

# Ammonites of the Oxfordian and Kimmeridgian Age from North of Mexico

**Raúl Sabino Carrasco-Ramírez**

National University, Instituto de Geología, Mexico City, Mexico

**Email address:**

[rcarrasco500829@gmail.com](mailto:rcarrasco500829@gmail.com)

**To cite this article:**

Raúl Sabino Carrasco-Ramírez. Ammonites of the Oxfordian and Kimmeridgian Age from North of Mexico. *American Journal of BioScience*. Vol. 10, No. 4, 2022, pp. 131-136. doi: 10.11648/j.ajbio.20221004.11

**Received:** May 27, 2022; **Accepted:** June 16, 2022; **Published:** August 17, 2022

---

**Abstract:** Few kilometres west of Aramberri, N. L. This research work deals with the study of the ammonites of the Upper Jurassic outcrops, México were studied ammonites from the Ibarillas South of Nuevo Leon, Mexico, driving on federal highway No. 61 we get to Aramberri locality section which consists of 40 m of limestones at its lower part of the Zuloaga Formation. which bears the ammonite fauna described herein. Most of the north-north-west trending ranges of the area are made up of schist rocks of Paleozoic age, resting unconformably are limestones of Upper Jurassic age and finally are covered unconformably by conglomerates of Tertiary age. All collected ammonites were taxonomically studied and at the same time are included pictures with descriptions of four species one is the Upper Oxfordian *Vinalesphinctes* ex gr. *roegi*, the other three came from the Lower Kimmeridgian of North of Mexico. One of the three taxa described here is the Upper Oxfordian genus *Vinalesphinctes*. Belong to the Superfamilies: Perisphinctacea and Haplocerataceae are included in two families, three genus and four species Its upper part are 70 m of argillaceous limestones, shales and sandstone of La Caja Formation. The main objective of this article is the description of ammonites fauna. Is the first time in Mexico to be presented a sequence of rocks like Ibarillas section containing indicative ammonites of Oxfordian and Kimmeridgian age. In the Zuloaga Fm. is first time describe the presence of *Vinalesphinctes* gr. *roegi* indicating the upper Oxfordian Bifurcating Zone. In the La Caja Fm. were recorded *Idoceras sanlazarense*, and *Haploceras* cf. *costatum*. of Kimmeridgian age. Close taxonomic and tectonic framework inside and outside Mexico of the Ibarillas fauna are not discussed in detail here, the ammonite species of the lower part of its section are common within faunas of Central México: Hidalgo and San Luis Potosí states which are therefore Thetyan in origin Fauna correlations are established with North– Central and North of México. The paleogeographic interpretation based on the ammonites described here indicate a position of marine communication between the eastern Tethys and the western Pacific by the so called Hispanic Corridor.

**Keywords:** México, Ammonites, Oxfordian-Kimmeridgian, Zuloaga, La Caja, Formations

---

## 1. Introduction

This research work deals with the study of the ammonites of the Upper Jurassic outcrops some kilometers west of Aramberri, N. L., México (Figure 1). The Aramberri region (south of Nuevo León) was studied several times, one of the most important monography because of its paleontology and stratigraphy is that made by “Burckhardt [2-4]” which are the first and initial full-monography with descriptions and plates of fauna fossil, this works are basis of the Upper Jurassic paleontology of Mexico; the “Imlay [11-14]” studies deal with geology and paleontology of Coahuila and Nuevo Leon, Mexico; “Verma and Westermann [27]” did an excellent

monographic work dealing and solving the Upper Jurassic ammonites and biostratigraphy of Real de Catorce, San Luis Potosí, Mexico; and “Oloris et al. [18]”, and “Villaseñor et al. [29]” are research on the Upper Jurassic biostratigraphy of Mexico. Ibarillas section holds lot of ammonites most of them are fragmentary there are complete phragmocone well preserved. One of the three taxa described here is the Upper Oxfordian genus *Vinalesphinctes*, other species of the same genus were studied in Hidalgo and San Luis Potosí, Mexico, by “Lopez-Palomino et al. [15]” and “Lopez-Palomino [16]” The other three taxa described belong to the genus: *Idoceras* and *Haplocera*. All species are correlated with the Europe Biostratigraphic Zones studied by “Zeiss (13)”.

