

## Remains of a sea turtle from the Austin Formation (Upper Cretaceous, Campanian), Coahuila, Mexico

*Restos de una tortuga marina de la Formación Austin (Cretácico Superior, Campaniano) Coahuila, México*

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### Abstract

New remains of a sea turtle from the San Carlos quarry (Upper Cretaceous, Campanian), Austin Formation in the north of Coahuila state, Mexico, are reported. San Carlos quarry is composed of limestones and its Campanian age is based on the presence of the ammonites *Scaphites hippocrepis* and *Delawarella delawarensis*. In addition to the presence of turtles, this quarry also contained ammonites, bivalves, crabs, sea urchins, bony fish remains, and shark teeth. The study material is housed at *Museo Paleontológico de Múzquiz*. The preserved fossil elements correspond to postcranial elements, which present morphological characteristics that allowed them to be identified as belonging to a small-sized turtle related to Protostegidae. These new sea turtle remains expand the knowledge and distribution of Protostegidae along the Western Interior Seaway, where large and medium-sized sea turtles were distributed.

**Keywords:** Campanian, Jiménez, Protostegidae, San Carlos quarry, Upper Cretaceous, Western Interior Seaway.

### Resumen

Nuevos restos de una tortuga marina de la cantera San Carlos (Cretácico Superior, Campaniano), Formación Austin en el norte del estado de Coahuila, México, son reportados. La cantera San Carlos está compuesta por calizas y su edad Campaniano se basa en la presencia de los ammonites *Scaphites hippocrepis* y *Delawarella delawarensis*. Además de la presencia de tortugas, en esta cantera se han recolectado ammonites, bivalvos, cangrejos, erizos, peces y dientes de tiburón. El material de estudio se encuentra resguardado en el Museo Paleontológico de Múzquiz. Los elementos fósiles conservados corresponden a elementos poscraneales, los cuales presentan características morfológicas que permitieron identificarlos como pertenecientes a una tortuga de tamaño pequeño relacionada a la familia Protostegidae. Estos nuevos restos de una tortuga marina permiten ampliar el conocimiento y la distribución de la familia Protostegidae a lo largo del mar interior de América del Norte, donde se distribuyeron tortugas marinas de tamaño grande y mediano.

**Palabras clave:** Campaniano, Jiménez, Protostegidae, Cantera San Carlos, Cretácico Superior, mar interior de América del Norte.

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## 1. Introduction

Protostegidae is a family of extinct of sea turtles, and its main representatives were distributed along the Western Interior Seaway (North America) during the Upper Cretaceous, their distribution is also known in Asia, Europe, Oceania, and South America; according to the fossil record its distribution could be cosmopolitan. This family of sea turtles is known from the Barremian to Maastrichtian (Zangerl, 1953; Collins, 1970; Hirayama, 1998; Kear and Lee, 2006; Sato *et al.*, 2012; Cadena and Parham, 2015; López-Conde *et al.*, 2019; Danilov *et al.*, 2022).

The Protostegidae turtles described so far and distributed along the Western Interior Seaway include: *Protostega gigas* (Cope, 1872), *Archelon ischyros* (Wieland, 1896), *Desmatochelys lowii* (Williston, 1894; Zangerl and Sloan, 1960; Nicholls, 1992; Elliott *et al.*, 1997; López-Conde *et al.*, 2019), *Chelosphargis advena* (Hay, 1908), *Calcarichelys gemma* (Zangerl, 1953), and *Terlinguachelys fischbecki* (Lehman and Tomlinson, 2004). Aside from these are the two records of *Atlantochelys mortoni* (Agassiz, 1849; Parris *et al.*, 2012) and *Neptunochelys tuberosa* (Wieland, 1900) which have traditionally been placed within Protostegidae.

