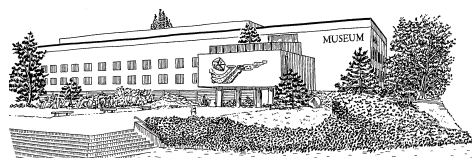


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Albian ammonite faunas from South America : the genus *Tegoceras* HYATT, 1903

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Abstract

The genus *Tegoceras* HYATT, 1903, is crucial for the understanding of the Upper Lower Albian of the Andean Basins. In South America, the genus was only described in Colombia (ETAYO SERNA, 1979) and Venezuela (RENTZ, 1982). New analysis of Colombian material of the BREISTROFFER's collection allow us to first mention *Tegoceras camatteanum* (D'ORBIGNY, 1841) and to describe a new species, *Tegoceras breistrofferi* n. sp., named in honor to the french paleontologist Maurice BREISTROFFER. Recent studies (ROBERT, 2002 and this paper) provide us to also first mention representatives of the genus *Tegoceras* in the Peruvian ammonite fauna, with *T. benavidescaceresi* ETAYO SERNA (1979) and *Tegoceras* sp.

Key words

Ammonitina, Acanthoceratoidea, Lyelliceratidae, Lyelliceratinae, *Tegoceras*, Cretaceous, Albian, South America.

I. INTRODUCTION

This systematic analysis originates from the study of the BREISTROFFER's collection specimens and a collection made by one of us (E.R.) in the Upper Lower Albian of Peru, both stored at the Institut Dolomieu of the University of Grenoble (France).

Comparative analysis of the Colombian and Peruvian faunas, made for the first time, provides new informations on the evolution of the Andean *Tegoceras* during the Upper Lower Albian. Oldest specimen (*Tegoceras* sp.), dated from the *Parengonoceras haasi* Subzone and *P. ebrayi* biohorizon (*Glottoceras raimondii* Zone), present primitive morphologies, close to *Tegoceras mosense* described in Europe (LATIL, 1995), with particularly rounded ventro-lateral tubercles. Peruvian *Tegoceras benavidescaceresi* and *Tegoceras breistrofferi* n.sp. from Colombia, later developed ornamental features close to that of the primitive forms but with lateral nodes on the younger stages, combined with a clear weakening of the ribs. Morphologically this character precludes the ornamentation developed by the Andean representatives of the advanced species *Tegoceras camatteanum*, initially described in Europe (D'ORBIGNY, 1841 ; LATIL, 1995) and must be considered as contemporaneous, or youngest, with *Tegoceras benavidescaceresi* and *T. breistrofferi*.

The Colombian and Venezuelan *Tegoceras* lack detailed

stratigraphic data. Ages are deduced from the Peruvian material. The bed by bed sampling of new specimens allow us to date the Andean representatives of the genus *Tegoceras* to the Upper Lower Albian. It should be noted that their stratigraphical distribution is identical with the European taxa.

II. CONVENTIONS

The following abbreviation is used to indicate the repository of specimens cited in the text. UJF-ID: Institut Dolomieu, Université Joseph Fourier (Grenoble I).

III. NOTES ON STRATIGRAPHY

Our specimens originate from the Northern Andean Basin, back-arc zone controlled by the development of a magmatic arc along the Peruvian margin and which sustain a major marine transgression during the Lower and Mid-Cretaceous times (JAILLARD *et al.*, 2000).

The BREISTROFFER Collection specimens are from Colombia. They have been collected in the departments of Cundinamarca and Tolima, from Central Colombia (Fig. 1). No precise stratigraphic data or faunal associations are available.