### 1.1. Study Area

South of Nuevo Leon, Mexico, driving on federal highway No. 61 we get to Aramberri locality from there some km west

is the studied section with relief abrupt and coordinates  $24^{\circ} 05' 45''$  North -  $99^{\circ} 52' 10''$  East and 1300-1400 m.a.s.l. (Figure 1).

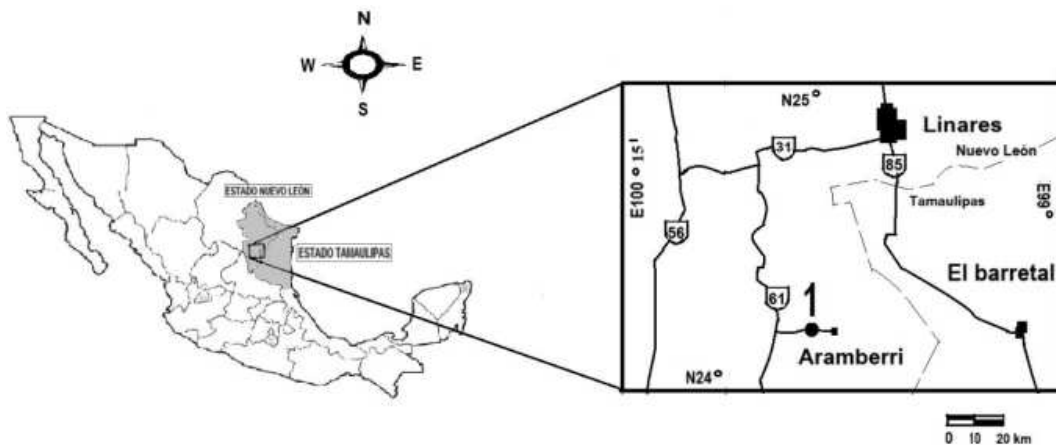


Figure 1. Map of Mexico showing Nuevo Leon State with intercalation of the study area.

### 1.2. Geologic Setting

Previous geologic works in the state of Nuevo León which include Aramberri are those of “Padilla y Sanchez [20]” and “Michalzik and Schumann [17]”. Most of the north-north-west trending ranges of the area (Carta Geologica 1:250 mil, CGSNEGI, Linares G14-11, edited, 1983) are made up of schist rocks of Paleozoic age, resting unconformably are limestones of Upper Jurassic age and finally are covered unconformably by conglomerates of Tertiary age. In the marine Upper Jurassic of northern Mexico two facies have been distinguished, one near-shore and the other off-shore.

The near-shore facies are around Mazapil, Zacatecas state, Mexico, approximately 200 km north of Aramberri, the offshore are developed in Aramberri - Ibarillas area they are la Caja and Zuloaga formations (“Oloris et al., [18, 19]”; “Verma and Westermann, [27]”) which bears the ammonite fauna described herein. In the Ibarillas section (Figure 1) the reference level is of monotonous limestones of Zuloaga Formation, 40 m thick, with some ammonite fragments and only one specimen well preserved. Above this level there is a sequence of argillaceous limestones and shales La Caja Formation which bear abundant fragments and complete ammonites in beds of levels 1, 2, 3 along 70 m (Figure 2).

