparisons made with the figures from Carvalho (1993, Pl. Fig.; 1996b, p. 388, Fig. 1) allow us to conclude that probably these forms belongs to the genus *Graptoestheriella* (mainly with *G. fernandoi* figured by Cardoso 1965, p. 21, Fig. 4) rather than to *Congestheriella* (see Fig. 3H). For this assigment we consider the following features: the presence of continuous 15 to 20 radial ribs that reach the ventral margin, and the ondulated outline. In *Graptoestheriella* the radial ribs reach both the dorsal and ventral region; the latter produce an ondulated outline of these specimens, in contrast with the diagnostic features of *E. lualabensis* observed by Defretin (1957) and Tasch (1987), with interrupted radial ribs, which do not reach the ventral margin and which lacks an ondulated outline.

b) *Estheriina* (*E.*)? *costai* Cardoso recorded by Carvalho (1993) from the Barro basin (Lower Cretaceous, Brasil). The specimen figured by Carvalho (1996a, Plate II, Fig. A) is totally different from the type material described by

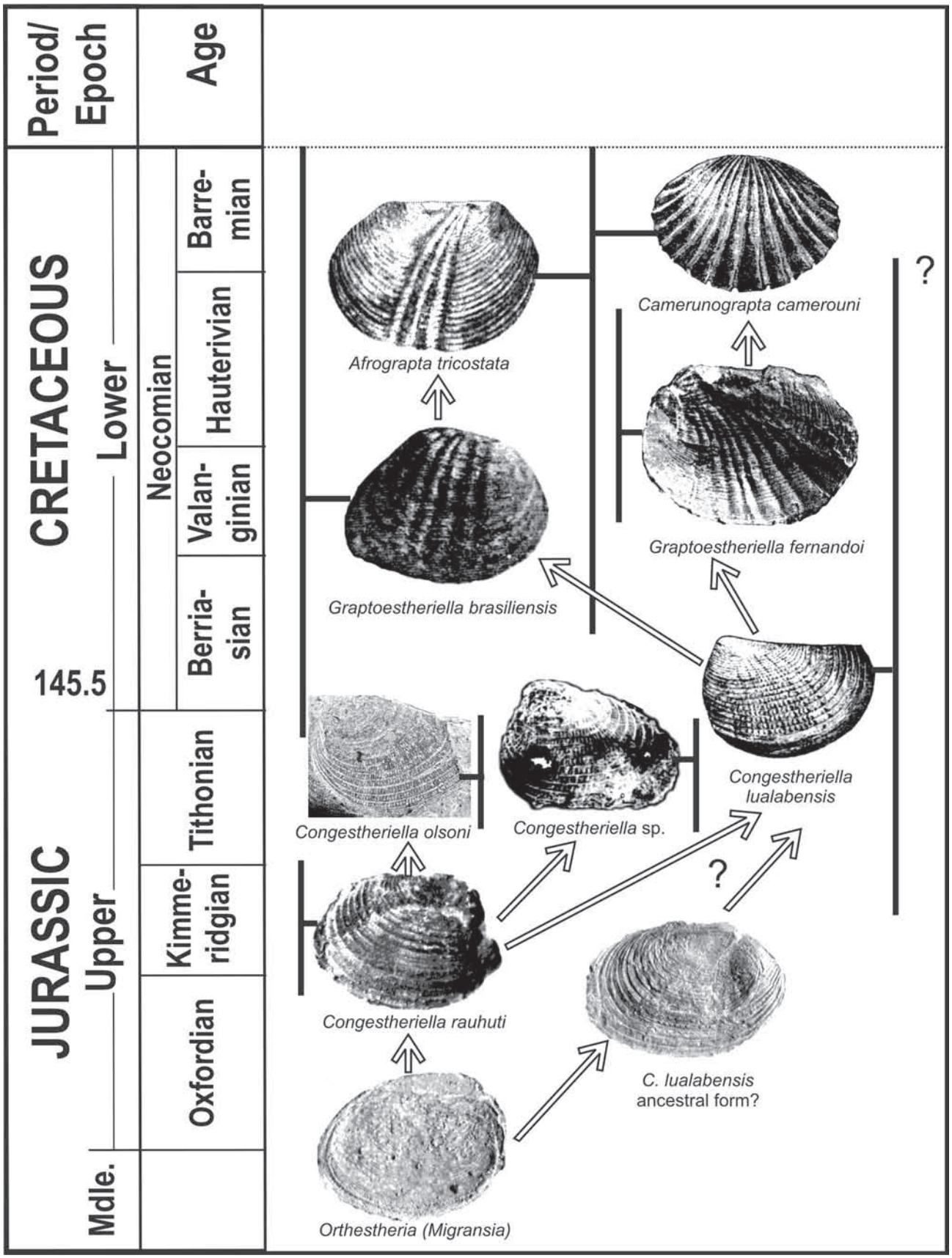

Figure 4. Tentative evolutional-chronological scheme of the Family Afrograptidae.