The ROBERT Collection specimens come from the

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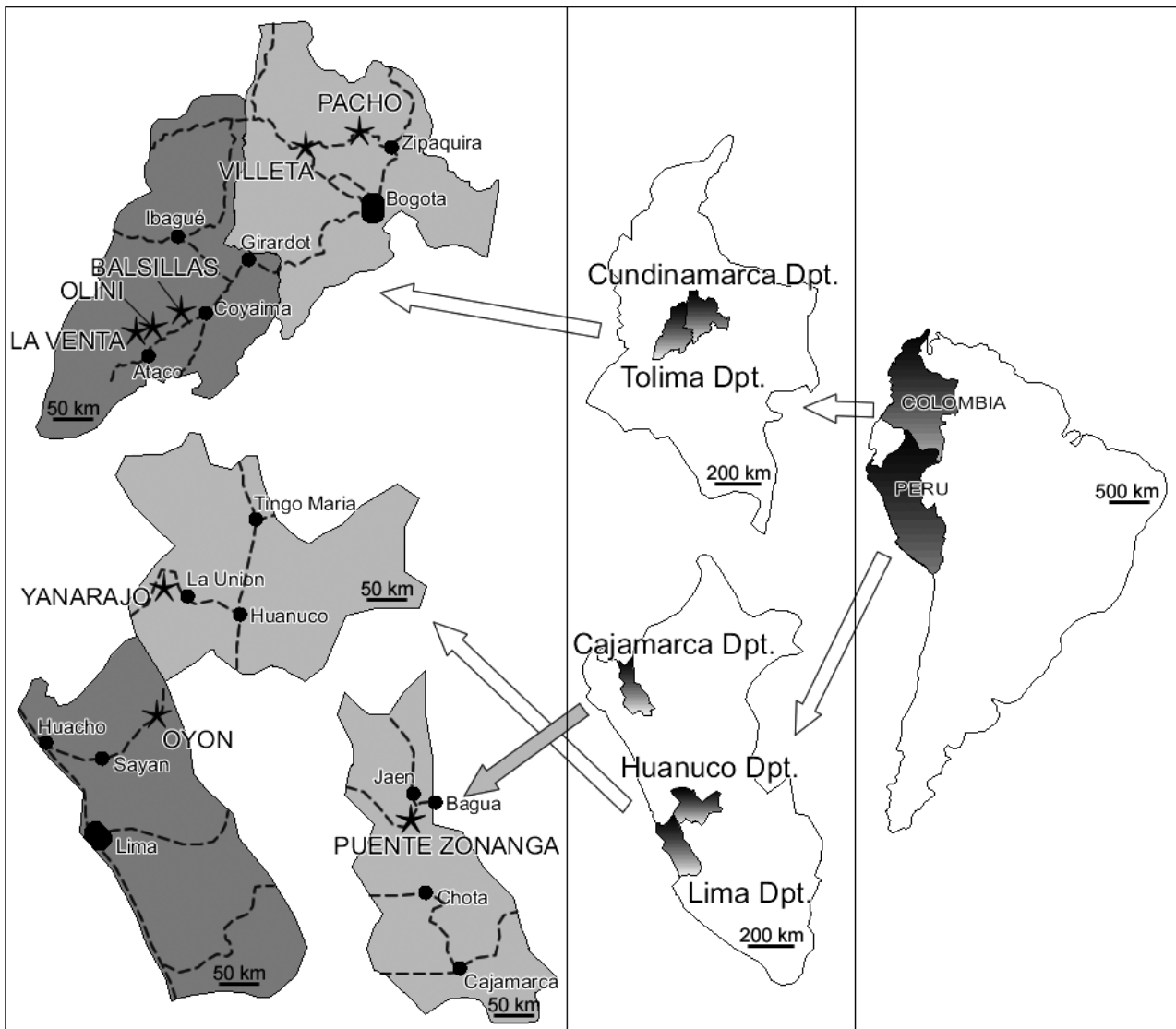


Fig. 1: Map of the Cundinamarca and Tolima Department of Colombia and the Lima, Huanuco and Cajamarca Department of Peru, showing the localities of the *Tegoceras* species studied.

Oyón, Yanarajo and Corral Quemado sections, situated in the departments of Lima, Huanuco and Cajamarca, from Central to Northern Peru (Fig. 1). These peruvian *Tegoceras* were collected in the Chulec and Pariatambo Formations, characterized successively by marine carbonates and bituminous facies (ROBERT, 2002). Their biostratigraphic distribution (Fig. 2) is from the *Parenonoceras haasi* Subzone to the *Prolyelliceras mathewsi* Subzone (*Glottoceras raimondii* Zone, Upper Lower Albian), which correlate with the *Sonneratia chalensis* Zone – *Otohoplites auritiformis* Zone interval of the European standard ammonite scale of OWEN (1984, 1988) (Robert *et al.*, 2002).

IV. SYSTEMATIC

- Order Ammonoidea ZITTEL, 1884**
Suborder Ammonitina HYATT, 1889
Superfamily Acanthoceratoidea GROSSOUVRE, 1894
Family Lyelliceratidae SPATH, 1921
Subfamily Lyelliceratinae SPATH, 1921
Genus *Tegoceras* HYATT, 1903
 (= *Raulinicer* H. DOUVILLÉ, 1911, p. 298: type *Hoplites gladiator*, BAYLE, 1878, pl. 45, fig. 1-2, OD)
 (= *Raulinicer* [*Seunesicer*] BREISTROFFER & DE VILLOUTREYS, 1953, p. 74: type *Ammonites lyelli*, PICTET & CAMPICHE, 1860, pl. 24, fig. 6)

Type species: *Ammonites mosensis* D'ORBIGNY, 1841, p. 237, pl. 67, fig. 5-7, by original designation of HYATT, 1903, p. 84.

Occurrence: The genus *Tegoceras* is known from Western Europe (see LATIL, 1995, for details), Madagascar (COLLIGNON, 1963), South Africa (COOPER, 1992), Venezuela (RENZ, 1982), Colombia (ETAYO SERNA, 1979 and this paper) and Peru (ROBERT, 2002 and this paper). The stratigraphic distribution of the genus ranges from the *Cleonicerias [C.] floridum* Subzone (*Sonneratia chalensis* Zone) to the upper part of the *Otohoplites auritifformis* Zone (Upper Lower Albian).

Discussion: We agree with WRIGHT *et al.* (1996) that *Raulinicerias* H. DOUVILLÉ, 1912 and *Seunesicerias* BREISTROFFER, 1953 are junior subjective synonyms of *Tegoceras*. Differences between *Tegoceras* and its direct descendant *Lyelliceras* have been discussed at length by DESTOMBES (1979), LATIL (1995) and LATIL & DOMMERGUES (1997). The reader is referred to those papers for more details. It should be noted that none of our observations in Europe and South America, supports the views developed by COOPER (1992).

