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Galeacornea guayaguensis sp. nov., a new elaterate pollen species from the Cretaceous of central-western Argentina

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Galeacornea guayaguensis sp. nov., a new elaterate pollen species from the Cretaceous of central-western Argentina

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Abstract
Here we present a revision of the elaterate pollen species that belong to the genus *Galeacornea*. We also describe a new species, *Galeacornea guayaguensis* sp. nov., from the Early Cretaceous (Albian?) of central-western Argentina. The specimens from this species were retrieved from sediments of the Lagarcito Formation (San Luis Basin) located at the Sierra de Guayaguás ranges in the San Juan province. *Galeacornea guayaguensis* shares with the other *Galeacornea* species the shape of the grain and the presence of an annular rim and distal appendages. The ridge-like appendages of *G. guayaguensis* are similar to those of *G. stoveri* and *G. tarimensis*, although they never fuse with the annular rim or with each other at their ends as it respectively occurs in these species. This new pollen species provides further evidence on the morphological variation of elaterate grains and extends the geographical distribution of *Galeacornea* to southern South America, far beyond the palaeophytogeographic Albian–Cenomanian Elaterates Province of the equatorial region. Finally, we propose a new combination of the species *Quantonenpollenites crassatus* to *Galeacornea crassatus*, considering that the morphological features of the former perfectly fit the diagnosis of the genus *Galeacornea*.

Keywords: *elaterate pollen grains,* Galeacornea*, Lower Cretaceous, Lagarcito Formation, San Luis Basin, central-western Argentina, South America*

Elaterate grains have distinctive appendages or projections that vary enormously in size, shape and position. They may be elater-like, horn-like, ridge-like, or resemble flaps or small knobs, among others. Appendages were originally associated with elaters like those from the extant *Equisetum* L. spores; however, the complex morphology of the grains may indicate an adaptation to insect pollination (Crane 1996; Friis et al. 2011, chapter 17). Body shapes are also variable: ellipsoidal, subspherical, fusiform or star polygonal (Table I). Regarding the apertures, Dino et al. (1999) mention that elaterate grains are probably inaperturate; otherwise, the apertural characters are not well understood or well documented.

The systematic position of the Elaterate complex is still uncertain; Dino et al. (1999) state that it is unknown whether the elaterates correspond to a botanically united group or have diverse origins. Nevertheless, the ultrastructural details of the pollen wall as well as the presence of morphological intermediates, perhaps infer that these grains may have been produced by Gnetales or related plants of the Bennettitales-Erdtmanithecales-Gnetales group (Friis et al. 2011). The genera included in the complex are: *Alaticolpites, Elaterocolpites, Elateroplicites, Elateropollenites, Elaterosporites, Galeacornea, Pentapsis, Regalipollenites, Senegalosporites* and *Sofrepites* (Table I).

The genus Galeacornea

The genus was erected by Stover (1963) with the four species *Galeacornea clavis, G. causea, G. acuminata* Stover and *G. protensa* Stover, characterised by the presence of an annular rim and one or more prominent

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distal appendages. For convenience in description, Stover (1963) placed the slit aperture on the considered 'proximal surface' and the prominent ornamentation on the 'distal surface'. Later, Jardiné and Magloire (1965) described *G. klaszi* Jardiné and Magloire and *G. verrucata* Jardiné and Magloire, both having three U-shaped appendages. In a revision of the elaterate grains from western Africa, Jardiné (1967) emended the diagnosis of *Galeacornea* with Stover's agreement (Jardiné 1967, p. 237), and created the genus *Elaterosporites* to include those forms with bilateral symmetry and three U-shaped appendages. Therefore, he held in *Galeacornea* those species with one prominent appendage (*G. causea, G. clavis*) and transferred the others to *Elaterosporites* (*E. acuminatus, E. klaszi, E. protensus, E. verrucatus*) (Table I). Elsik (1974) proposed the retention of *Galeacornea* in the sense of Stover (1963) and created *G. stoveri* with three to nine prominent ridges and knob-like projections at the ends of the longer axis (Table II). Some species of *Steevesipollenites* present well developed terminal knobs at both ends of the longer axis of the grain, such as *Steevesipollenites* sp.1 illustrated by Schrank (2010). However, the main difference with *Galeacornea* is that *Steevesipollenites* comprises fusiform pollen grains with variable number of uniform longitudinal ridges alternating always with narrow grooves; with the poles equally modified, forming convex caps or solid subspherical knobs (Jansonius & Hills 1976) and they do not have an annular rim.

From Chinese sediments, Yu et al. (1983) erected the elaterate genus *Quantonenpollenites* with a species having a proximal annular rim and a unique transversal pillow-like appendage on the distal face (*Q. crassatus*). Later, Zhang and Zhan (1986) created the species *Galeacornea tarimensis* that has four to six appendages (plate- or flap-like), which may connect at their ends (Table II). Li (2001) emended the genus *Quantonenpollenites* to include those species with flap/tabular- or pillow-like distal appendages and transferred *G. causea* to *Q. causea* and *G. tarimensis* to *Q. tarimensis*.