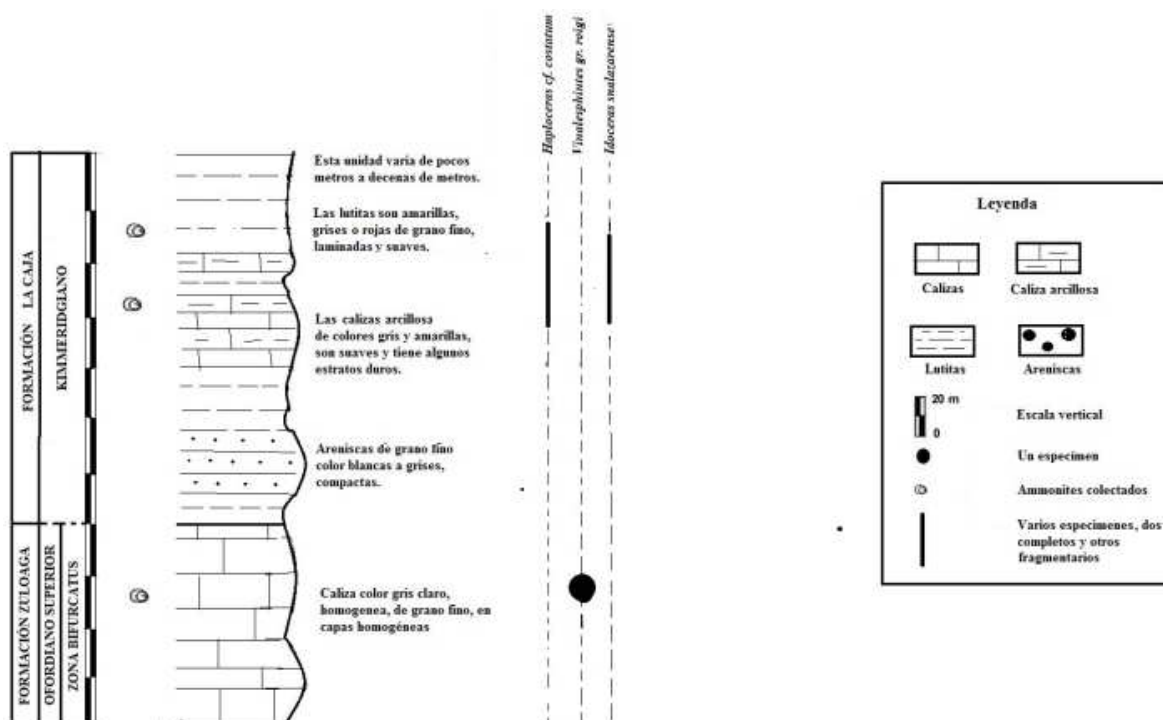


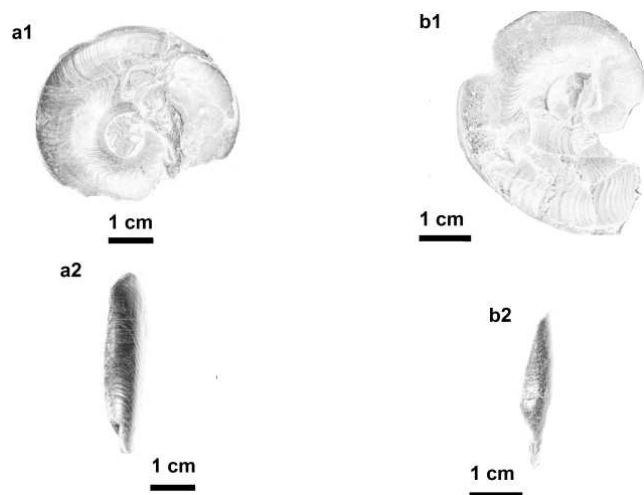
Figure 2. Columnar section of Ibarillas, Aramberri, N. L., Mexico.

## 2. Material and Methods

Cartographic material used includes: Topographic map G14C87 Aramberri, scale 1: 50 000 “CETENAL, [8]”, Geologic map G14-11 Linares scale 1: 250 000 “Cgsnegi, [7]”, Por las Carreteras de Mexico, Guia Roji, 2002 and [Www.google.maps.com.mx](http://www.google.maps.com.mx). The geologic and topographic cartography was useful during the geologic section survey “Finkl, [10]”. Paleontology studies were applied describing morphology of fossil ammonites and systematic position “Arkel ed. Enay and Howart, [1]” this is basically supported by collecting approximately 60 fragments and complete specimens figured.

## 3. Systematic Descriptions

All collected ammonites were taxonomically studied and at the same time are included pictures of this specimens. This chapter deal with descriptions of four species one is the Upper Oxfordian *Vinalesphinctes* ex gr. *roigi*, the other three came from the Lower Kimmeridgian of North of Mexico. Belong to the Superfamilies: Perisphinctacea and Haplocerataceae are included in two families, three genus and four species. All specimens are in the Paleontology Collection of the Bernardo Grousset School (SBG). Dimensions are in millimeters and are included conventional abbreviations. Suture line of specimens is not included because was not possible to obtain.



