

About the generic attribution of *Megatyloceras casei* HUMPHREY, 1949 (Ammonoidea, Ancyloceratina), from the Aptian of Mexico

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Abstract: In the present work we review the generic attribution of the Mexican ammonoid species *Megatyloceras casei* HUMPHREY, 1949, through a careful examination of the holotype housed in the University of Michigan and with reference to new biostratigraphic data from the type locality. We assign here this species to the subfamily Cheloniceratinae and to the genus *Epicheloniceras* CASEY, 1954.

Key Words: Ammonites; Cheloniceratinae; *Epicheloniceras*; Lower Cretaceous; Aptian; Mexico.

Citation : MORENO-BEDMAR J.A. & DELANOY G. (2013).- About the generic attribution of *Megatyloceras casei* HUMPHREY, 1949 (Ammonoidea, Ancyloceratina), from the Aptian of Mexico.- *Carnets de G ologie [Notebooks on Geology]*, Brest, Letter 2013/06 (CG2013_L06), p. 315-323.

R sum  : *Sur l'attribution g n rique d'une ammonite de l'Aptien du Mexique: Megatyloceras casei HUMPHREY, 1949 (Ammonoidea, Ancyloceratina).*- Dans ce travail, nous r visons l'attribution g n rique de l'esp ce mexicaine d'ammonite *Megatyloceras casei* HUMPHREY, 1949. Gr ce   un examen minutieux de l'holotype conserv    l'Universit  du Michigan et gr ce aussi aux nouvelles donn es biostratigraphiques obtenues dans la localit -type, cette r vision nous permet d'inclure maintenant cette esp ce dans le genre *Epicheloniceras* CASEY, 1954.

Mots-Clefs : Ammonites ; Cheloniceratinae ; *Epicheloniceras* ; Cr tac  inf rieur ; Aptien ; Mexique.

Introduction

In Europe, the genus *Megatyloceras* HUMPHREY, 1949, is restricted to the *Roloboceras hambrovi* Subzone (REBOULET *et al.*, 2011) that coincides with the Oceanic Anoxic Event 1a (=OAE 1a) [e.g., MOULLADE *et al.*, 1998; RENARD *et al.*, 2005; BOVER-ARNAL *et al.*, 2010; MORENO-BEDMAR *et al.*, 2009, 2010; NAJARRO *et al.*, 2011]. Currently, this subzone and the OAE 1a are placed in the *Deshayesites forbesi* Zone (e.g., REBOULET *et al.*, 2011; MORENO-BEDMAR *et al.*, 2012a; GAONA-NARVAEZ *et al.*, 2013) or the *Deshayesites deshayesi* Zone (e.g., RENARD *et al.*, 2005; MOULLADE *et al.*, 2011). *Megatyloceras casei* HUMPHREY, 1949, is known from only a single specimen from the La Pe a Formation in the Sierra del Rosario, Durango State, Northern Mexico. Based on the most recent research on the ammonoid record of Mexico (MORENO-BEDMAR *et al.*, 2012b, 2013), we propose assigning this species to the interval between the uppermost lower Aptian and the lowermost upper Aptian. The Mexican *Megatyloceras* is younger than the two possible ages of the *Roloboceras hambrovi*

Subzone proposed in Europe. This biostratigraphic inconsistency is reflected in the stratigraphy. The deposition of the La Pe a Formation is related to the Ap 4 sequence (MORENO-BEDMAR *et al.*, 2011, 2012b) and the *Roloboceras hambrovi* Subzone is associated with the older sequence Ap 3 (GRADSTEIN *et al.*, 2012). In the present work we review the generic attribution of *Megatyloceras casei* HUMPHREY, 1949, by means of the taxonomic review of its holotype, specimen UMMP 21865 (Fig. 1) housed in the University of Michigan Museum of Paleontology (=UMMP).

Original description, dimensions and an excerpt of the remarks

HUMPHREY's (1949, p. 149-150) original description reads as follows:

"This species is represented by one large internal cast on which the inner whorls are imperfectly shown.

Form discoidal, depressed, evolute. Whorl section coronatiform, much wider than high, apparently embracing only one-fifth of the preceding

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Manuscript online since November 11, 2013

[Scientific editor: Michel MOULLADE; technical editor: Bruno GRANIER; language editor: Stephen CAREY]