Geological setting

The Cretaceous San Luis Basin is located in central-western Argentina, with sedimentary successions exposed in the San Juan and San Luis provinces (Figure 1). It is represented by the continental sediments of the El Gigante Group: the Los Riscos, El Jume, La Cantera, El Toscal, La Cruz and Lagarcito formations (Figure 2). Prámparo (1990, 1994) and Prámparo et al. (2007) assigned a late Aptian age to the La Cantera Formation, based on the palynological association recovered from the Sierra del Gigante ranges. The Lagarcito Formation comprises siliciclastic fluvio-lacustrine sediments deposited in a Cretaceous extensional basin related to the break-up of Gondwana (Rivarola & Spaletti 2006). Based on the fossil content (conchostracans, pleuropholid fishes, pterosaurs) and the K-Ar dates of 107.4 to 109.4 myr (Yrigoyen 1975) for the basalts of the underlying La Cruz Formation, Chiappe et al. (1998) and Arcucci et al. (2015) assigned an Albian age for the Lagarcito Formation at its type locality in Sierra de las Quijadas (Figure 2).

The palynologic samples studied here come from well exposed mudstones of the Lagarcito Formation at the 'La Yesera Sur' section, eastern side of the Sierra de Guayaguás ranges, San Juan province (31° 40′ 67″ S; 67° 11′ 64″ W; Figure 1). Several lake episodes have been detected in the studied section, but only three of them yield fossils. Prámparo et al. (2005) reported the paleontological content of the unit: Conchostracans, ostracods and chlorophycean algae inferring a shallow lacustrine environment rich in nutrients. High levels of evaporation are also indicated by interstratified gypsum towards the top of each lacustrine episode. The psamopelitic-evaporitic sequence with gypsum and anhydrite intercalations yields a rich palynoflora of continental origin (fluvio-lacustrine) (Prámparo & Milana 1999; Prámparo et al. 2005; Mego & Prámparo 2013). Mego and Prámparo (2013) estimated an Aptian–Albian range for the palynologic association recovered in the study area, based on the occurrence of different verrucate spores taxa.

Material and methods

Only five samples, out of the 19 processed for palynology, were productive. The levels yielding palynomorphs are located between 30 and 70 m above the base of the profile ('La Yesera Sur' section; Figure 1). A detailed description of the Lower Cretaceous Lagarcito Formation succession in Sierra de Guayaguás is included in Prámparo et al. (2005).

The physical and chemical extraction of palynomorphs was performed in the Palaeopalynology Laboratory at IANIGLA (Instituto Argentino de Nivología, Glaciología y Ciencias Ambientales, Men-
doza, Argentina). Samples were treated with hydrochloric and hydrofluoric acids following the standard palynological processing techniques according to Volkheimer and Melendi (1976). The residue was sieved with a 10-μm-nylon mesh-sieve and a portion