**Figure 3.** *Haploceras* cf. *costatum* Burckhardt, BGS-101, Ibarillas, upper portion of the La Caja Formation; a1 flank view; a2, ventral view; BGS-102, b1 flank view; b2 ventral view.

Class CEPHALOPODA Cuvier, 1795  
 Order AMMONOIDEA Zittel, 1884  
 Suborder AMMONITINA Hyatt, 1889  
 Superfamily HAPLOCERATACEAE Hyatt, 1867  
 Family HAPLOCERATIDAE Zittel, 1884  
 Genus *Haploceras* Zittel, 1870  
*Haploceras* cf. *costatum* Burckhardt, 1906  
 Sinonimia. *Haploceras* aff *costatum* Burckhardt;  
 Burckhardt 1906, p. 97, lam. 25, Figures 1-2.

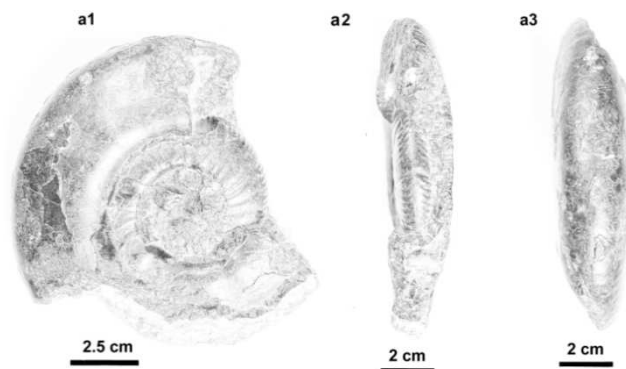
*Haploceras costatum* Burckhardt; Burckhardt 1906, p. 96, lam. 25.

**Description.** The species is represented by three specimens all considered as holotypes. Shell discoidal; whorl ovate in section; flanks are lightly plane, venter narrowly rounded not sharpened. The umbilical region is deep. The ornamentation consists of striae begin at the line of involution incline slightly forward on the umbilical wall, curve slightly backward on the lower fourth of the flanks, are strongly inflected forward just above the middle of the flanks, and then are inflected backward on the upper part of the flanks. There is not ornamentation on venter.

**Material and occurrence.** The material (Table 1) was collected as fragments and complete specimens from the the Ibarillas section La Caja Formation.

**Table 1.** Datos del espécimen: *Haploceras* cf. *costatum*. Dimensiones (mm).

Paratipo Num.	D	U	H	W	U/D	H/D	W/D
EBG-101	30	8	16	--	0.26	0.53	--
EBG-103	49	8	20	--	0.16	0.40	--



**Figure 4.** *Vinalesphinctes* ex gr. *roigi* Spath, 1931, BGS-104, Ibarillas section, lower position, Zuloaga Formation; a1, flank view; a2, ventral view. a3, ventral view

Superfamily PERISPHINCTACEAE Steinmann, 1890

Family PERISPHINCTIDAE Steinmann, 1890

Subfamily PERISPHINCTINAE Steinmann, 1890

Genus *Vinalesphinctes* Spath, 1931

*Vinalesphinctes* ex gr. *roigi* Spath, 1931

Sinonimia: *Pictonia* (*Colladites*) *granadillense* Cantú; Cantú 1967, p. 6, lam. 1, Figure 1-2.

Type species: *Vinalesphinctes roigi* Spath, 1931

**Description.** Shell platycone with 136 mm diameter, semi-flat, evolute, covering approximately half of the prior whorl. The habitation chamber is located approximately in the whole of the last whorl. Whorls gradually are more high than broad looking like trapeze forms with longest width at the umbilical region. Ventral region is rounded and flat. Ornamentation: With primaries ribs very distant towards the end of whorls. At the same time the ribs are big in size they become weak to the middle of the flank and in the ventral region become smooth. In the last whorl where there is the habitation chamber the shell is almost smooth. In the internal whorl ribs are dense and show two constrictions both

following strong primaries ribs.