***Tegoceras camatteanum* (D'ORBIGNY, 1841)
Fig. 3.1-3.8**

- 1841. *Ammonites Camatteanum* D'ORBIGNY, p. 241, pl. 69, figs 1, 2.
- 1847. *Ammonites Seneberianus* PICTET in PICTET & ROUX, p. 73, pl. 6, fig. 7.
- 1860. *Ammonites Lyelli* PICTET & CAMPICHE, p. 198, pl. 24, figs 5, 6.
- 1887. *Acanthoceras camattei* D'ORBIGNY.– SEUNES, p. 52, pl. 13, fig. 3.
- 1896. *Acanthoceras seunesi* PARONA & BONARELLI, p. 48, pl. 14, fig. 9.
- 1953. *Raulinicerias (Seunesicerias) collignoni* BREISTROFFER in BREISTROFFER & DE VILLOUTREYS, 1953, p. 74.
- 1957. ? *Tegoceras camatteanum* D'ORBIGNY.– ALMELLA & DE LA REVILLA, p. 32, pl. 8, fig. 2.
- 1963. *Tegoceras (Raulinicerias) seunesi* PARONA & BONARELLI.– COLLIGNON, pl. 317, fig. 1346.
- 1977. *Tegoceras quadratum* DESTOMBES, p. 39, pl. 1, fig. 2.
- 1979. *Tegoceras camatteanum* (D'ORBIGNY).– DESTOMBES, p. 108, pl. 4-13, fig. 3.
- 1982. *Tegoceras gladiator* (BAYLE).– RENZ, p. 39, figs 26 a-b, pl. 5, fig. 16.
- 1988. *Tegoceras seneberianum* (PICTET).– DELAMETTE, pl. 13, fig. 3.
- 1989. *Tegoceras seneberianum* (PICTET).– DELAMETTE, pl. 2, fig. 5.

lithostratigraphy		biostratigraphy				
Formations	lithology	Peruvian standard zones		Sub-stages	European standard zones	
		Robert, 2002	Benavides Caceres 1956		Owen, 1984, 1988	
Yumagual		<i>Prolyelliceras ulrichi</i>	<i>Oxytropidoceras (Oxytropidoceras) carbonarium</i>	M i l d b d i l a n	<i>Hoplites (Hoplites) dentatus</i>	
Pariatambo						
Chulec	sup.	<i>Lyelliceras pseudolyelli</i> <i>Prolyelliceras mathewsi</i>	<i>Glottoceras raimondii</i>	L o w e r A l b i a n	<i>D o m u a v i m l l e l c e r a s</i>	<i>Otohoplites auritifformis</i>
	med.	<i>Prolyelliceras alternum</i>				
	inf.	<i>Parengonoceras ebrayi</i>				
Inca		<i>Parengonoceras haasi</i>	<i>Neodeshayesites nicholsoni</i>			<i>Sonneratia chalensis</i>
		interzone				

Fig. 2: Litho- and biostratigraphic nomenclature of the Albian of Peru, with correlation with the European standard ammonite scale.