Research focused on sea turtles from Mexico has been historically scarce (López-Conde and Alvarado-Ortega, 2017; López-Conde *et al.*, 2022). Until recently, the fossil record of Pan-Chelonioida turtles in Mexico was limited to members of Cheloniidae. However, the recent description of the first turtle belonging to Protostegidae (*Desmatochelys cf. D. lowii*, López-Conde *et al.*, 2019) and the record of sea turtles from different Mexican localities (Carbot-Chanona *et al.*, 2020), indicate that the

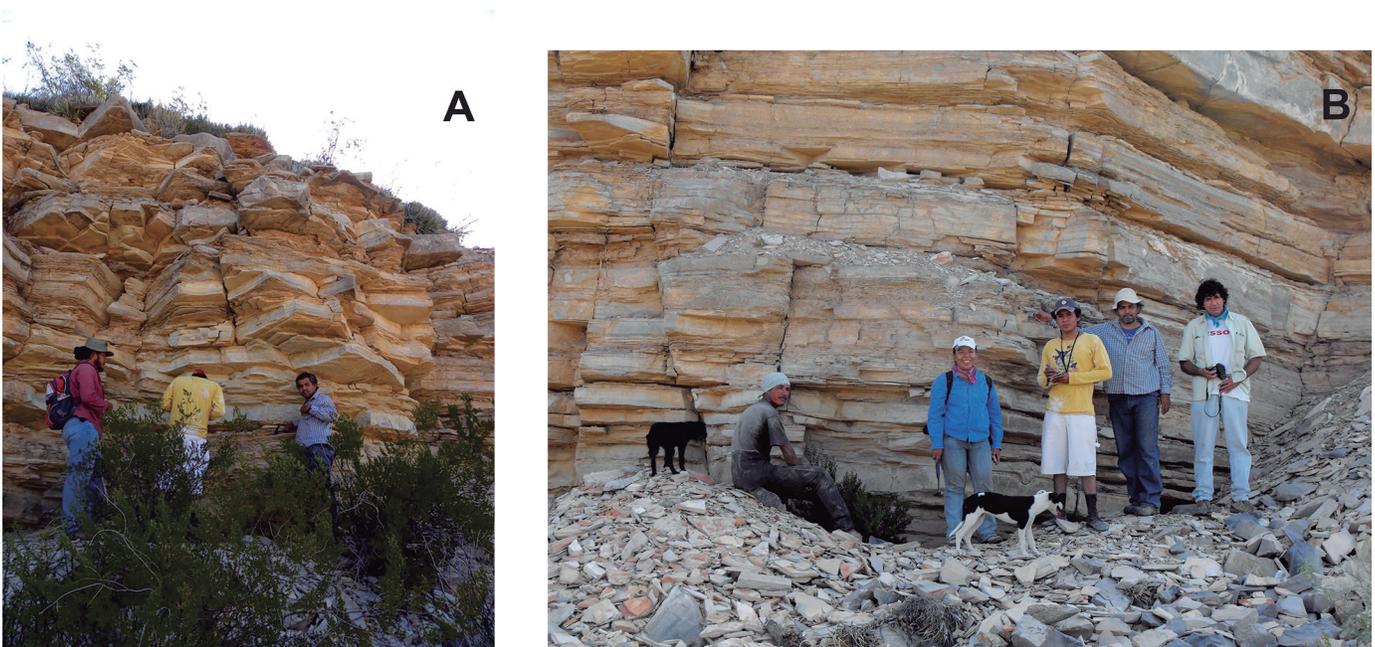
richness of Pan-Chelonioida turtles in the Mexican fossil record is still underestimated, because indeterminate specimens from other Cretaceous formations have not been studied in detail (*e.g.* Agua Nueva and Eagle Ford formations; Ifrim *et al.*, 2007; López-Conde *et al.*, 2018; 2020).

The specimens described here were collected in the San Carlos quarry, Austin Formation (Upper Cretaceous, Campanian), Coahuila State, Mexico (Figure 1), the same locality where *Desmatochelys cf. D. lowii* was previously collected, which is the first sea turtle formally described for Mexico.

The San Carlos quarry is important because it continues to provide new fossil material waiting to be formally described and with this information obtained, expand the knowledge of the fossil record for one of the southernmost localities in the Western Interior Seaway, giving a broader picture in the biogeographic knowledge of the different marine organisms of the Upper Cretaceous of North America.