Discussion. In order to define the taxonomic position of the studied specimen we were looking among the Perisphinctacea in “Arkel ed. Enay and Howart, 2019 [1]”. In this way we identified the illustration of the genus *Vinalesphinctes* (L325) of Upper Oxfordian age, created by “Spath [25]” taking consideration to “Sanchez-Roig, [24]”. “Cantú-Chapa [5]” studied some specimens from Tampico, Mexico and he classified this as *Pictonia* (*Colladites*) *granadillense* because seems to him with morphologic differences of our specimen. In Hidalgo and San Luis Potosi, Mexico, “Lopez-Palomino et al., [15]”; “Lopez-Palomino, [16]”; “Villaseñor et al., [29]” studied the same genus and assign it different species. “Wierzbowski [30]” point out that he has studied specimens of the *roigi* group and the *niger* group the difference of one to the other is the ornamentation. The *roigi* group have early weakness ornamentation, the *niger* group have late weakness ornamentation this indicate that the specimen described here belongs to *roegi* group since show early weakness of its ornamentation.

Material and Occurrence. We collected (Table 2) fragments and only one complete excellently preserved specimen, this came, from the lower position level 0 of the Ibarillas section Zuloaga Formation.

Table 2. Datos del especimen: *Vinalesphinctes* gr. *roegi*. Dimensiones (mm).

Paratipo Num.	D	U	H	W	U/D	H/D	W/D
EBG-104	138	68	47	36	0.49	0.34	0.26

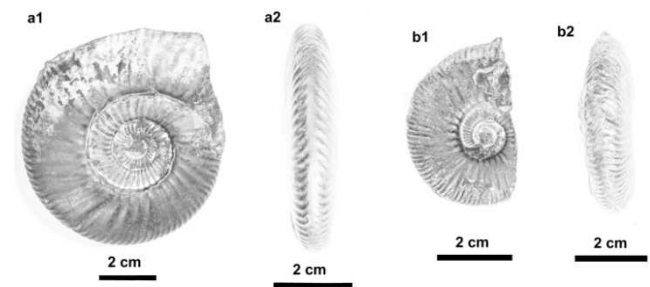


Figure 5. *Idoceras* ex gr. *sanlazarense* Imlay, 1939, BGS-105, of the Ibarillas section, La Caja Formation, a1 flank view, a2, ventral view; BGS-106, b1, flank view, b2, ventral view; b2

Superfamily PERISPINTACEAE Steinmann, 1890  
Family PERISPINCTIDAE Steinmann, 1890  
Subfamily ATAXIOCERATINAE, Buckman, 1921  
Genus *Idoceras* Burckhardt, 1906  
*Idoceras* ex gr. *sanlazarense* Imlay, 1939.  
Figure 5 (a1, a2; b1, b2)  
Type species: *Idoceras sanlazarense* Imlay 1939, p. 39, pl 11.

Description. Form discoidal; flanks nearly flattened, rounding evenly into venter; venter gently convex, becoming narrower during growth; whorl section becoming higher during growth; whorls embracing about one half. Wall fairly high nearly vertical on inner whorl steeply inclined on outer whorls, rounding rather abruptly into flanks; umbilicus fairly deep, moderate in width, tending to become wider during growth. Ornamentation: The ribs are strong on the inner

whorls. Are rounded and separated by wider interspaces. Begin at the line of involution, trend nearly radially across the flank, and arch forward on the venter which they cross with only slight diminution in strength. Bifurcation is common on the upper part of the flanks.

The ribs are wide, on the outer whorls, rounded, strong, and as wide or wider than the interspaces. They begin at the line of involution, incline forward slightly on flank. They arch forward on the venter to form chevrons but undergo only slight diminution in strength except on the body chamber where a narrow smooth band is developed. Almost all ribs bifurcate, or trifurcate, on the upper third of the flanks. The upper part of flanks bearing some intercalary ribs. All stages the secondary ribs are narrower but more pronounced than the primary ribs. This relationship is most pronounced on the body chamber where the primary ribs become broad and faint and the secondary ribs somewhat stronger. About three constrictions on last whorl.

Discussion. *Idoceras* is known from northern Mexico outside of the study area in great variety and profusion. “Burckhardt [2, 3]” named several species to which someone added by “Imlay [11]”. Was also studied by “Cantú-Chapa [28]” who considered the age of this gender is: Lower Kimmeridgian. However, *I. sanlazarense* “Imlay, [12]” is analogous to the specie described here it is difficult that we were dealing with the same species that only is recognized as belong to the group.