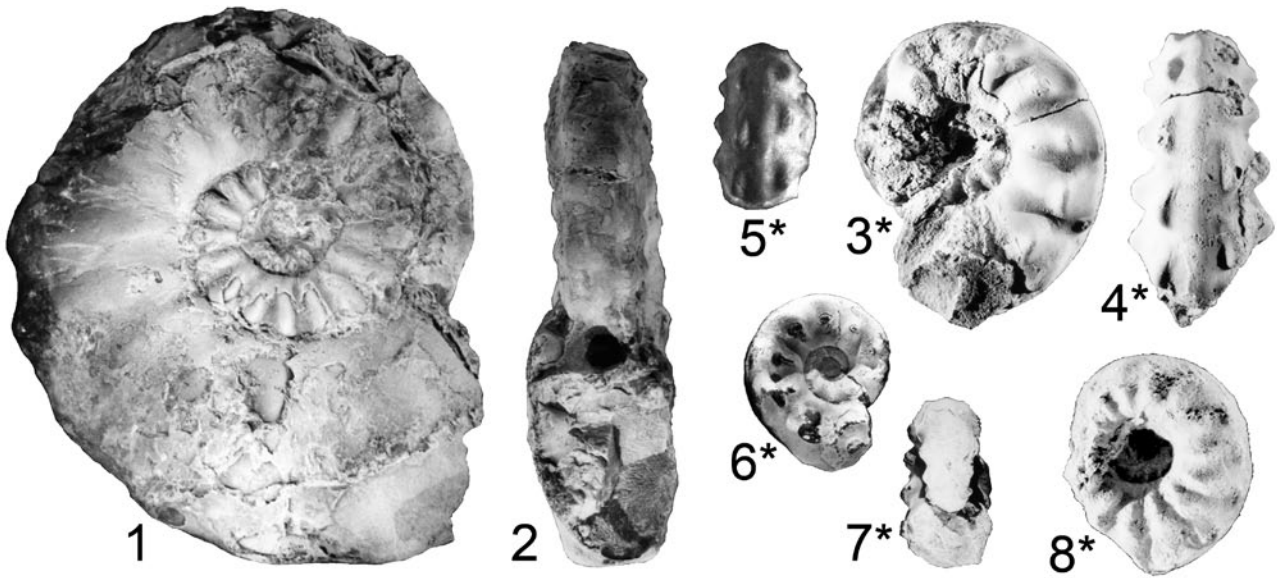


Fig. 3: *Tegoceras camatteanum* (D'ORBIGNY). 1, 2 (UJF-ID.10595): south of Balsillas (Dpt. Tolima, Colombia), Upper Lower Albian (1). 3, 4 (UJF-ID.10596): road Coyaima-Atoco (Dpt. Tolima, Colombia), Upper Lower Albian (1,5). 5-7 (UJF-ID.10597): Pacho (Dpt. Cundinamarca, Colombia), Upper Lower Albian (1,5). 8 (UJF-ID.10598): Olini (Dpt. Tolima, Colombia), Upper Lower Albian (1,5).

1992. *Tegoceras camatteanum* (D'ORBIGNY).— LATIL, p. 98, fig. 40, pl. 5, figs 6-13.
1992. *Tegoceras seunesi* (PARONA & BONARELLI).— COOPER, p. 24, figs 2E-F
1995. *Tegoceras camatteanum* (D'ORBIGNY).— LATIL, p. 352, fig. 19, pl. 1, figs 6-13.
1997. *Tegoceras camatteanum* (D'ORBIGNY).— LATIL & DOMMERGUES, fig. 1.
1997. *Tegoceras camatteanum* (D'ORBIGNY).— DELAMETTE *et al.*, pl. 21, fig. 2.
1997. *Tegoceras cf. camatteanum* (D'ORBIGNY).— DELAMETTE *et al.*, pl. 21, fig. 4.

Description: Shell slightly involute and heavy, with a maximum diameter of 90 mm (Fig. 3.1). Whorl section subquadrangular in younger stages (Fig. 4.1, 4.2), becoming subellipsoid and clearly higher than wide on the body chamber (Fig. 4.3). Umbilical angle well develop. Ribbing is composed by 16 ribs per volution, beginning at umbilical wall and giving rise to the ventral shoulder. Ribs, attenuated on juvenile whorl, become strong and falcate on intermediate stage. Ribs tend to disappear and zigzagging on the ventral area and on adult stage. Spiral tubercles on the lower third of flanks on juvenile specimens. Ventrolateral pointed or spiral tubercles developed on all ontogenetic stages. Details of the septal line not visible.

Material examined: UJF-ID.10595, UJF-ID.10596, UJF-ID.10597, UJF-ID.10598.

Occurrence: All specimens are from Colombia and belong to the Breistroffer collection housed at the Institut Dolomieu in Grenoble. No precise stratigraphic data are available. Specimen UJF-ID.10595 was collected south of Balsillas (Dpt. Tolima). Specimen UJF-ID.10596 originates from Pacho (Dpt. Cundinamarca). Specimen UJF-ID.10597 is from Olini (Venta-Istanbul, Dpt. Tolima). Specimen UJF-ID.10598 was collected along the road Coyaima – Atoco (Q. Olini, Dpt. Tolima). No other colombian specimens have been described in the literature.

Discussion: The material from Colombia falls within the intraspecific variation of *Tegoceras camatteanum* described by LATIL (1995). Two different morphotypes can be distinguished. UJF-ID.10595 is a rather large and compressed form with coarse ornamental features that corresponds to the type specimen of *Ammonites seneberianus* PICTET. The other specimens are smaller, inflated with strong morphological features that characterize *Raulinicer* (*Seunesicer*) *collignoni* BREISTROFFER.

Tegoceras camatteanum has a widespread geographical distribution (Western Europe, Madagascar, South Africa and Venezuela) in the Upper Lower Albian (*Otohoplites auriformis* Zone, *O. bulliensis* to *Lyelliceras pseudolyelli* Subzones). The species is herein reported from Colombia for the first time. *Tegoceras camatteanum* has been reported from the Middle Albian of South Africa by COOPER (1992). This stratigraphic attribution is erroneous