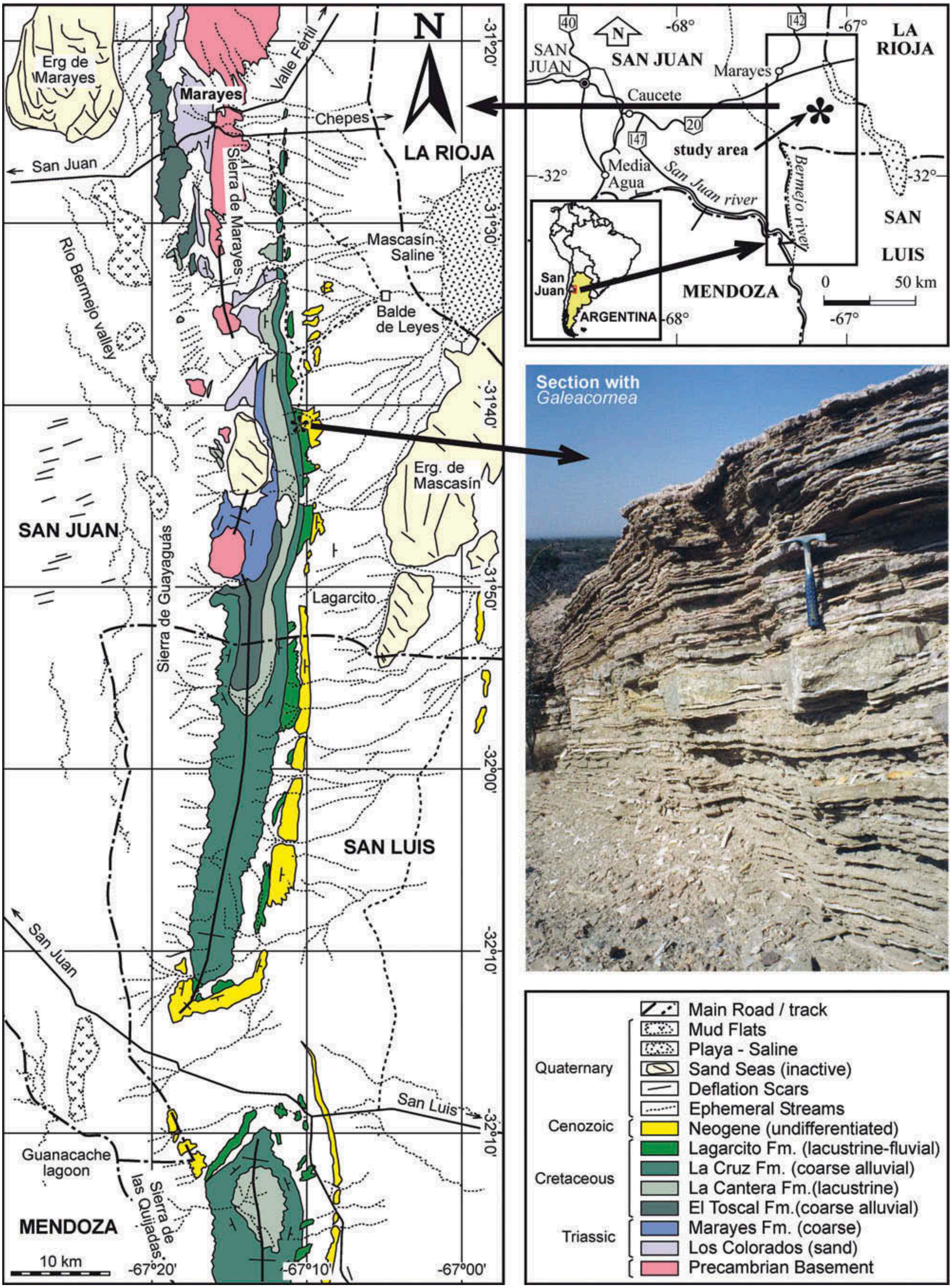

Figure 1. Map showing the location of the 'La Yesera Sur' section in the eastern side of the Sierra de Guayaguás ranges, San Juan Province, Argentina.

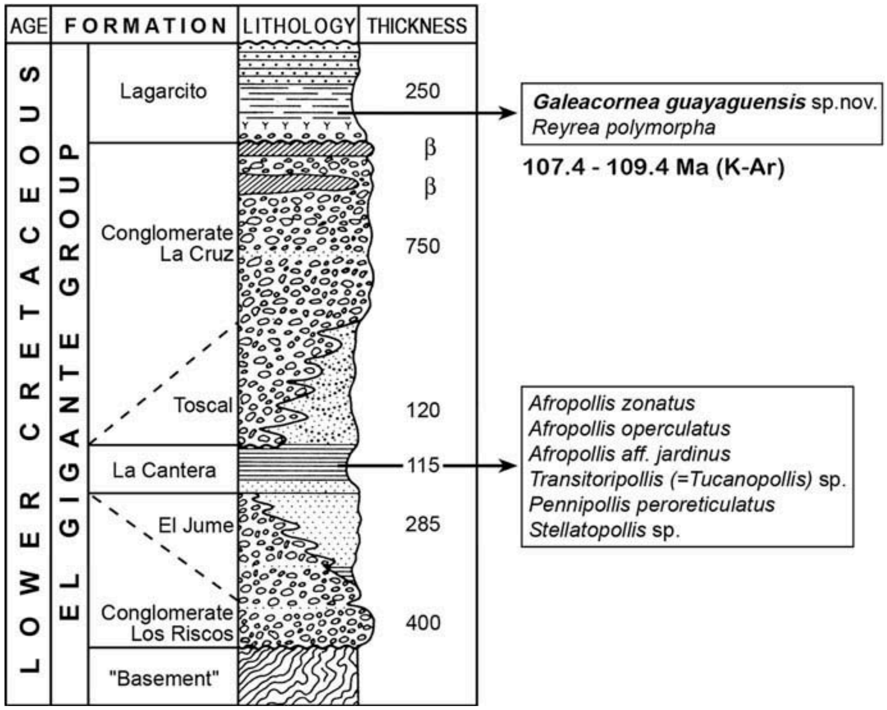

Figure 2. Generalized stratigraphic column of the Cretaceous San Luis Basin (modified from Yrigoyen 1975; Prámparo 1994). In the right column, the principal biostratigraphic markers (palynomorphs) recovered from the La Cantera and Lagarcito formations.

was stained with safranine. Slides were examined under a light microscope (Olympus BX50 with an adapted digital camera) for qualitative and quantitative assessment of palynomorphs. Specimens were located in the slide using an England Finder graticule. The slides are stored at the Palaeopalynologic Collection at IANIGLA under the catalogue numbers: 5861–5862, 5967–5969, MPLP (Mendoza-Paleopalinoteca-Laboratorio-Paleopalinología).