## 2. Geological setting

The name Austin limestone was first applied by Shumard (1860) to describe a calcareous-clay rock unit that crops out in the surroundings area of Austin, Texas, United States of North America (Young, 1963). This unit was divided into four sub-units (Taff, 1892), from the bottom to the top: Lower Austin, Sandy layer, Aucella layer, and the last one, a calcareous marl limestone. In northwest Mexico, this unit has been informally divided into diverse members (Carrasco, 1963; Stinnesbeck *et al.*, 2005). In a stratigraphic study at Jimenez, Coahuila,



**Figure 1:** San Carlos quarry, Austin Formation (Upper Cretaceous, Campanian).

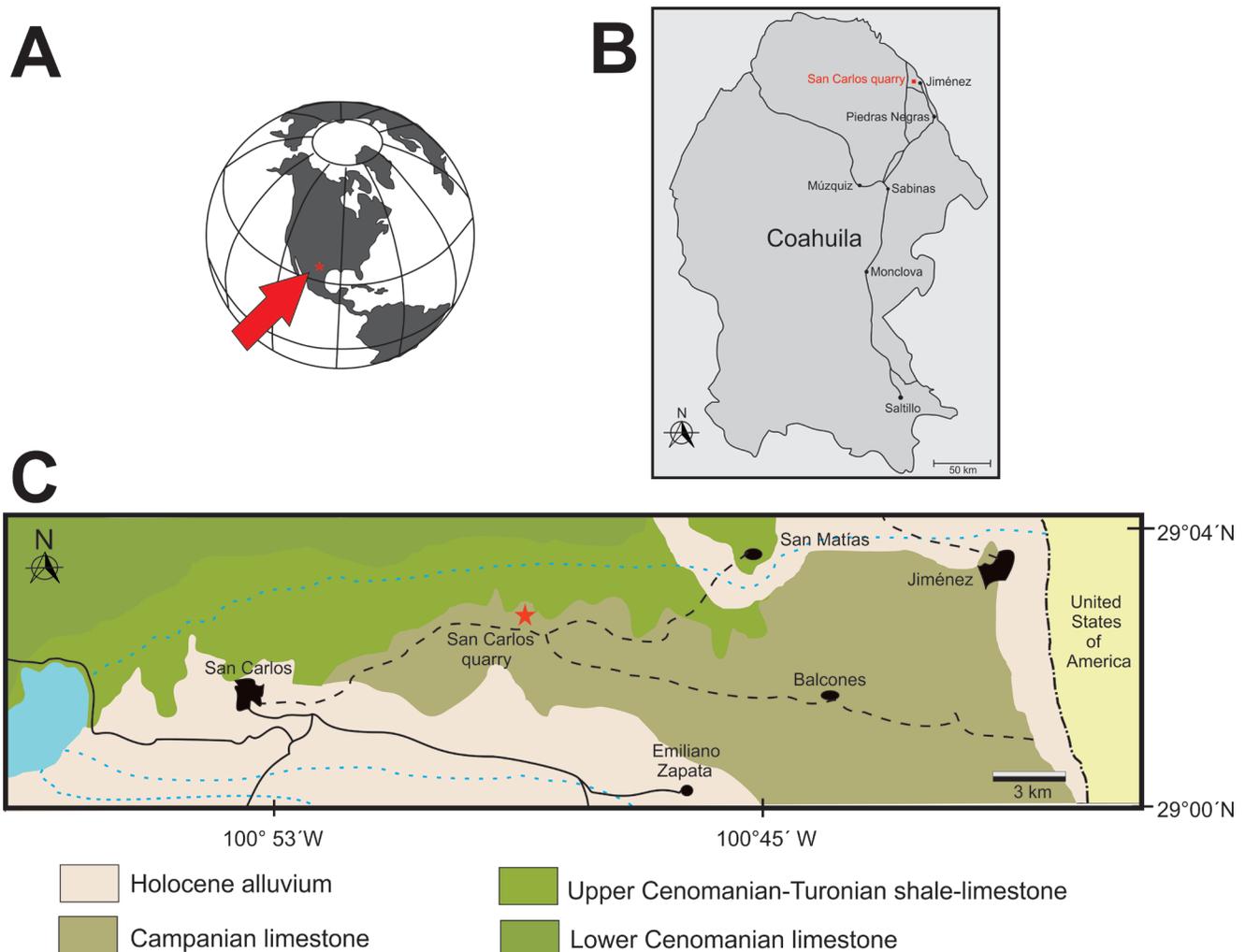
the Austin Formation was divided into two members: La Dessau, (yellowish-white chalk and marl) and La Tecolotes (limestone and marl), both belonging to the lower Campanian (Carrasco, 1969). The fossils (mainly ammonites, bivalves and crabs) were obtained from the Tecolotes member. Until now, there have only been a few studies on this unit, and there is not a consensus for these divisions in both Mexico and Texas. Most of the studies that have been conducted in northwest Mexico have referred this unit as undifferentiated and have also been cited as the Austin Formation.