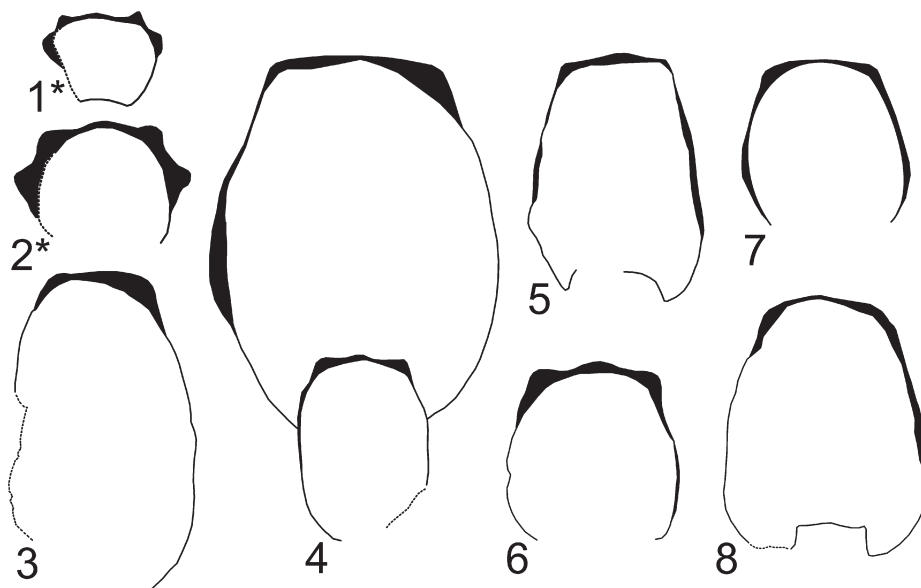


Fig. 4: Whorl sections. 1 *Tegoceras camatteanum* (D'ORBIGNY) (UJF-ID.10597), Pacho (Dpt. Cundinamarca, Colombia), Upper Lower Albian (x 1,5). 2 *Tegoceras camatteanum* (D'ORBIGNY) (UJF-ID.10596), road Coyaima-Atoco (Dpt. Tolima, Colombia), Upper Lower Albian (x 1,5). 3 *Tegoceras camatteanum* (D'ORBIGNY) (UJF-ID.10595), south of Balsillas (Dpt. Tolima, Colombia), Upper Lower Albian (x 1). 4 *Tegoceras benavidescaceresi* ETAYO SERNA (UJF-ID.12141), Yanarajo (Dpt. Huanuco, Peru), Upper Lower Albian (x 1). 5 *Tegoceras benavidescaceresi* ETAYO SERNA (UJF-ID.10594), Villeta (Dpt. Cundinamarca, Colombia), Upper Lower Albian (x 1). 6 *Tegoceras benavidescaceresi* ETAYO SERNA (UJF-ID.12217), Yanarajo (Dpt. Huanuco, Peru), Upper Lower Albian (x 1). 7 *Tegoceras breistrofferi* n. sp. (UJF-ID.10599), east of La Venta (Dpt. Tolima, Colombia), no stratigraphic data (x 1). 8 *Tegoceras* sp. (UJF-ID.12142), Puente Zonanga (Dpt. Cajamarca, Peru), Lower Albian (x1).

since unpublished material collected by H. KLINGER and W.J. KENNEDY was collected from Upper Lower Albian beds (Albian II-III *sensu* KENNEDY & KLINGER, 1975) in northern Zululand (KLINGER, pers. comm., 2002).

Tegoceras benavidescaceresi ETAYO SERNA, 1979

Fig. 5.1-5.6

1979. *Tegoceras benavidescaceresi* ETAYO SERNA, p. 82-83, pl. 11, fig. 8, text-figs 8z-z'.
- ? 1993. *Tegoceras maderoense* YOUNG, p. 174, figs 2:22, 23, 25-27, 30-43, figs 3:6, 8-11.
2002. *Tegoceras benavidescaceresi* ETAYO SERNA.– ROBERT, p. 137-138, pl. 17, figs 1-3.

Description: Shell evolute. Whorl section is subquadrate on the younger stages, but become subrectangular (higher than wide) and the body chamber (Fig. 4.4-4.6). Venter and sides are flat. Maximum of thickness between the umbilical wall and the upper third of flanks. Umbilical angle inclined and rounded. Ribbing is moderately dense, ranging about 24 to 26 ribs per revolution. Ribs begin at the umbilical angle and give rise to a very spiral ventrolateral tubercle. All ribs are simple, large and falcate. Rectiradiate to weakly convex from the umbilical wall to the middle of flanks, they tend to convexity on the ventral shoulder. Ribs become strongly attenuated and zigzagging on ventral area. Suture is unknown on both

Peruvian and Colombian specimens.

Material examined: UJF-ID.10593, UJF-ID.10594, UJF-ID.12141, UJF-ID.12217.

Occurrence: The peruvian specimens of the ROBERT Collection were collected in the Upper Lower Albian (*Glottoceras raimondii* Zone, *Prolyelliceras mathewsi* Subzone) at Yanarajo (Dpt. Huanuco, Central Peru) (Fig. 2). The colombian material belongs to the BREISTROFFER collection housed at the Institut Dolomieu in Grenoble. No precise stratigraphic data are available. Specimen UJF-ID.10593 was collected south of Balsillas (Dpt. Tolima). Specimen UJF-ID.10594 from Villeta (Dpt. Cundinamarca). According to ETAYO SERNA (1979, p. 83) the type specimen of *T. benavidescaceresi* is of Middle Albian age; because of its co-occurrence with *Parengonoceras duartei* ETAYO SERNA at the type locality we rather suggest an Upper Lower Albian age for the association (see ROBERT, 2002, p. 138).