Systematic palynology

Genus Galeacornea *Stover 1963*

Type species. — *Galeacornea clavis* Stover 1963

Galeacornea guayaguensis *Prámparo, Narváez et Mego sp. nov.*
(Figures 3A–T, 4K–Q)

Derivation of the specific epithet. — From the Sierra de Guayaguás ranges, where the sediments yielding the palynomorphs are located.

Specific diagnosis. — Pollen grains with ellipsoidal to sub-hemispherical body. Proximal face with a continuous annular rim running proximally with respect to the body and generally arched, of usually uniform width. Distal face convex, ornamented with prominent appendages that run parallel to the long axis. Ridge-like appendages with rounded ends, rarely hemispheric.

Dimensions. — Long axis: 26–(33.6)–44 μm; short axis: 20–(24)–36 μm (52 specimens).

Holotype designated here. — 5967E: X35/0 MPLP (Lagarcito Formation, 'La Yesera Sur' section, Sierra de Guayaguás, sample 080996/6) (Figures 3A, 4K).

Paratypes designated here. — 5968H: W35/4 MPLP (Lagarcito Formation, 'La Yesera Sur' section, Sierra de Guayaguás, sample 080996/7) (Figure 3B); 5968X: T31/0 MPLP (Lagarcito Formation, 'La Yesera Sur' section, Sierra de Guayaguás, sample 080996/7) (Figure 3C).

Type locality. — 'La Yesera Sur' section from the Lagarcito Formation outcrop succession at the Sierra de Guayaguás ranges, San Juan province, Argentina (31° 40′ 67″ S; 67° 11′ 64″ W) (Figures 1, 2).

Type stratum. — Lagarcito Formation.

Age. — Early Cretaceous (Albian?).

Table I. Elaterate genera (based on Dino et al. 1999).

Features	Genera	*Alaticolpites* Regali et al. 1974[1,2]	*Elaterocolpites* (Jardiné & Magloire 1965) Srivastava 1984[2,3,4,5]	*Elateroplicites* Herngreen 1973[2,6]	*Elateropollenites* Herngreen 1973[2,6]	*Elaterosporites* Jardiné 1967[2,4]
Body	**Symmetry**	Radial	Radial	Asymmetric	Asymmetric	Bilateral
	Shape	Ellipsoidal to subspherical	Ellipsoidal to subspherical	Ellipsoidal	Subtriangular	Ellipsoidal to subhemispherical
	Long axis (µm)	70.0–72.0	35.0–53.0	35.0–62.0	33.0–45.0	35.0–75.0
	Short axis (µm)	48.0–68.0	25.0–38.0	20.0–41.0	30.0–33.0	20.0–45.0
	Annular rim width (µm)	No	No	No	No	Approx. 15.0
	Exine thickness (µm)	1.0–3.0	1.0–1.2	0.9–2.5	1.0–1.5	1.0
	Exine ornamentation	Smooth	Smooth to microgranular	Plicate (ridges 2.5–13.0 µm wide)	Finely striate (striae <0.5 µm)	Smooth, spinose, verrucate
Appendages	**Number**	10	5–10	2–4	2–3	3
	Shape	Handle-shaped	Cylindrical, broad bases, rounded apices	Elater-like (long and slender)	Knob-like (short and slender)	U-shaped
	Orientation	Implanted in pairs, in five meridional bands, parallel to longer axis	Implanted in pairs, in five meridional bands, perpendicular/oblique to longer axis	Projection of two (or rarely four) of the ridges beyond the body	At the ends and centre of the body	Implanted in three meridional lines, parallel to longer axis
	Length (µm)	20.0–40.0	17.0–38.0	13.0–80.0	3.0–11.0	30.0–140.0
	Width (µm)	12.0–22.0	5.0–10.0	2.5–6.0	3.0–5.0	4.0–10.0
		Galeacornea Stover 1963[2,7,8]	*Pentapsis* Lammons 1970[2,9]	*Regalipollenites* De Lima 1980[2,10]	*Senegalosporites* (Jardiné & Magloire 1965) Herngreen 1973[2,3,6]	*Sofrepites* Jardiné 1967[2,4]
Body	**Symmetry**	Bilateral to asymmetric	Pentameral	Bilateral	Bilateral to asymmetric	Bilateral to asymmetric
	Shape	Ellipsoidal to subhemispherical	Star palygonal	Ellipspoidal to fusiform	Cylindrical to fusiform	Subspherical, ellipsoidal, or subtetrahedral
	Long axis (µm)	29.0–60.0	<71.0	30.0–70.0	45.0–100.0	20.0–45.0
	Short axis (µm)	15.0–42.0	>53.0	25.0–30.0	19-.0–40.0	20.0–42.0
	Annular rim width (µm)	1.0–10.0	No	No	No	No
	Exine thickness (µm)	**Exine thickness (µm)**	1.7–2.5	Not provided	Not provided	1.0–3.0
	Exine ornamentation	Smooth to granulate	Smooth	Plicate (narrow ridges)	Plicate (ridges 2.5–4.0 µm wide)	Smooth to infragranulate
Appendages	**Number**	1–7	5	1	2	2–3
	Shape	Y-shaped, flap-like, pillow-like, prominent ridge-like	Buttress-like	Cylindrical, broad base, rounded apex	Cylindrical	Cylindrical (short and stubby)
	Orientation	Oblique/parallel/transversal to longer axis	Terminally attached at ± equal angles along the periphery of each of two parallel pentagonal polar plates	At one end of the body	At both ends of the body	At the ends and centre of the body
	Length (µm)	3.5–50.0	30.0–55.0	6.0–15.0	7.0–20.0	7.0–30.0
	Width (µm)	2.0–16.0	9.0–13.0	3.0–6.0	3.0–6.5	3.0–6.0