Cardoso (1966). The material referred to 40-Co (Department of Geology-Universidade Federal de Rio do Janeiro), shares radial lirae ornamentation between growth lines. This characteristic is not mentioned by Cardoso (1966) and only mentioned by Carvalho (1996a) in the figure caption. Due to this feature, Gallego & Martins-Neto (2006) proposed that this form probably belongs to *Congestheriella*, because it shares with *C. rauhuti* the strong convexity of the carapace and with *C. olsoni* Bock the fine radial interrupted lirae between the growth lines (see Fig. 3G).

c) The specimen UNPSJB-PI 301 of the morphotype C from *Cyzicus (Lioestheria)* sp. 1 described by Vallati (1986, p. 34-35, pl. II, figs. 10-12.) is tentatively excluded from the type material of *C. rauhuti* sp. nov. It belongs to a different species due to its elliptical outline, transversally serrated growth lines and isolated tubercle ornamentation in the upper half of the last ten growth bands. Also these tubercles are weakly evident in the rest of the valve and neither constitute radial ribs. Tubercles and the serrated growth lines show close affinity with *Congestheriella lualabensis* (see Pl. I, figure E).

The presence of the afrograptids, as well as other groups, shows close paleogeographic relationships between northern South America and Central Africa during the Late Jurassic to Early Cretaceous (Carvalho 1993, Rohn & Cavalheiro 1996, Arai & Carvalho 2001, Cunha Lana & Carvalho 2002, Rohn et al. 2005). Shen (2003) (in Gallego & Martins-Neto 2006) proposed that during the Late Jurassic and Early Cretaceous existed a biogeographic province (Fig. 5), including Africa-South America (ASA) represented by Afrograptidae faunas (*Afrograpta, Camerunograpta*, *Graptoestheriella* and *Congestheriella*) adding the joint record of *Pteriograpta* cf. *reali*, *"Lioestheria" mawsoni* and *"Lioestheria" cassambensis* in both areas, Brazil and central Africa. Moreover, the new evidence provided by the record of *Congestheriella*, added the record of *Orthestheria (Migransia) ferrandoi* (a *mawsoni-cassambensis* related form) extends tentatively this paleobiogeographical province to northwestern (Venezuela) and southern (Argentina and Uruguay) South America, until now only during the Middle to Late Jurassic.

Gallego & Rinaldi (2004) suggested the probable dispersion-migration routes for the interchange of these species, across the paleo-Orinoco-Amazonas River (with an around 25% larger basin than actually known) in connection with another great African river system (as Congo or Niger River). On the other hand, the dispersion from Patagonia toward northern South America is tentatively assigned to the Paraná-Paraguay River system (with S-N drainage direction until Late Miocene), the SW-NE paleowind system (responsible of the deposition of the Botucatú paleodesert, that includes freshwater-ponds) and Trade (East) winds.

The records of *Congestheriella olsoni* and *C. rauhuti* added to the other South American records bring new information and support previous speculations on the evolution of this particular conchostracan group (Afrograptidae) (Fig. 4). These discoveries suggest that the weakly striated forms (*olsoni* and *rauhuti*) from the Kimmeridgian-Tithonian probably give rise to the tuberculated and radial-ribbed forms. The specimen UNPSJB-PI 301 of *Cyzicus (Lioestheria)* sp. 1 (morphotype C, Vallati 1986), probably is a new species of the genus *Congestheriella* and it evolves toward the interrupted-ribbed *Congestheriella lualabensis* from the Kimmeridgian-Barremian. The last one gives rise to two lineages, the multi-ribbed *Graptoestheriella fernandoi* from the Valanginian-Hauterivian and *Camerunograpta* from the Berriasian-Barremian. The other branch appears with the multi-ribbed *Graptoestheriella brasiliensis* from the Tithonian-Barremian and the three-ribbed *Afrograpta* from the Berriasian-Barremian.