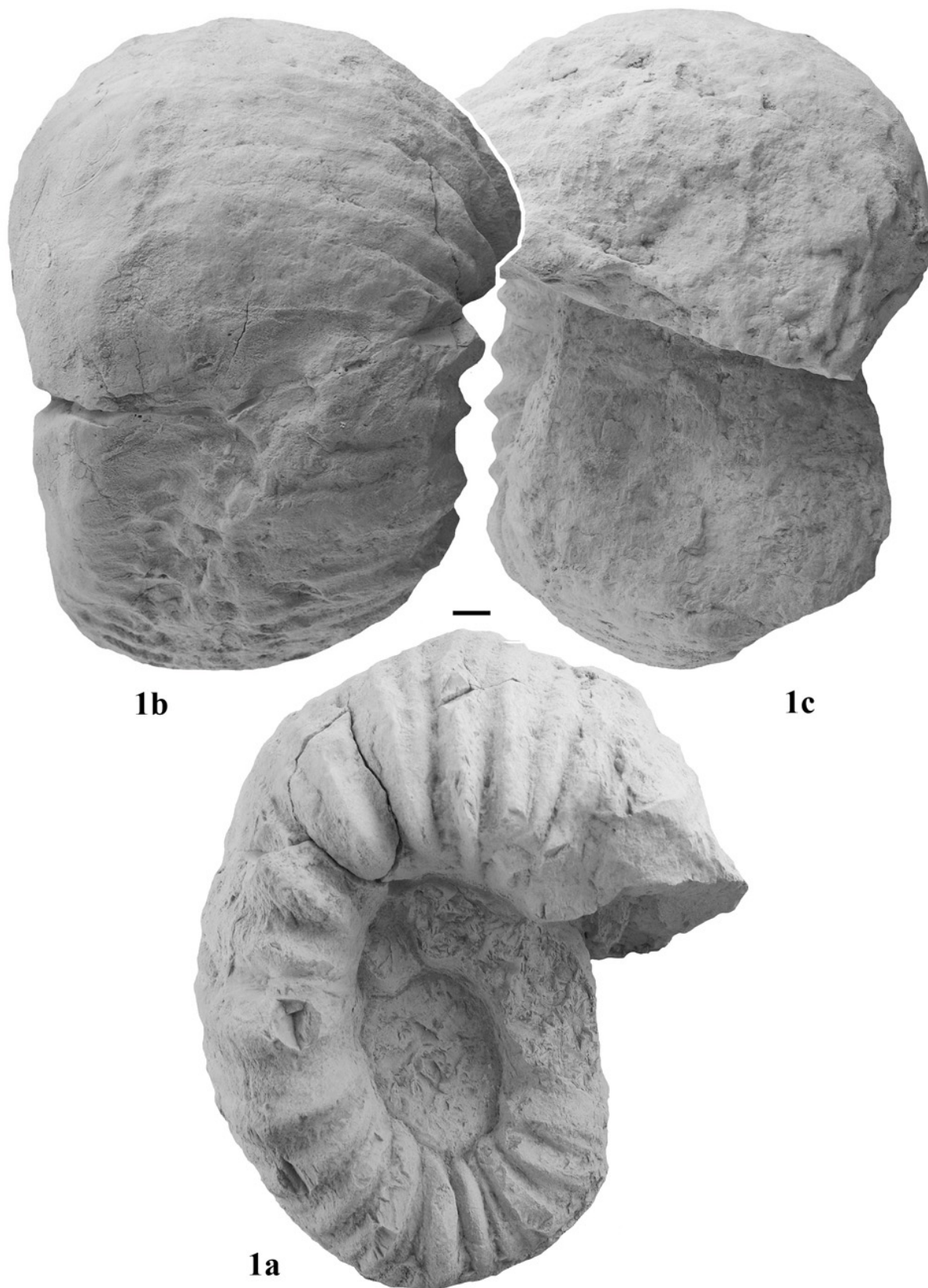


Figure 1: *Megatyloceras casei* HUMPHREY, 1949, lateral (1a), ventral (1b) and frontal (1c) views of the holotype, specimen UMMP 21865. Scale bar is 10 mm.

whorls. Flanks narrowly convex, venter broadly rounded. Umbilicus deep, rather wide; umbilical wall high, steeply inclined. Shell ornamented by irregularly alternating primary and secondary ribs. Primaries begin on umbilical wall and form exaggerated lateral bullae from which, on posterior part of outer whorl, two or three rounded ribs may branch. One secondary may rise independently on broad venter between branching primaries. All ribs cross venter transversely without alteration, being somewhat irregularly spaced and subequal in size. On anterior portion of outer whorl, bifurcation from large bullae is rare, and two secondaries may be present between two simple primaries. On inner whorls there is suggestion that the bullae are represented by small, double nodes and that whorl height may be relatively greater. Suture lines not shown. Holotype U.M 21865."

The dimensions (in mm), given by HUMPHREY, are: diameter =176 mm, width of umbilicus = 85, whorl height = 68, whorl thickness = 150.

Remarks: "The new species is named in honor of Professor Emeritus Ermine Cowles CASE of the University of Michigan, Ann Arbor, Michigan."

Age assignment

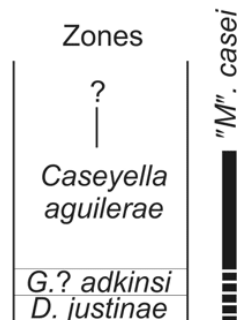
The ammonoid record of the La Peña Formation contains three zones: the *Dufrenoyia justinae* Zone of the uppermost lower Aptian, the *Gargasicerias ? adkinsi* Zone that contains the boundary between the lower and upper Aptian and the *Caseyella aguilerae* Zone of the lowermost upper Aptian (MORENO-BEDMAR *et al.*, 2013). The oldest zone to which *Megatyloceras casei* HUMPHREY, 1949, can be assigned, *i.e.*, *Dufrenoyia justinae* Zone, is younger than the record of *Megatyloceras* in the *Roloboceras hambrovi* Subzone of Europe (Fig. 2). The older Aptian taxa, which come from the basal strata of the La Peña Formation, are referable to the genera *Dufrenoyia* and *Burckhardtites*, *Dufrenoyia justinae* Zone. HUMPHREY (1949) and HUMPHREY and DÍAZ (1956) reported some *Dufrenoyia* and *Burckhardtites* in the lower part of the La Peña Formation or laterally equivalent units including the Cuchillo Formation of Chihuahua State, the Sierra de los Muertos, Sierra de Parras, Cuesta del Cura, Puerto de las Palomas, Cañón de San Antonio and other localities of Coahuila State; some localities in Nuevo León State such as Cerro de la Silla and Arroyo de

Reboulet et al. (2011)

	Zones	Subzones
Upper Aptian ↑	<i>Epicheloniceras martini</i>	<i>E. buxtorfi</i>
		<i>E. gracile</i>
		<i>E. debile</i>
Lower Aptian	<i>Dufrenoyia furcata</i>	<i>D. dufrenoyi</i>
		<i>D. furcata</i>
	<i>Deshayesites deshayesi</i>	<i>D. grandis</i>
	<i>Deshayesites forbesi</i>	<i>R. hambrovi</i>
<i>Deshayesites oglanlensis</i>	<i>D. luppovi</i>	

■ *Megatyloceras* spp.
 ■ *Roloboceras* spp.