References: 1, Regali et al. (1974); 2, Dino et al. (1999); 3, Jardiné and Magloire (1965); 4, Jardiné (1967); 5, Srivastava (1984); 6, Herngreen (1973); 7, Stover (1963); 8, This paper; 9, Lammons (1970); 10, De Lima (1980).


A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
P
Q
R
S
T

Description and remarks on the species. — Pollen grains biconvex, with ellipsoidal to sub-hemispherical body. Proximal face convex with a continuous annular rim of mostly uniform width (1.0–2.5 μm), running proximally with respect to the body, generally arched (e.g. Figures 3A, E, G, 4K, M). In some grains, the annular rim may be interrupted or missing due to torn or bad preservation. At the proximal face, there is a furrow running parallel to the long axis, which is usually not visible. The proximal face of the grains is usually torn or absent. Distal face more convex than proximal face, ornamented with 3–(4)–7 μm ridge-like appendages (rarely hemispheric, e.g. Figure 3F, O). Appendages straight to slightly sinuous, 3.5–(21.4)–40.0 μm long, 2.0–(4.5)–7.0 μm wide, 2–(5.6)–11 μm high, with rounded extremes, running parallel to the longer axis, 0.5–(2.8)–10.0 μm apart. The number of appendages mostly varies from three to six; a unique specimen was found with seven appendages (Figure 3C). Sometimes, two appendages appear longitudinally aligned (Figures 3C, R, S, 4P, Q). Exine smooth, thinner between the ridges (*c.* 0.2 μm); thickened in the annular rim and appendages (0.5–0.7 μm).

Comparison. — The appendages of *Galeacornea guayaguensis* are similar to those of *G. stoveri* (Figure 4F, G; Table II), but in the latter, the most distal ridge is sometimes fused at one or both ends to the annular rim where the knob-like projections are formed (Elsik 1974). In *G. guayaguensis*, the appendages never fuse with the annular rim (Figure 4N–K). The illustrations of *G. tarimensis* in Zhang and Zhan (1986, plate II, figures 22–23) resemble our specimens, but, the appendages are more like plates or flaps instead of ridge-like, and may join at their ends, which does not occur in *G. guayaguensis* (Figure 4, Table II).

Galeacornea crassatus *(Yu, Guo et Mao) Prámparo, Narváez et Mego comb. nov.*

Basionym. — *Quantonenpollenites crassatus* Yu, Guo et Mao 1983, Professional Paper of Stratigraphy and Palaeontology 10, p. 65, plate 28, figure 1.

Remarks on the species. — The diagnosis of the genus *Quantonenpollenites* of Yu et al. (1983) and Li (2001) is very similar to that of *Galeacornea* (Stover 1963), only differing in the morphology of the distal appendages (i.e. the addition of pillow-like shape). We consider that Stover's (1963) definition of *Galeacornea* species, comprising a wide diversity of appendage shapes and including bands, horns and distal flaps (Figure 4), is broad enough to include *Q. crassatus*. Therefore, it is considered a junior synonym of *Galeacornea*.

We propose this new combination based on the detailed description of *Quantonenpollenites crassatus*, the numerous illustrations and the schematic drawings present in the literature consulted (Yu et al. 1983; Li 2001) (Figure 4H–J); although a restudy of this type of material would be ideal to corroborate it.

Comparison. — *Galeacornea crassatus* and *G. causea* Form A *sensu* Jardiné (1967, p. 240, figure 2a–c) are quite similar based on the width of the annular rim, the distal appendage shape and the orientation that are the differences between them (Figure 4A–C; H–J; Table II).

Discussion

Based on the morphological features of the new species recorded in Argentina (*Galeacornea guayaguensis*), we reinforce Elsik's (1974) proposal to maintain the definition of the genus *Galeacornea sensu* Stover (1963). Hence, we disregard the new combination suggested by Jardiné (1967) that included only those species with a unique distal appendage.