Discussion: Originally, the species was described from a single specimen. Our additional columbian specimens allow a better understanding of *T. benavidescaceresi*. The large fragment (UJF-ID.10594) corresponds to septate outer whorls and the mature body chamber is not preserved. UJF-ID.10593 is still entirely septate at a diameter of 118 mm. Our material does not show any significant difference with the holotype at similar growth stages. Nevertheless, observation of adult morphology

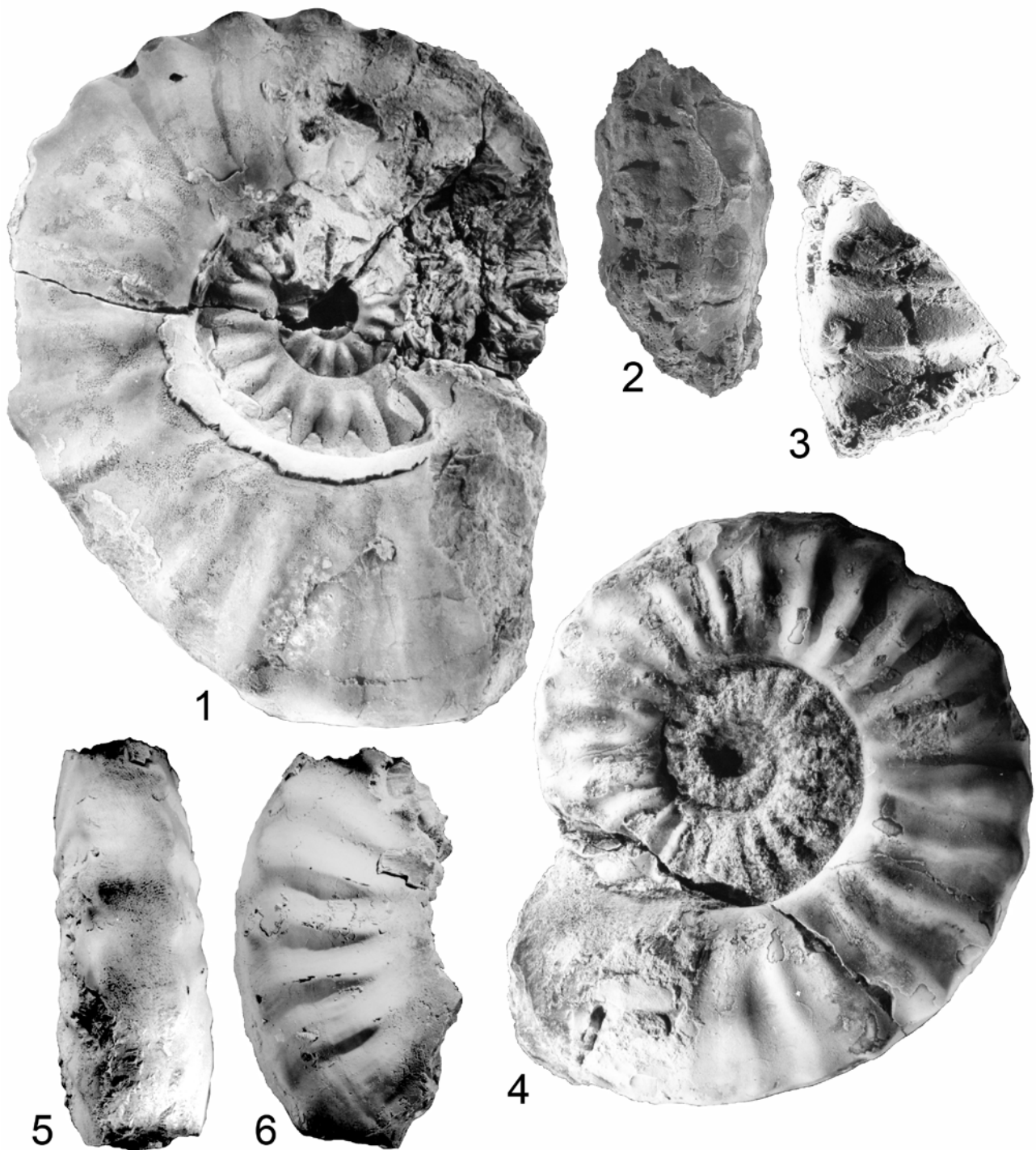


Fig. 5: *Tegoceras benavidescaceresi* ETAYO SERNA. 1 (UJF-ID.12141): Yanarajo (Dpt. Huanuco, Peru), Upper Lower Albian. 2, 3 (UJF-ID.12217): Yanarajo (Dpt. Huanuco, Peru), Upper Lower Albian. 4 (UJF-ID.10593): south of Balsillas (Dpt. Tolima, Colombia), Upper Lower Albian. 5, 6 (UJF-ID.10594): Villeta (Dpt. Cundinamarca, Colombia), Upper Lower Albian. All figures are $\times 1.0$.

(end of phragmocone) shows the disappearance of the lateral tubercles and peri-umbilical bullae combined with a clear weakening of the ribs and ventro-lateral tubercles. Our larger peruvian specimen (UJF-ID.12141, $D_{max} = 145$ mm) is less evolute and shows a more inflated whorl section. The umbilical wall is less steep.

YOUNG (1993) differentiates *Tegoceras maderoense* by its “weakly sigmoid” ribs compared to their more rectiradiate shape on *T. benavidescaceresi*; nevertheless, we observe a weakly falcate ribbing on our representatives. Other characters of *T. maderoense*, as high whorl, dense ribbing, or clearly spiral ventrolateral tubercle, are close to *T. benavidescaceresi*. We suggest a probable synonymy between both species.