Moreno-Bedmar et al. (2013)



◀ **Figure 2:** Tethyan lower Aptian and lowermost upper Aptian standard ammonite zonation of REBOULET *et al.* (2011) with the ranges of the species of *Megatyloceras* and *Roloboceras*, and Mexican uppermost lower Aptian and lowermost upper Aptian ammonite zonation of MORENO-BEDMAR *et al.* (2013) with the range of *Megatyloceras casei*.

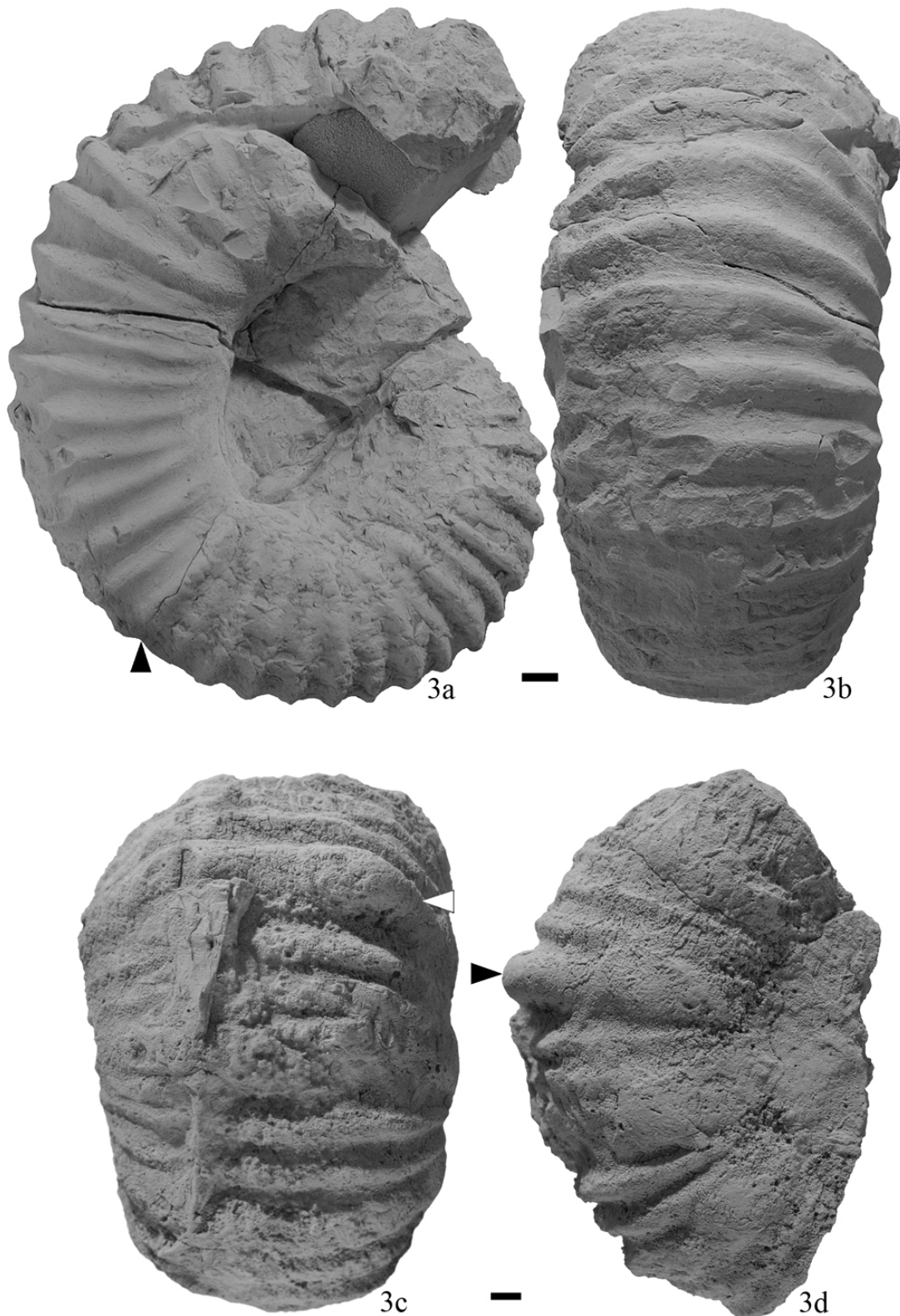


Figure 3: a-b) *Cheloniceras* sp. of 210 mm of maximum diameter lateral (3a) and ventral (3b) views of the specimen UMMP 16414. Black triangle indicates the end of the phragmocone. El Mulato Ranch, Durango State; **c-d)** *Epi-cheloniceras* sp., ventral (3c) and lateral (3d) views of the specimen UMMP 23215. White and black triangles indicate the equivalent ventral tubercle, characteristic of this genus. North of Rio Nazas Valley, Durango State. Scale bar is 10 mm.