Paleophytogeographic implications

Diversity and frequency levels of the elaterates climaxed during late Albian–Cenomanian times (Dino et al. 1999). The high stratigraphic value of elaterate species was already stressed by Jardiné (1967). Herngreen and Chlonova (1981) defined the Africa-South America (ASA) palaeo-phytogeographic province characterised by the presence of this morphological group;

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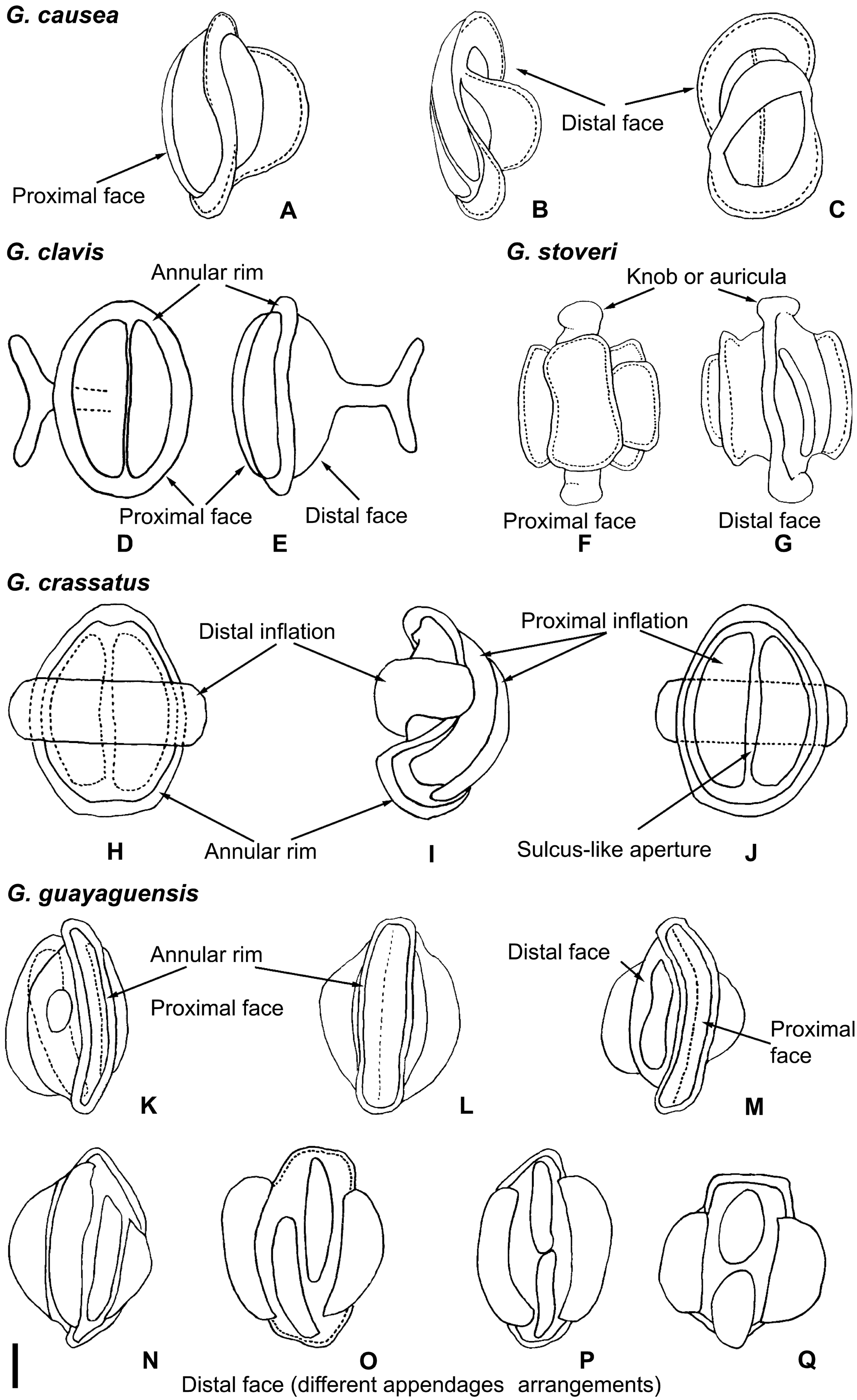
Figure 3. *Galeacornea guayaguensis* sp. nov. **A**. Holotype: 5967E: X35/0 MPLP, four appendages on distal face. **B**. Paratype 1: 5968H: W35/4 MPLP, three appendages. **C**. Paratype 2: 5968X: T31/0 MPLP, seven appendages. **D**. 5969E: K26/0 MPLP, five appendages. **E**. 5967D: T42/0 MPLP, four appendages. **F**. 5968C′: U45/3 MPLP, five appendages. **G**. 5862J: K21/1 MPLP, four appendages. **H**. 5968C′: J27/0 MPLP, three appendages. **I**. 5968C′: C34/4 MPLP, three appendages. **J**. 5968Z: N22/0 MPLP, three appendages. **K**. 5968H: J42/0 MPLP, three sinuous appendages. **L**. 5968K: T42/1 MPLP, four appendages. **M**. 5968B′: D43/0 MPLP, four appendages. **N**. 5968A′: H43/4 MPLP, four appendages. **O**. 5968A′: F33/1 MPLP, four appendages. **P**. 5968X: N38/4 MPLP, four appendages. **Q**. 5968W: E27/0 MPLP, six appendages. **R**. 5968C′: C32/4 MPLP, four appendages. **S**. 5968B′: F39/0 MPLP, four appendages. **T**. 5968I: X31/1 MPLP, four appendages. All photomicrographs were taken under interference contrast. Scale bar – 10 μm.