The San Carlos quarry, near Jiménez town, Coahuila State, Mexico (Figure 2), is composed of calcareous marls and yellowish-white chinks, and the upper part is composed of gray limestone and yellowish-brown marls. These lithologies are disposed in decimeter layers. The thickness of limestone varies between 40 and 60 cm, chinks, and marls vary between 20 and 100 cm, while the thickness of lutites varies from a few centimeters to 40 cm. Studies by Reeside (1927) and Carrasco (1969) in Jiménez, Coahuila provide a Campanian age for this unit. The

age is determined based on the presence of ammonites *Scaphites hippocrepsis* and *Delawareella delawarensis*. In addition to ammonites, the fossil record from the San Carlos Formation comprises many bony fish remains, shark teeth, bivalves, crabs, and sea urchins, among others (Silva-Martínez *et al.*, 2014).

### 3. Material and methods

The specimens described in this study are housed at Museo Paleontológico de Múzquiz, in Melchor Múzquiz, Coahuila, Mexico, under the catalog number MUZ-3916 and MUZ-3917. MUZ-3916 corresponds to several post-cranial elements (*e.g.*, humerus, ilium, and plastron) and MUZ-3917 corresponds to an isolated scapula. The rock was removed using pneumatic tools and dental needles and hardened by applying a layer of plexyglum dissolved in cyanoacrylate. The specimens were observed and measured directly, and photographs were obtained under different light conditions.



**Figure 2:** Map of the locality. A, general map of Mexico showing the state of Coahuila; B, close up of the state of Coahuila and location of Jiménez municipality and San Carlos quarry; C, Geological map of the north of Coahuila, indicating San Carlos quarry (modified from Servicio Geológico Mexicano, 2008).

**Institutional abbreviations:** MUZ, Museo Paleontológico de Múzquiz, Melchor Múzquiz, Coahuila, México.

**Anatomical nomenclatures:** We based our comparisons on the descriptions published by Nicholls *et al.* (1990); Hirayama (1998); Hooks (1998); Parham *et al.* (2003); Tong *et al.* (2006); López-Conde *et al.* (2019).