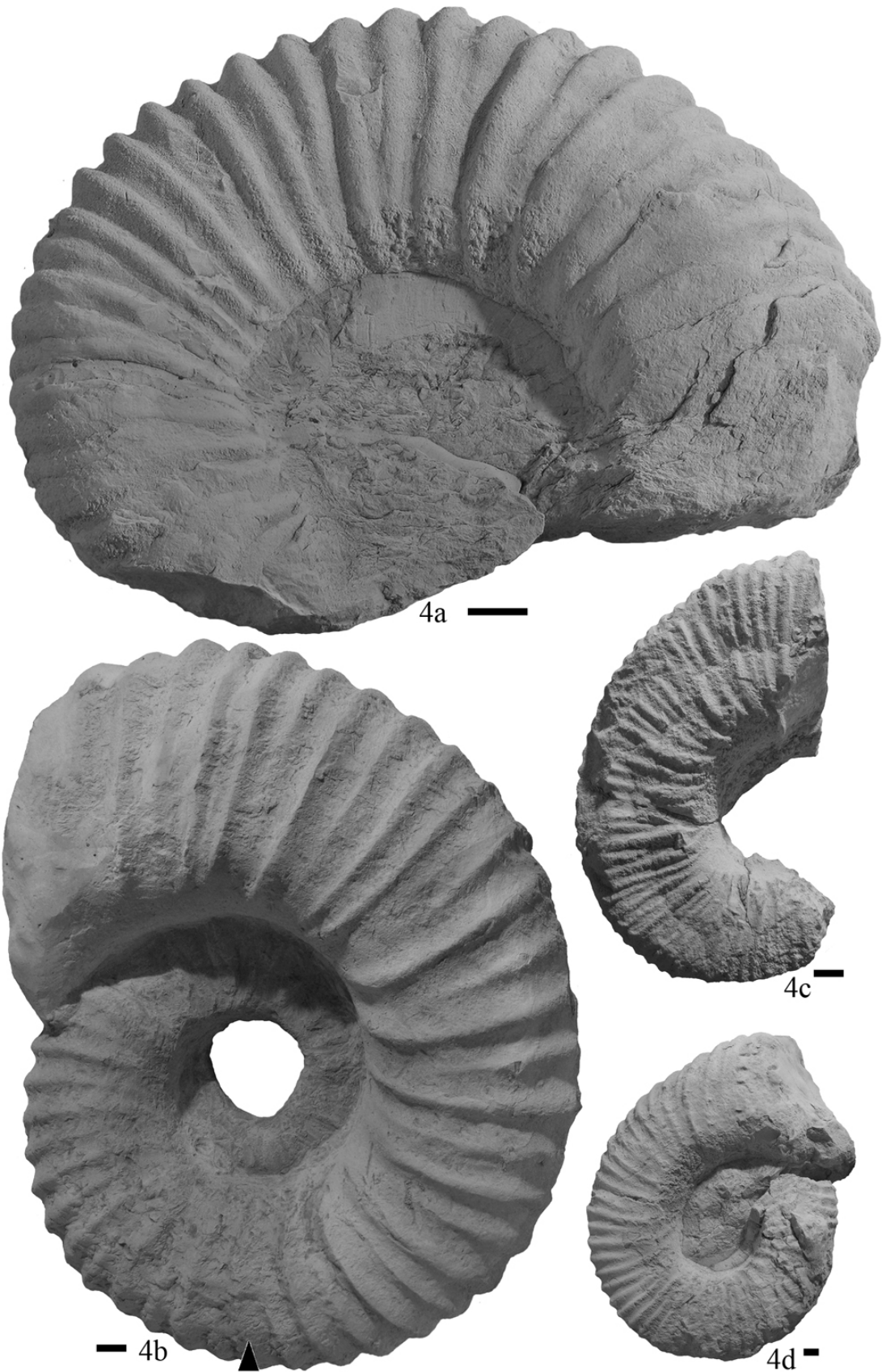


Figure 4: **a)** *Chelonicerias* sp. of 175 mm of maximum diameter, lateral view of specimen UMMP 23458. South of Sierra del Rosario, Durango State; **b)** *Chelonicerias* sp. of 320 mm of maximum diameter, lateral view of the specimen UMMP 23479. Black triangle indicates the end of the phragmocone. Rio Nazas Valley, Durango State; **c)** *Chelonicerias* cf. *meyendorffi* of 160 mm of maximum diameter, lateral view of specimen UMMP 23485. West side of Sierra del Rosario, Durango State; **d)** *Chelonicerias* sp. of 225 mm of maximum diameter, lateral view of specimen UMMP 23480. North of Rio Nazas Valley, Durango State. Scale bar is 10 mm.