G. causea
Proximal face
A
Distal face
B
C
G. clavis
Annular rim
Proximal face
Distal face
D
E
G. stoveri
Knob or auricula
Proximal face
Distal face
F
G
G. crassatus
Distal inflation
Proximal inflation
Annular rim
Sulcus-like aperture
H
I
J
G. guayaguensis
Annular rim
Proximal face
Distal face
Proximal face
K
L
M
N
O
P
Q
Distal face (different appendages arrangements)

later, Herngreen et al. (1996) renamed it the Albian–Cenomanian Elaterates Province and extended its palaeogeographic distribution based on new findings. The latitudinal arrangement of palaeo-phytogeographic provinces during the Cretaceous suggests that palaeoclimates played a major role in the geographical extension of land plants and their sporomorphs (Herngreen 1998). The elaterates have been mostly recorded within a few degrees latitude of the palaeo-equator in South America, Africa, the Middle East, Bahama Islands, the Southern Alps (southern Switzerland, northern Italy), western China and Papua-New Guinea (Hochuli 1981; Herngreen & Dueñas Jimenez 1990; Dino et al. 1999). Dino et al. (1999) concluded that, based on highest abundances, the *circum*-Atlantic basins of northern South America and northern Africa could have been the radiation and diversification centre of the complex.

The southernmost record of an elaterate grain was found in the Cretaceous Huincul Formation, Neuquén Province, Argentina (approximately 36° S latitude; Vallati 2006, 2013). The author mentioned the occurrence of *Elateroplicites africaensis* Herngreen and also illustrates a unique poorly preserved specimen assigned with doubt to *Galeacornea*, stating that further material is needed to assure the presence of the genus in these sediments. Hence, our specimens of *Galeacornea guayaguensis* constitute the first definite occurrence of the genus *Galeacornea* in Argentina.

Galeacornea guayaguensis was found within an association dominated by gymnospermous elements, mainly represented by plicate and rimulate grains. *Classopollis* is abundant (nearly 20%) in all the assemblages. Within the plicate grains (23–34%), the different species of *Cycadopites* and a rich variety of the *Ephedripites* plexus are the most frequent elements. Pteridophyte spores are represented by several taxa: *Cicatricosisporites, Concavissimisporites, Crybelosporites, Deltoidospora, Impardecispora* and *Leptolepidites*. Often aquatic forms such as *Scenedesmus, Ovoidites* and *Crucigeniella*, account for nearly 20% of the assemblages (Prámparo & Milana 1999; Prámparo et al. 2004, 2005; Mego & Prámparo 2013; Narváez et al. 2013). Among the recovered palynomorphs, *Reyrea polymorphus* Herngreen is one of the most significant taxa for age determination (early–middle Albian from Brazil; Herngreen 1973) (Figure 2).

Prámparo (1990, 1994) studied the palynological content of the La Cantera Formation (Late Aptian), which underlies the Lagarcito Formation in the San Luis Basin, and concluded that the palynoflora containing common *Ephedripites, Afropollis* and *Transitoripollis* (Figure 2) are transitional between the Northern and Southern Gondwana palynofloristic provinces (Brenner 1976) or between the northern *Dicheiropollis etruscus*/*Afropollis* Province (Berriasian–Aptian) and the southern Early Cretaceous–Cenomanian *Trisaccates* Province (*sensu* Herngreen et al. 1996). The presence of a unique elaterate species (*Galeacornea guayaguensis*) with abundant plicate grains and *Classopollis* sp. suggests the Lagarcito Formation palynological association could be considered transitional between the equatorial Albian–Cenomanian Elaterates Province and the austral Early Cretaceous–Cenomanian *Trisaccates* Province.

Conclusion

A new elaterate species named *Galeacornea guayaguensis* has been described from sediments of the Lagarcito Formation (San Luis Basin) in the 'La Yesera Sur' section at the Sierra de Guayaguás ranges in San Juan Province, central-western Argentina. This study constitutes the first effective report of *Galeacornea* appearing outside the boundaries of the Albian–Cenomanian Elaterates Province and thus extending the geographical distribution of *Galeacornea* to southern South America. A new combination of the species *Quantonenpollenites crassatus* has been proposed to *Galeacornea crassatus*. The revision of the elaterate genera and all *Galeacornea* species provides additional information on the morphological variation of the Elaterate Complex.

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Figure 4. Comparative schematic illustrations of *Galacornea* species. **A–C**. *Galacornea causea* (modified from Jardinè 1967). **D, E**. *Galacornea clavis* (modified from Stover 1963). **F, G**. *Galacornea stoveri* (modified from Elsik 1974) **H–J**. *Galacornea crassatus* (modified from Li 2001). **K–Q**. *Galacornea guayaguensis*. (There are no original schemes of *G. tarimensis* in Zhang and Zhan 1986, which is why it is not illustrated here). Scale bar – 10 μm.