Other closest known species is *Lyelliceras vaasti* DESTOMBES, JUIGNET & RIOULT. Nevertheless, several major morphological features justify the attribution of both species to different genera. *L. vaasti* is characterized by a smaller adult size ($D_{max} = 54$ mm) and a well expressed row of peri-umbilical tubercles. Moreover, to the difference of *T. benavidescaceresi*, the lateral row of tubercles is situated on the upper third of the flank and the ribs are clearly club-shaped on the ventral shoulder. The typical *Lyelliceras* morphology, e.g. ribbing zigzagging weakly over the venter, is well expressed on the phragmocone. Tuberculation also persists on the body chamber.

Two additional specimens (UJF-ID.12218 and UJF-ID.12219) from older beds (Lower Albian, *Glottoceras raimondi* Zone, *G. raimondi* and *Prolyelliceras mathewsi* Subzones) are tentatively referred to *T. benavidescaceresi*. They differ from the other specimens by their more compressed whorl section and less extended trituberculated stage.

Tegoceras breistrofferi new species

Fig. 6.1-6.2

Diagnosis: Small *Tegoceras*, clearly evolute. Whorl section quadrangular (Fig. 4.7). Flat venter and sides. Ribs simple, rectiradiate and club shaped on flanks, zigzagging on venter. Coarse ventrolateral tubercles. Pointed nodes on the inner third of flanks at young stage. Both ribbing and tuberculation weakening on the body chamber.

Description: The single specimen is a well preserved ammonite with a maximum diameter of 84 mm. The phragmocone ends at about 70 mm. Very evolute shell ($U/D = 0.46$). Quadrangular whorl section with maximum of thickness on the inner third of flanks. Umbilical moderately steep. Single ribs appear on the umbilical angle, radial to slightly prorsiradiate and club shaped, very prominent and coarse on the phragmocone, less prominent on the body chamber. On the ventral area the ribs are attenuated and zigzagging. Row of coarse node on the inner third of flank at young stage. Coarse ventrolateral nodes weakening on the body chamber. The

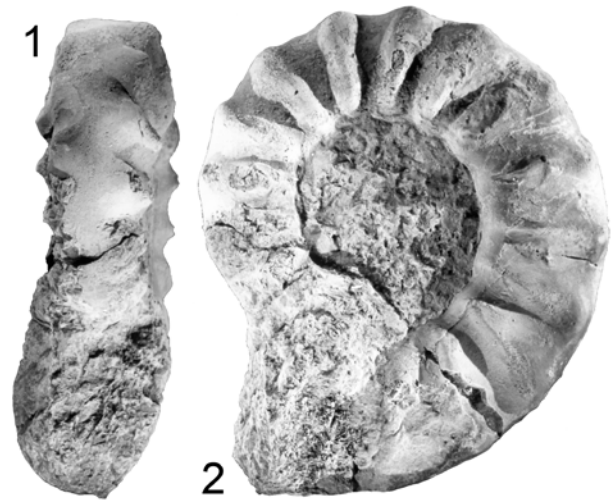


Fig. 6: *Tegoceras breistrofferi* n. sp. Holotype. 1, 2 (UJF-ID.10599): east of La Venta (Dpt. Tolima, Colombia), no stratigraphic data. Figures are 0.84.

nodes seems to disappear completely on the last rib of the body chamber. Details of the septal line not visible.

Etymology: The species is named in honor of the french paleontologist Maurice BREISTROFFER.

Type: The holotype UJF-ID.10599, from East of La Venta, West of Olini Dome (Dpt. Tolima, Colombia). No stratigraphic data are available.

Discussion: This new species shows an atypical coiling and whorl section that hardly compare with any other *Tegoceras* described so far. The ornamental features are similar to that of the primitive *T. mosense* but differs by the lateral nodes on the younger stages. Morphologically this character precludes the ornamentation developed in *T. camatteanum*.

Tegoceras sp.

Fig. 7.1-7.3

2002. *Tegoceras* sp., ROBERT, p. 138-139, pl. 17, fig. 4-6.

Description: Poorly preserved material, with large dimension. Maximum diameter reaches 110 mm (UJF-ID.12142). Whorl section, compressed, higher than wide (fig. 4.8). Maximum of thickness on the upper third of flanks. Venter and sides flat to slightly convex. Ribbing little dense, with large intercostae. Ribs attenuated, become stronger on the upper third of flanks. Ribs begin on the umbilical angle and give rise to ventrolateral, spiral and alternated, tubercles; zigzagging and tend to disappear on the ventral area. Suture line is unknown.

Material examined: UJF-ID.12142, UJF-ID.12220, UJF-ID.12221.