Material and Occurrence. In the studied area few preserved *I. ex gr. sanlazarense* occurs in the level 2 of the Ibarillas section La Caja Formation. Were collected (Table 3) fragments most of which are either broken or distorted beyond recognition. Since *Idoceras* is an important faunal element of the Mexican Jurassic only complete preserved specimens are in consideration on the left side.

Discussion.  
Despite all descriptive characteristics of this specimen are included we can say that only umbilicus and width were not register very well because of limestone material covering. However, the specie described is recognized with affinity to *Idoceras viverosi* “Burckhardt [2]”.

Material and Occurrence. Were collected many fragments but broken or with ribs unrecognized was studied. Belong to the levels of the Ibarillas section La Caja Formation.

Table 3. Datos del especimen: *Idoceras sanlazarense*. Dimensiones (mm).

Pratipo Num.	D	U	H	W	U/D	H/D	W/D	CE/D
EBG-105	74	37	22	22	0.5	0.29	0.29	0.33
EGS-106	74	25	27	21	0.33	0.36	0.28	0.36

4. Discussion

4.1. Age and Distribution of the Ammonite Assemblage

Is the first time in Mexico to be presented a sequence of rocks like Ibarillas section containing indicative ammonites of Oxfordian and Kimmeridgian age. “Zell et al. [32]”

described a fossil invertebrate mollusks collection from Galeana, N. L., Mexico, includes ammonites of the *Vinalesphinctes* genus, however, they show few fragmentary individuals badly contorted due to plastic deformation. Also, is important to point out that neither “Verma and Westermann [27]” nor “Oloris et al. [18]” were able to study a section like this. The distribution under study occurs in abundance through 110 m (intervals 0-3, Figure 2) of limestone and argillaceous limestone and shale. It includes at its lower part: *Vinalesphinctes* ex gr. *roigi* which is correlated with the Bifurcatus Zone, Upper Oxfordian. And at its upper part by: *Idoceras* ex gr. *Sanlazarense* and *Haploceras* cf. *costatum*, Lower Kimmeridgian. All distribution is supported from the point of view of the Europe Biostratigraphic and Standard Zones (“López-Palomino et al., [15]”, “Zeiss, [31]” and “Villaseñor et al. [29]”).

#### 4.2. Paleobiogeography

Close taxonomic and tectonic framework inside and outside Mexico of the Ibarillas fauna are not discussed in detail here, the ammonite species of the lower part of its section are common within faunas of Central México: Hidalgo and San Luis Potosí states which are therefore Tethyan in origin “López Palomino, [16]”. The upper part of the Ibarillas section contain following species: *Idoceras* ex gr. *sanlazarense*, and *Haploceras* cf. *costatum* analogous to those of North-Central Mexico reported by “Oloris et al. [18]” and “Verma and Westermann [27]”. Such a faunistic affinity is compatible with the plate tectonic and Hispanic Corridor of the Tethyan realm “Damborenea, [9]”; “Pindel et al., [23]”.

## 5. Conclusions

The Ibarillas section is close to Aramberri, N. L. México, where outcrop rocks consisting at its lower position of limestone and at its upper position of argillaceous limestone. Representing two units: Zuloaga and La Caja formations. The collected ammonites were studied mainly from the taxonomic point of view belong to the Superfamilies: Perisphinctacea and Haplocerataceae and are included in two families, three genus and 3 species. In the Zuloaga were found fragments unidentified and only one specimen well preserved of *Vinalesphinctes* ex gr. *roigi* this indicate the Bifurcatus Zone of Upper Oxfordian age. La Caja Formation holds following ammonites: level 2-3, several fragments and complete specimens of *Haploceras* cf. *costatum*; fragments and complete specimens of *Idoceras* ex gr. *sanlazarense*; unidentified fragments Lower Kimmeridgian age. Correlations of the studied fauna point out to North-Central México: Hidalgo and San Luis Potosi States where outcrop similar rocks and fauna of Ibarillas section. Correlation with Europe indicate that we have mainly the same Tethyan ammonite faunas in what is interpreted as the Hispanic Corridor “Damborenea, [9]”; “Pindel et al., [23]”.