Table II. Morphological data of the *Galeacornea* species.

Features	Species	*Galeacornea clavis* Stover 1963[1,2,3,4,5,6]	*Galeacornea causea* Stover 1963[1,2,3,4,5,7,8,9]	*Galeacornea stoveri* Elsik 1974[6,10]	*Galeacornea tarimensis* Zhang et Zhan 1986[11,12]	*Galeacornea crassatus* (Yu, Guo et Mao) comb. nov.[12, 13,14]	*Galeacornea guayaguensis* sp. nov.
Body	**Shape**	Ellipsoidal	Ellipsoidal	Ellipsoidal	Ellipsoidal	Ellisoidal to subspherical	Ellipsoidal to subhemispherical
	Long axis (μm)	40.0–50.0	30.0–57.0	32.0–60.0	30.0–43.0	29.0–51.0	26.0–44.0
	Short axis (μm)	25.0–35.0	23.0–42.0	15.0–38.0	18.0–30.0	20.0–41.0	20.0–36.0
	Annular rim width (μm)	3.0–5.0	2.0–10.0	1.0–2.5	4.0–7.0	2.5–4.0	1.0–2.5
	Exine thickness (μm)	1.0–2.0	1.0–3.0	1.0–2.5	Not provided	Not provided	0.2
	Exine ornamentation	Smooth	Smooth	Smooth	Smooth to granulate	Not provided	Smooth
Appendages	**Number**	1	1	3–9	4–6	1	3–7
	Shape	Y-shaped horn	Sheet- or flap-like	Prominent ridge-like plus two knob-like projections at the ends of the grain	Plate- or flap-like that may join at the ends	Pillow-like	Prominent ridge-like
	Orientation	Central	Oblique	Parallel to long axis	Parallel to long axis	Transversal to long axis	Parallel to long axis
	Length (μm)	30.0–50.0	27.0–38.0	Not provided	Not provided	Not provided	3.5–40.0
	Width (μm)	3.0–5.0	10.0–15.0	*c.* 3.0	Not provided	11.0–16.0	2.0–7.0
	Height (μm)	Not provided	<20.0	2.0–6.5	Not provided	*c.* 15.0	2.0–11.0
	Distance between appendages (μm)	—	2.0–3.0	Not provided	Not provided	Not provided	0.5–10.0
Distribution		Africa (Surinam, Guinea-Bissau, Nigeria), Brazil, Peru	Africa (Egypt, Gabon, Guinea-Bissau, Ivory Coast, Nigeria, Sudan, Senegal), Brazil, Surinam, Southern Alps, westernmost China, Papua New-Guinea	Nigeria, SE USA	NW China	NE China	Central-western Argentina
Age		Albian-Cenomanian	Albian-Turonian	Late Jurassic (USA), Albian-Cenomanian (Nigeria)	Coniacian-Santonian	Cenomanian-Turonian	Albian?

References: 1, Stover (1963); 2, Jardiné (1967); 3, Brenner (1968); 4, Herngreen and Dueñas Jimenez (1990); 5, Dino et al. (1999); 6, Ola-buraimo and Boboye (2011); 7, Herngreen (1973); 8, Regali et al. (1974); 9, Atta-Peters (2013); 10, Elsik (1974); 11, Zhang and Zhan (1986); 12, Li (2001); 13, Yu et al. (1983); 14, this paper.

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Disclosure statement

No potential conflict of interest was reported by the authors.

Specimens investigated

Galeacornea guayaguensis Prámparo, Narváez et Mego. Argentina: San Juan, Sierra de Guayaguás ranges. Juan Pablo Milana, 10 May1996. MPLP 5862I: U25/0; 5862J: K21/1 (MPLP).

Galeacornea guayaguensis Prámparo, Narváez et Mego. Argentina: San Juan, Sierra de Guayaguás ranges. Juan Pablo Milana and Mercedes B. Prámparo, 8 September 1996. MPLP 5967C: Q39/3; 5967D: T42/0; 5967E: X35/0; 5968F: F24/0; 5968H: E27/0, J42/0, N25/0, N40/4, P40/1, R25/1, T39/4, V26/0, V34/3, W35/4, W39/4; 5968I: X31/1; 5968J: D26/0, G22/1, J40/0, O21/4; 5968K: P23/0, R26/1, T42/1; 5968W: E27/0, N33/0, R23/0, S34/1, V41/0, Y22/4; 5968X: D29/2, N38/4, Q40/3, T31/0, V24/1; 5968Z: N22/0, M24/0, Q42/1; 5968A′: F33/1, H43/4; 5968B′: D43/0, F39/0, R35/1, T31/0; 5968C′: C32/4, C34/4, C36/0, J27/0, U45/3, V41/2; 5969E*: K26/0 (MPLP).

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