Occurrence: All specimens are from Peru. Specimen UJF-ID.12220 was collected from the Lower Albian

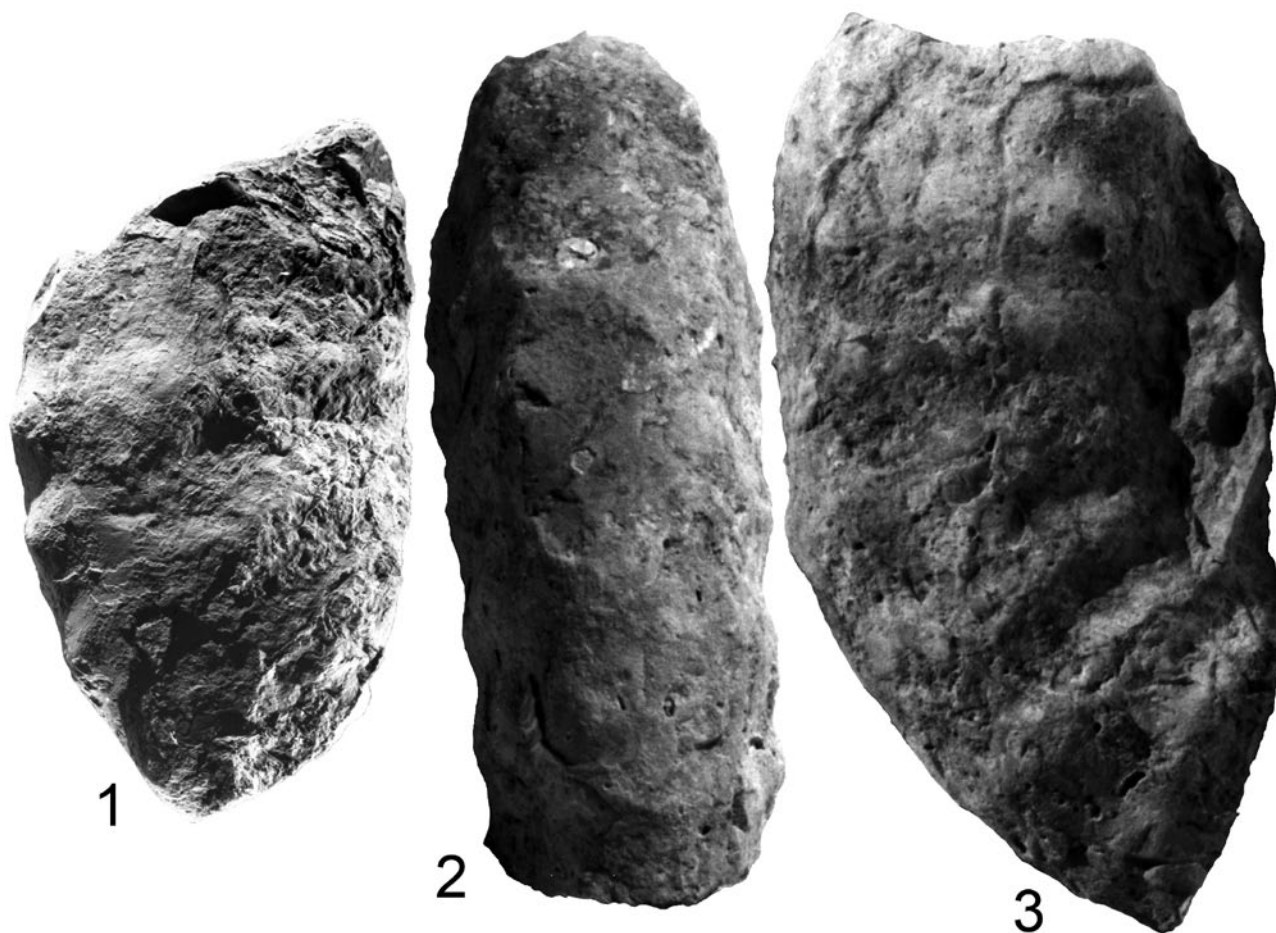


Fig. 7: *Tegoceras* sp. 1 (UJF-ID.12220): Oyon (Dpt. Lima, Peru), Lower Albian. 2, 3 (UJF-ID.12142): Puente Zonanga (Dpt. Cajamarca, Peru), Lower Albian. All figures are $\times 0.92$.

(*Glottoceras raimondi* Zone, *Parengonoceras haasi* Subzone) at Oyón (Dpt. Lima). Specimens UJF-ID.12142 and UJF-ID.12221 are coming from the Lower Albian (*G. raimondii* Zone, *P. ebrayi* biohorizon) at Puente Zonanga (Dpt. Cajamarca) (Fig. 2). Individuals UJF-ID.12142 is the oldest *Tegoceras* known from Peru.

Discussion: The material is too fragmentary for identification at the specific level. The best fragment shows rounded ventro-lateral nodes typical of primitive *Tegoceras* (*Tegoceras mosense* [D'ORBIGNY]). The stratigraphic position is in agreement with this interpretation.

V. CONCLUSION

The revision of Upper Lower Albian Lyelliceratinae from Peru and Colombia provides new informations on their systematics and stratigraphic and paleogeographic significances. The article first establishes that the genus *Tegoceras* is present in the entirety of the Northern Andean

Basins (Venezuela, Colombia and Peru). *Tegoceras* sp., characterized by its primitive morphology, becomes one of the oldest representatives of the genus. Cosmopolitan *T. camatteanum* is mentioned for the first time in the Lower Albian of Colombia. New species *T. breistrofferi* n.sp. is created from Colombian material. Colombian and Peruvian faunas are compared, like *T. benavidescaceresi* present in both areas.

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