## Acknowledgements

We would like to thank INEGI-Monterrey, Mexico, Department of Geography for enabling us to reach geologic field work in the Ibarillas section in order collect ammonites, main purpose of this research. We thank to Eng. Jorge A. Gomez Godoy, Private consultant, Mexico City, who contributed with ingles redaction. Also, we thank some other persons who helped for this purpose.

## References

- [1] Enay and Howart, 2019. Mesozoic ammonioidea, in Arkell, R. (ed), Treatise on Invertebrate Paleontology, Mollusca L, part 4: University of Kansas Press, L80-L490.
- [2] Burckhardt, C., 1906. La fauna jurassique de Mazapil avec un appendice sur les fossils du Crétacique Inférieur: Boletín del Instituto Geológico de México, 23, 216 p.
- [3] Burckhardt, C. 1912. Faunes Jurassiques et Cretaciques de San Pedro del Gallo, Durango: Boletín del Instituto Geológico de México, 29, 264 p.
- [4] Burckhardt, C., 1930. Étude syntetique sur le Mésozoique mexicain: Mémoires de la Société Paléontologique Suisse, 40, 280 p.
- [5] Cantu-Chapa, A., 1967. Se propone *Colladites* Subgen Nov. (Ammonoidea), del Kimmeridgiano Inferior. Ingenieria Petrolera, vol. VII, No. 2, pp 5-9.
- [6] Cantu-Chapa, A., 1992. Importancia de la segunda silla lateral en la caracterización de la amonita Perisphinctidae *Idoceras* del Kimmeridgiano Inferior. Revista de la sociedad mexicana de paleontología, vol. 5, num. 1, 1992, pp. 15-35.
- [7] Cgsnegi (Coordinación general de los servicios nacionales de estadística, geografía e Informática), 1983: Carta Geológica, 1: 250 000, Linares G14 – 11.
- [8] CETENAL, 1988. Carta Topográfica, 1: 50 000, Aramberri G14C87.
- [9] Damborenea, S. E., 2000. Hispanic Corridor: Its evolution and the biogeography of bivalve Molluscs, In Hall, R. L, Smith, P. L. (Eds.), Advances in Jurassic Research: Switzerland Trans Tech Publications, 369-380.
- [10] Finkl, C. W. JR., 1988. The encyclopedia of field general and geology. 911 págs. Texas, Van Nostrand Reinhold, New York.
- [11] Imlay, R. W., 1938. Studies of the Mexican Geosyncline: Bulletin of the Geological Society of America, 49 (11), 1651-1694.
- [12] Imlay, R. W., 1939. Upper Jurassic Ammonites from Mexico: Geological Society of America Bulletin, 50 (1), 1-78.
- [13] Imlay, R. W., 1943. Upper Jurassic Ammonites from the Placer de Guadalupe District, Chihuahua, Mexico: Journal of Paleontology, 17 (5), 527-543.
- [14] Imlay, R. W., 1945. Jurassic fossils from Southern States, no. 2: Journal of Paleontology, 19 (3), 253-276.