San Roque; and the El Mulato Ranch and several other localities in the Nazas River area of Durango State. Other authors have correlated the base of the La Peña Formation with the *Dufrenoyia justinae* Zone. Recently, MORENO-BEDMAR *et al.* (2011, 2012b) concluded that the base of La Peña Formation is isochronous and assignable to the *Dufrenoyia justinae* Zone. HUMPHREY (1949) does not specify the position where *Megatyloceras casei* HUMPHREY, 1949, was found within the La Peña Formation. Thus, *M. casei* could come from anywhere within the interval, uppermost lower Aptian to lowermost upper Aptian, that contains the ammonoid record of the La Peña Formation (Fig. 2). However, in the section of the La Peña Formation studied by MORENO-BEDMAR *et al.* (2013), three large fragments of a poorly preserved Cheloniceratinae were collected in beds 136 and 138 of the *Caseyella aguilerae* Zone (lowermost upper Aptian). In this particular section it seems that this is the only part of the La Peña Formation that provides large Cheloniceratinae. The dimensions and preservation of these large fragments of Cheloniceratinae resemble *Megatyloceras casei*. Accordingly, it is likely that *Megatyloceras casei* was collected from a similar position within the La Peña Formation and its age is probably earliest late Aptian. In order to test this probable age we reviewed all of the Cheloniceratinae of a similar size to *Megatyloceras casei* housed in the University of Michigan, Museum of Paleontology (UMMP), that come from the same or nearby areas to where *Megatyloceras casei* was collected. In this collection we recognize specimens of *Cheloniceras* (Fig. 3a-b; Fig. 4a-d), all of which must be assigned to the lower Aptian, as this genus is restricted to this interval. One of these specimens (Fig. 4c) with a high density of ribbing resembles *Cheloniceras meyendorffi* (d'ORBIGNY, 1845). In Europe this species is assigned to the uppermost lower Aptian (*e.g.*, CASEY, 1961a; ROPOLO *et al.*, 2008; MORENO-BEDMAR *et al.*, 2012a). We also found one specimen that belongs to the genus *Epicheloniceras* (Fig. 3c-d). Given the particular ammonoid record of the PFZ section, the presence of *Cheloniceras* (uppermost lower Aptian) in the UMMP collection precludes a lowermost upper Aptian position for *Megatyloceras casei*. Thus, the range of *M. casei* is uppermost lower Aptian to lowermost upper Aptian (Fig. 2).

About the subfamilial attribution of *Megatyloceras casei*

The genus *Megatyloceras* HUMPHREY, 1949, possesses "but one row of prominent lateral bullae in the adult stages" (HUMPHREY, 1949, p. 149). The generic assignment of *Megatyloceras casei* is placed in doubt by HUMPHREY's (1949, p. 150) observation, "On inner whorls there is a suggestion that the bullae are represented by

small, double nodes". CASEY (1961b) comments that at 176 mm diameter this taxon is similar to the genus *Roloboceras* CASEY, 1954, CASEY (1961b) also remarks on the "double nodes" mentioned by HUMPHREY, which are problematic as *Roloboceras* has one tubercle, similar to a bulge, in the peri-umbilical position. CASEY (1961b) concludes that the Mexican taxon is more similar to the subfamily Cheloniceratinae SPATH, 1923, than the subfamily Roloboceratinae CASEY, 1961b, which includes the genera *Megatyloceras* HUMPHREY, 1949, and *Roloboceras* CASEY, 1954. Later, PAULIUC and GRÄDINARU (1970) make a similar argument in coming to the same conclusion as CASEY.

Megatyloceras casei HUMPHREY, 1949, cannot be assigned to the genus *Megatyloceras* because of some clear morphological differences. At the same diameter, the large mid-lateral tubercles that coronate the whorl section appear to be absent and the ribs do not bifurcate or trifurcate regularly as is common in species of *Megatyloceras*. In the Mexican taxon, ribs are clearly visible in the umbilical wall whereas in *Megatyloceras* and *Roloboceras*, ribs are more discreet or absent in this position. *Megatyloceras casei* HUMPHREY, 1949, cannot be included in the genus *Roloboceras* CASEY, 1954, because the majority of *Roloboceras* species of a similar size to the Mexican specimen possess the bulges characteristic of the genus. The only exception is *Roloboceras saxbyi* CASEY, 1961b, in which bulges disappear very early during ontogeny, but this species differs from the Mexican taxon because the ribs are stronger and have a more regular costulation pattern. In addition, the whorl section of *Megatyloceras casei* HUMPHREY, 1949, is of maximum width at the middle of the flank while in all species of *Roloboceras* the maximum width is located at the lower flank position.

The inner whorls of the Mexican species are very badly preserved (Fig. 5).

However, in the last whorl it seems that two very rudimentary tubercles occur in one rib, as indicated by the two white triangles in Fig. 5. This observation accords with the "double nodes" of HUMPHREY (1949). The presence of two such tubercles is a characteristic of Cheloniceratinae SPATH, 1923. The presence of two tubercles therefore enables us to eliminate the possibility that this ammonoid belongs to the genus *Megatyloceras* HUMPHREY, 1949, or the genus *Roloboceras* CASEY, 1954, from the Roloboceratinae, in accordance with the opinions of CASEY (1961b) and PAULIUC and GRÄDINARU (1970). Meanwhile, the fact that the whorl section of *Megatyloceras casei* HUMPHREY, 1949, has the maximum width at midflank is also characteristic of the genera *Cheloniceras* HYATT, 1903, and *Epicheloniceras* CASEY, 1954.