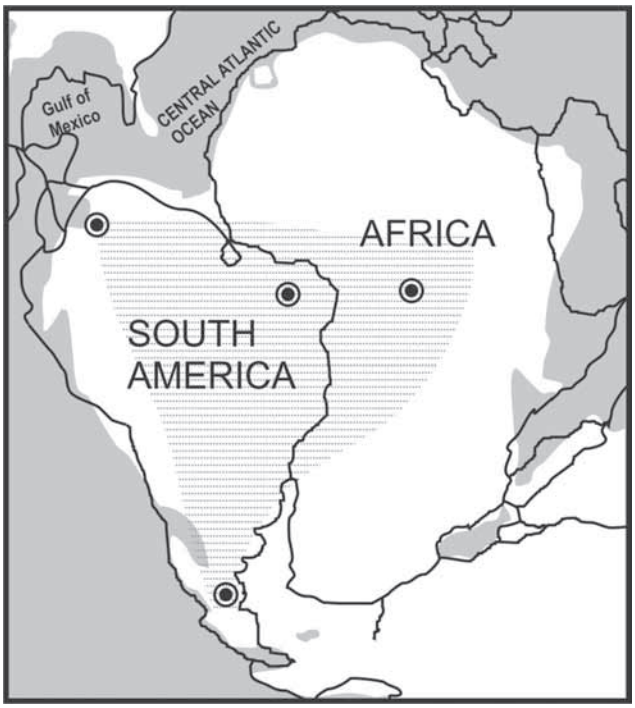

Figure 5. Paleobiogeographic distribution of the Family Afrograptidae and the Central Africa-South America (ASA) bioprovince.

Concerning to the evolution of the Afrograptidae, Chen & Shen (1985) suggested that *Afrograpta* and *Camerunograpta* probably originated from *Migransia* (a weakly striated form with beaded growth lines). It is possible that all of this group evolved from striated forms that are common in the southern South American Jurassic-Cretaceous record. The species like "*Lioestheria" malacaraensis* and *Orthestheria (Migransia) ferrandoi*, would be the ancestral forms of *Congestheriella rauhuti* and *C. olsoni* (see Fig. 4).

FINAL COMMENTS

These new discoveries increase the knowledge of the Jurassic-Cretaceous faunas from the southern hemisphere.

The records of both forms, *Congestheriella olsoni* and *C. rauhuti,* support new data on the age of the bearing levels. The Venezuelan species co-occurred with the ostracod *Cypridea valdensis* and fish remains of the genus *Lepidotus*, both of Wealden age (Late Berriasian to Barremian) from Europe. Also, the unpublished records of the dinoflagellate

cysts *Batioladinium* sp. and *Mendicodinium* sp. and the trilete spore *Cicatricosisporites* sp., in the dark grey facies of the Jají Member from the La Quinta Formation, suggest an age not older than Late Jurassic.

On the other hand, the age suggested by *C. rauhuti* supports previous ideas about the Late Jurassic to Early Cretaceous age for the upper section (Puesto Almada Member) of the Cañadón Asfalto Formation (Figari & Courtade 1993, Rauhut 2006) and the existence of a diachronism between different depocenters of the Middle Chubut River and Gastre-Gan Gan areas (Silva Nieto et al. 2007). –

According with the stratigraphic distribution and age *Congestheriella* is considered as a potential marker for the Upper Jurassic to Lower Cretaceous sedimentary succesions from western Gondwana.

On the other hand, its paleogeographic distribution allow us to propose different alternative migration routes for the dispersion of these taxa across Central Africa, northern South America and Patagonia.

The occurrence of the same taxa in both paleogeographic regions, Central Africa and South America, suggests the presence of a biogeographic province comprising these areas.

According to Gallego & Martins-Neto (2006) *Congestheriella olsoni* and *C. rauhuti* belong to the Assemblage I, defined for the Middle – Late Jurassic South American forms, that includes the species: *Asiolimnadiopsis* sp., *Pseudestherites* sp., *Congestheriella* spp. and several other Argentinean species under revision (belonging to Eosestheriidae and Fushunograptidae) and "*Lioestheria*" *malacaraensis,* that closely resemble *L. mirandibensis*; also includes the Brazilian species *Macrolimnadiopsis pauloi*, *M. barbosai* and *L. mirandibensis* (*sensu* Rohn & Cavalheiro 1996). These authors include *Congestheriella lualabensis* described by Carvalho, 1996a (now assigned to *Graptoestheriella fernandoi*) from Brazil in the Assemblage II defined by Late Jurassic – Early Cretaceous (Neocomian) South American forms; mainly *Graptoestheriella brasiliensis*, *Graptoestheriella* sp., and the Uruguayan species *Orthestheria (Migransia) ferrandoi*.

Finally, from the Middle Jurassic (Callovian) through the Early Cretaceous (Barremian), an interval of about 40 Ma, the small but diversified fauna of the Family Afrograptidae appears and evolves, in the Central African-South American (ASA) bioprovince.

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