- [15] López-Palomino, R. I., Villaseñor, A. B., Oloris, F., 2006. Primer registro del género *Vinalesphinctes* (Ammonitina) en el Oxfordiano de México: Significación bioestratigráfica y consideraciones paleobiogeográficas en el Jurásico Superior de América: Revista Mexicana de Ciencias Geológicas, 23 (2), 162-183.
- [16] López-Palomino, R. I., 2013. Bioestratigrafía y análisis ecoestratigráfico de la Formación Santiago (Jurásico Superior-Oxfordiano) en el centro de México: Implicaciones paleoecológicas y paleobiogeográficas. Universidad Nacional Autónoma de México, México, Ph. D. Thesis, 186 p.
- [17] Michalzik, D., Schumann, D., 1994. Lithofacies relationships and paleoecology of a Late Jurassic -Early Cretaceous fan delta to self-depositional system in the Sierra Madre Oriental of northeast Mexico. Sedimentology 41, 463-477. doi: 10.1111/j.1365-3091.1994.tb02006.x.
- [18] Oloris, F., Villaseñor, A. B., González-Arreola, C., Westermann, G. E. G., 1999b. Ammonite Biostratigraphy and correlations in the Latest Jurassic-Earliest Cretaceous La Caja Formation of North-Central Mexico (Sierra de Catorce, San Luis Potosí) in Oloris, F., Rodríguez-Tovar, F. J. (Eds.), Advancing Research on Living and Fossil Cephalopods: Plenum Press, London, 463-492. doi: 10.1016/S0016-6995(94)80124.
- [19] Oloris, F., Villaseñor, A. B., González-Arreola, C., 2003. Major lithostratigraphic units in land-outcrops of north-central Mexico and the subsurface along the northern rim of Gulf of Mexico Basin (Upper Jurassic – Lowermost Cretaceous): a proposal for correlation of tectono-eustatic sequences. J. S. Am. Earth Sci. 16, 119-142. doi: 10.1016/S0895-9811(03)00049-X.
- [20] Padilla y Sánchez, R. J., 1985. Las estructuras de la curvatura de Monterrey, estados de Coahuila, Nuevo León, Zacatecas y San Luis Potosí. Univ. Autón. México, Inst. Geología, Revista, vol. 6, num. 1, p. 1-20.
- [21] Palacios-Rojí, J., 2002. Por las carreteras de México. Editado por Guía Rojí, S. A. de C. V: 8a. edición, 140p.
- [22] Parent, H., Schweigert, G., Meléndez, G., 2006. Oxfordian perisphinctid ammonites from Chacabuco, Argentina. Paläontol. Z. 80 (4), 307-324. doi: 10.1007/BF02990207.
- [23] Pindell, J. L., S. C., Cande, Pitman III, D. B. Rowley, J. F. Dewley, J. Labrecque and W Haxby, 1988. A plate tectonic framework for models of Caribbean evolution. Tectonophysics, 155, p. 121-138.
- [24] Sánchez-Roig, M., 1951. La fauna jurásica de Vinales. Anales Acad. Cien. Médicas y Físicas Nat. La Habana, tomo 89, fasc. 2, pl. 1-28, 46-94.
- [25] Spath, L. F., 1924. The ammonites of the Blue Lias. Proc. Geol. Assoc., 18 pl., v. 35, p. 186-211.
- [26] Spath, L. F., 1927-33. Revision of the Jurassic cephalopod faunas of Kachh (Cutch). India Geol. Survey Mem., Paleont. Indica, new ser., v. 9, mem 2, pts. 1-6, 130 pl., p. 945.
- [27] Verma, H., Westermann, G. E. G., 1973. The Tithonian (Jurassic) ammonite fauna and stratigraphy of Sierra de Catorce, San Luis Potosí, Mexico: Bulletin of American Paleontology, 63 (277), 107-320.
- [28] Villaseñor, A. B., González, C., 1988. Fauna de amonitas y presencia de *Lamellaptychus Murocostatus* Trauth del Jurásico Superior de la Sierra de Palotes, Durango. Univ. Nal. Autón. México, Inst. Geología, Revista, vol 7, núm. 1, p. 71-77.
- [29] Villaseñor, A. B., Oloris, F., López Palomino, I., López Caballero, I., 2012. Updated Ammonite biostratigraphy from Upper Jurassic deposits in Mexico. In Revue de Paléobiologie Gèneve, vol. spécial 11, pp. 249-267.
- [30] Wiezbowski, A., 1976. Oxfordian ammonites of the Pinar del Río province (Western Cuba); their revision and stratigraphical significance: Acta Geologica Polonica, 26 (2), 137-260.
- [31] Zeiss, A. 2003. The Upper Jurassic of Europe: its subdivision and correlation: Geological Survey of Denmark and Greenland Bulletin, 1, 75-114. doi: 10.34194/geusb.v.1.4649.
- [32] Zell, P., Seija Beckmann, Wolfgang Stinnesbeck, Martin Götze, 2015. Mollusk of the Upper Jurassic (upper Oxfordian-lower Kimmeridgian) shallow marine Minas Viejas Formation, northeastern Mexico. Journal of South America Earth Sciences, 62, 92-108. doi: 10.1016/j.sames.2015.05.006.