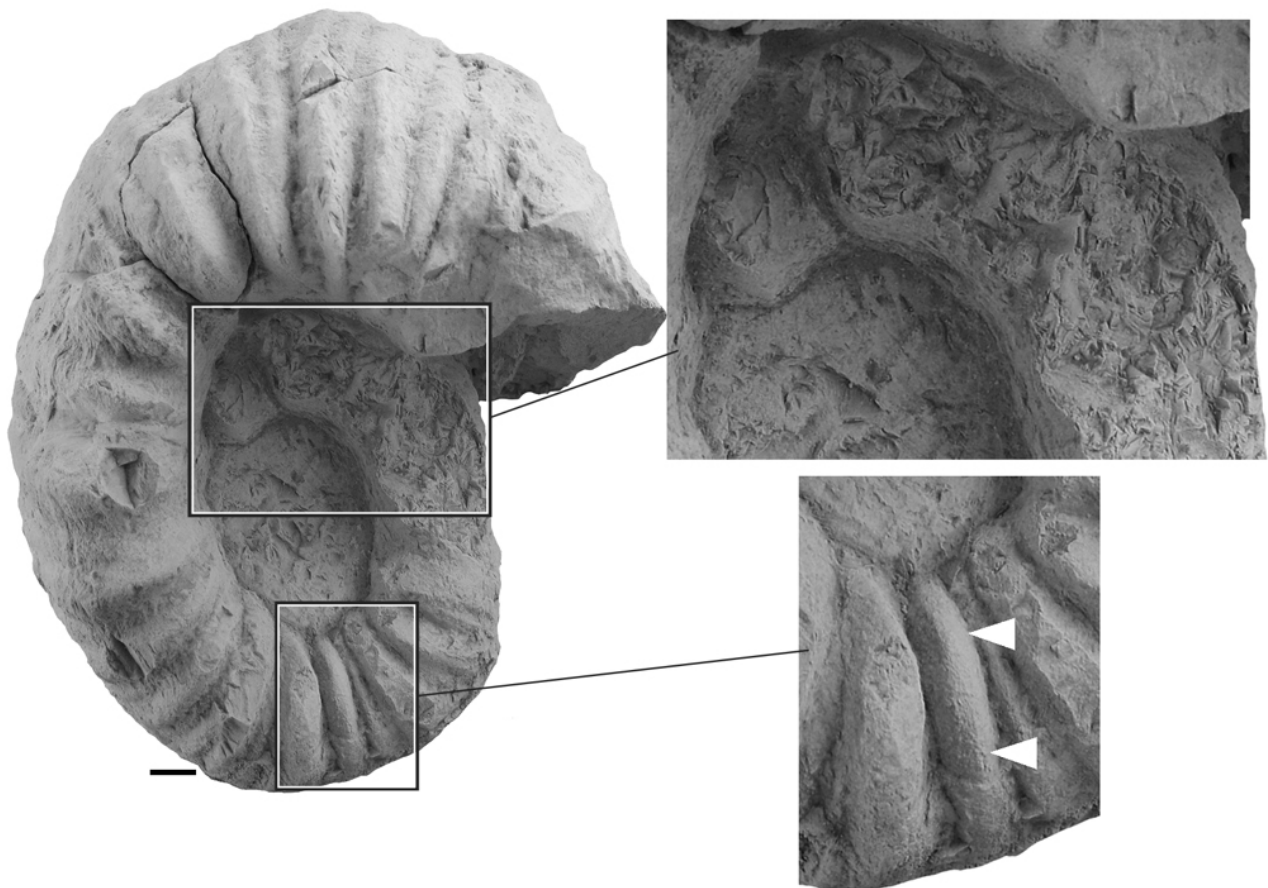


Figure 5: Lateral view of the holotype of *Megatyloceras casei* HUMPHREY, 1949, UMMP 21865 with two enlargements. The two white triangles show two very rudimentary tubercles. Scale bar is 10 mm.

About the generic attribution of *Megatyloceras casei*

The Mexican specimen is characterized by the irregularity of its ribbing pattern, especially of the secondary ribs. This important feature was also noted by HUMPHREY (1949): "*Shell ornamented by irregularly alternating primary and secondary ribs*". Species of the genus *Chelonicerias* HYATT, 1903, have a more regular rib pattern. Species of the genus *Epicheloniceras* have a less regular rib pattern, especially in the secondary ribs. In juvenile specimens of the genus *Epicheloniceras* we can clearly see the characteristics of the genus *Epicheloniceras*: siphonal depression in the primary ribs and ventrolateral tubercles. In the current specimen, which is a subadult or adult, inner whorls are not visible and these characteristics cannot be observed. Therefore we compare our specimen with other subadult or adult specimens that belong to the genus *Epicheloniceras* CASEY, 1954. DUTOUR (2005) uses an interesting conception of the macroconch and microconch for the genus *Epicheloniceras*. According to DUTOUR (2005) *Epicheloniceras* microconchs are small forms with low costulation density, very regular rib pattern, less pronounced tuberculation and little difference between the primary and secondary ribs. In contrast, *Epicheloniceras* macroconchs

are larger specimens with higher costulation density, more irregular rib pattern especially in secondary ribs, well developed tuberculation during the first ontogenetic stages and a pronounced difference between the primary and secondary ribs. According to DUTOUR's conception, our specimen would be a subadult-adult macroconch. SINZOW (1906, Pl. 3, figs. 1-3) figured very well preserved specimens of macroconchs of *Epicheloniceras tschernyschewi* (SINZOW, 1906), the type species of the genus. In his Pl. 3, figs. 2 (diameter, D=100 mm) and 3, the high costulation density and the irregularity of the secondary ribs are clearly evident. Further, they show how, during the ontogeny, primary ribs become less tuberculated and more similar to the secondary ribs. On SINZOW's larger specimen (*op. cit.*, Pl. 3, fig. 1) the tuberculation virtually disappears; in its inner whorls it is difficult to see the initial tuberculated stages. NIKCHITCH (1915, Pl. 3, fig. 2) shows a larger specimen (D=174 mm) of the same species with identical features, but in this case the inner whorls are more distinct and it is possible to see the initial tuberculated stages. On the bigger specimen (D=215 mm) (NIKCHITCH, 1915, Pls. 4-5), the tuberculation seems to disappear completely. This absence of clear tuberculation, and the rib pattern of the large Mexican specimen (D=176 mm), resemble features of *Epicheloniceras* specimens of similar

size figured by NIKCHITCH (1915, Pls. 4-5). More recent authors show examples of large specimens of the genus *Epicheloniceras* with the same, previously noted features (e.g., CASEY, 1962, text-fig. 85c; ROPOLO *et al.*, 2008, Pls. 17, 19-20; Pl. 21, fig. 1; Pl. 22 & Pl. 24, fig. 3).

In addition, the Mexican specimen seems to have a big tubercle placed on a robust primary rib (Fig. 5). Robust primary ribs with a well developed tubercle can be seen on some specimens of DUTOUR (2005) e.g., Pl. 21, fig. 1b and Pl. 22, 2a & 2c. The comparison of the Mexican taxon with other *Epicheloniceras* specimens illustrated in the literature shows clear similarities.

Additionally, if we compare the species studied here with other Mexican Cheloniceratinae of a comparable size that come from the same or nearby areas to where *Megatyloceras casei* was collected, it is clear that the specimens assigned to the genus *Cheloniceras* (Fig. 3a-b; Fig. 4a-d) are very different in their regular rib pattern. The only specimen with an irregular rib pattern is assigned to the genus *Epicheloniceras* (Fig. 1c-d).

Conclusions

Despite poor preservation of the inner whorls, the morphological and ornamental features of *Megatyloceras casei* lead us to conclude that this taxon should be assigned to the subfamily Cheloniceratinae. Further, we consider it appropriate to place *M. casei* within the genus *Epicheloniceras* as *Epicheloniceras casei* (HUMPHREY, 1949). *E. casei* (HUMPHREY, 1949) is assigned to the uppermost lower Aptian.

Acknowledgements

We appreciate the assistance and access to facilities to review the Mexican Aptian ammonoids housed in the University of Michigan, Museum of Paleontology, provided by Dr. Dan MILLER, Coordinator of the Invertebrate Collection of the Museum of Paleontology, and Dr. William SANDERS, Preparator of the Vertebrate Fossil Preparation Laboratory, both of the University of Michigan, Ann Arbor, Michigan, USA. We are very grateful for the helpful corrections and suggestions made by Dr. Ottilia SZIVES and Dr. Yves DUTOUR. We are very grateful to the Language Editor, Stephen CAREY, for his corrections which allow significant improvements to the manuscript.

Bibliographic references

BOVER-ARNAL T., MORENO-BEDMAR J.A., SALAS R., SKELTON P.W., BITZER K. & GILI E. (2010).- Sedimentary evolution of an Aptian syn-rift carbonate system (Maestrat Basin, E Spain): effects of accommodation and environmental change.- *Geologica Acta*, Barcelona, vol. 8,

n° 3, p. 249-280.

CASEY R. (1954).- New genera and subgenera of Lower Cretaceous ammonites.- *Journal of the Washington Academy of Sciences*, vol. 44, n° 4, p. 106-115.

CASEY R. (1961a).- The stratigraphical palaeontology of the Lower Greensand.- *Palaeontology*, London, vol. 3, p. 487-621.

CASEY R. (1961b).- A monograph of the Ammonoidea of the Lower Greensand, part III.- *Monograph of the Paleontographical Society*, London, vol. 115, p. 119-216.

CASEY R. (1962).- A monograph of the Ammonoidea of the Lower Greensand, part IV.- *Monograph of the Paleontographical Society*, London, vol. 116, p. 217-288.

DUTOUR Y. (2005, unpublished).- Biostratigraphie, évolution et renouvellement des ammonites de l'Aptien supérieur (Gargasien) du bassin vocontien (Sud-Est de la France).- Doctoral thesis, Université Claude Bernard Lyon I, 1-302 p.

GAONA-NARVAEZ T., MAURRASSE F.J.-M.R. & MORENO-BEDMAR J.A. (2013).- Stable carbon-isotope stratigraphy and ammonite biochronology at Madotz, Navarra, northern Spain: implications for the timing and duration of oxygen depletion during OAE-1a.- *Cretaceous Research*, London, vol. 40, p. 143-157.

GRADSTEIN F.M., OGG J.G., SCHMITZ M. & OGG G. (eds., 2012).- A geologic time scale.- Elsevier, Amsterdam, 1176 p.

HUMPHREY W.E. (1949).- Geology of Sierra de Los Muertos area, Mexico (with descriptions of Aptian cephalopods from the La Peña Formation).- *Geological Society of America, Bulletin*, Tulsa, vol. 60, p. 89-176.

HUMPHREY W.E. & DÍAZ T. (1956, unpublished).- Jurassic and Lower Cretaceous stratigraphy and tectonics of northeast Mexico.- *Petróleos Mexicanos*, internal report, Mexico, 390 p.

HYATT A. (1903).- *Pseudoceratites* of the Cretaceous.- *Monographs of the United States Geological Survey*, Washington, vol. 54, 351 p.

MORENO-BEDMAR J.A., COMPANY M., BOVER-ARNAL T., SALAS R., DELANOY G., MARTÍNEZ R. & GRAUGES A. (2009).- Biostratigraphic characterization by means of ammonoids of the lower Aptian Oceanic Anoxic Event (OAE 1a) in the eastern Iberian Chain (Maestrat Basin, eastern Spain).- *Cretaceous Research*, London, vol. 30, p. 864-872.

MORENO-BEDMAR J.A., COMPANY M., BOVER-ARNAL T., SALAS R., DELANOY G., MAURRASSE F.J.-M.R., GRAUGES A. & MARTÍNEZ R. (2010).- Lower Aptian ammonite biostratigraphy in the Maestrat Basin (Eastern Iberian Chain, Eastern Spain). A Tethyan transgressive record enhanced by synrift subsidence.- *Geologica Acta*, Barcelona, vol. 8, n° 3, p. 281-299.

MORENO-BEDMAR J.A., BOVER-ARNAL T., BARRAGÁN R. & SALAS R. (2011).- La transgresión tetisiana del Aptiense inferior terminal: compa-

- ración entre su registro en México y España y relación con el ciclo global de tercer orden Ap4.- *Paleontologia i Evolució Memòria especial*, Sabadell, vol. 5, p. 259-262.
- MORENO-BEDMAR J.A., COMPANY M., SANDOVAL J., TAVERA J.M., BOVER-ARNAL T., SALAS R., DELANOY G., MAURRASSE F.J.-M.R. & MARTÍNEZ R. (2012a).- Lower Aptian ammonite and carbon isotope stratigraphy in the eastern Prebetic Domain (Betic Cordillera, south-eastern Spain).- *Geologica Acta*, Barcelona, vol. 10, n° 4, p. 333-350.
- MORENO-BEDMAR J.A., BOVER-ARNAL T., BARRAGÁN R. & SALAS R. (2012b).- Uppermost Lower Aptian transgressive records in Mexico and Spain: chronostratigraphic implications for the Tethyan sequences.- *Terra Nova*, Oxford, vol. 24, p. 333-338.
- MORENO-BEDMAR J.A., BARRAGÁN MANZO R., COMPANY SEMPERE M. & BULOT L.G. (2013).- Aptian (Lower Cretaceous) ammonite biostratigraphy of the Francisco Zarco Dam stratigraphic section (Durango State, north-east Mexico).- *Journal of South American Earth Sciences*, Amsterdam, vol. 42, p. 150-158.
- MOULLADE M., KUHNT W., BERGEN J.A., MASSE J.-P. & TRONCHETTI G. (1998).- Correlation of biostratigraphic and stable isotope events in the Aptian historical stratotype of La Bédoule (southeast France).- *Comptes-Rendus de l'Académie des Sciences*, Paris, (Série II - Sciences de la Terre et des Planètes), vol. 327, p. 693-698.
- MOULLADE M., GRANIER B. & TRONCHETTI G. (2011).- The Aptian Stage: Back to fundamentals.- *Episodes*, Bangalore, vol. 34, n° 3, p. 148-156.
- NAJARRO M., ROSALES I., MORENO-BEDMAR J.A., DE GEA G.A., BARRÓN E., COMPANY M. & DELANOY G. (2011).- High-resolution chemo- and biostratigraphic records of the Early Aptian oceanic anoxic event in Cantabria (N Spain): Palaeoceanographic and palaeoclimatic implications.- *Palaeogeography, Palaeoclimatology, Palaeoecology*, Amsterdam, vol. 299, p. 137-158.
- NIKCHITCH J. (1915).- Représentants du genre *Douvilleiceras* de l'Aptien du versant septentrional du Caucase.- *Mémoire du Comité géologique*, Paris, (Nouvelle Série), Livre 121, 53 p. [in Russian]
- ORBIGNY A. d' (1845).- *In*: MURCHISON R.I., VERNEUIL E. de & KEYSERLING A., *Géologie de la Russie d'Europe et des montagnes de l'Oural*.- London and Paris, vol. 2, p. 419-498.
- PAULIUC S. & GRĂDINARU E. (1970).- Sur la présence de l'Aptien inférieur dans le secteur du sud-ouest des Monts Persani *Megatyloceras persaniense* nov. sp.- *Analele universitatii Bucuresti, Geologie*, Bucarest, vol. 19, p. 1-41.
- REBOULET S., RAWSON P.F., MORENO-BEDMAR J.A., AGUIRRE-URRETA M.B., BARRAGÁN R., BOGOMOLOV Y., COMPANY M., GONZÁLEZ-ARREOLA C., IDAKIEVA STOYANOVA V., LUKENEDER A., MATRION B., MITTA V., RANDRIANALY H., VAŠÍČEK Z., BARABOSHKIN E.J., BERT D., BERSAC S., BOGDANOVA T.N., BULOT L.G., LATIL J.-L., MIKHAILOVA I.A., ROPOLLO P. & SZIVES O. (2011).- Report on the 4th International Meeting of the IUGS Lower Cretaceous Ammonite Working Group, the "KILIAN Group" (Dijon, France, 30th August 2010).- *Cretaceous Research*, London, vol. 32, p. 786-793.
- RENARD M., RAFÉLIS M. de, EMMANUEL L., MOULLADE M., MASSE J.-P., KUHNT W., BERGEN J.A. & TRONCHETTI G. (2005).- Early Aptian $\delta^{13}\text{C}$ and manganese anomalies from the historical Cassis-La Bédoule stratotype sections (S.E. France): relationship with a methane hydrate dissociation event and stratigraphic implications.- *Carnets de Géologie [Notebooks on Geology]*, Brest, Article CG2005/04 (CG2005_A04), 18 p., DOI: 10.4267/2042/3229
- ROPOLO P., CONTE G., MOULLADE M., TRONCHETTI G. & GONNET R. (2008).- The Douvilleiceratidae (Ammonoidea) of the Lower Aptian historical stratotype area at Cassis-La Bédoule (SE France).- *Carnets de Géologie [Notebooks on Geology]*, Brest, Memoir 2008/03 (CG2008_M03), 60 p., DOI: 10.4267/2042/18125
- SINZOW J. (1906).- Die Beschreibung einiger *Douvilleiceras*-Arten aus dem oberen Neocom Russlands.- *Verhandlungen der Russisch-Kaiserlichen Mineralogischen Gesellschaft zu St. Petersburg*, (series 2), vol. 44, n° 1, p. 157-198.
- SPATH L.F. (1923).- A monograph of the Ammonoidea of the Gault, part 1.- *Monograph of the Paleontographical Society*, London, (1921), vol. 75, 72 p.