#### 4. Systematic paleontology

Testudines Batsch, 1788

Cryptodira Cope, 1868

Pan-Chelonioidea Joyce, Parham & Gauthier, 2004

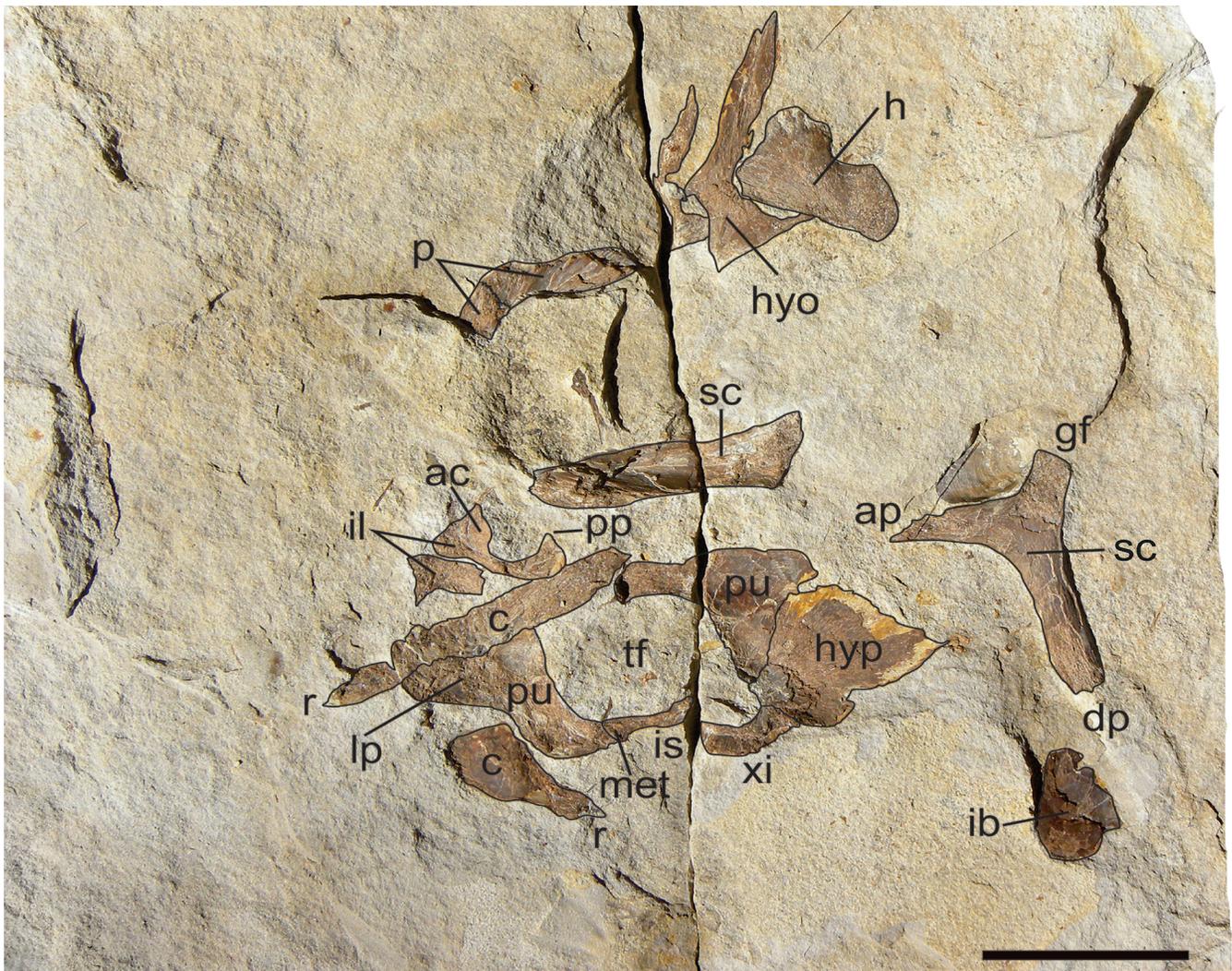
Protostegidae Cope, 1872

Protostegidae indet.

**Referred specimens:** MUZ-3916 (Figure 3), is a disarticulated specimen represented only by postcranial elements (*e.g.*, costal, humerus, ilium, ischium, peripheral, plastron, and scapula), and MUZ-3917 (Figure 4) corresponds to an isolated scapula.

**Occurrence:** San Carlos quarry, Jiménez town, Coahuila State, Mexico. Upper Cretaceous (Campanian), Austin Formation.

**Description:** MUZ-3916 is a specimen of a sea turtle composed of several postcranial elements. This specimen is disarticulated, with some bones displaced from their original positions. A detailed comparative study was carried out, which included the postcranial elements that have been identified for their description (Figure 3). On the other hand, MUZ-3917 corresponds to



**Figure 3:** MUZ-3916 corresponding to postcranial elements of Protostegidae indeterminate from the Upper Cretaceous (Campanian), San Carlos quarry, Austin Formation, Coahuila, Mexico. ac, acetabulum; ap, acromion process; c, costal; dp, dorsal process; gf, glenoid fossa; h, humerus; hyo, hyoplastron; hyp, hypoplastron; ib, indeterminate bone; il, ilium; is, ischium; lp, lateral process; met, metischial process; p, peripheral; pp, posterior process; pu, pubis; r, rib; sc, scapula; tf, thyroid fenestra; xi, xiphiplastron. Scale bar equals 5 cm.

an isolated scapula (Figure 4). The following bones were identified from MUZ-3916 and MUZ-3917 (humerus, scapula, ilium, ischium, pubis, costals, peripherals, hypoplastron, hypoplastron, and xiphoplastron).

**Humerus:** This is a partial humerus with a maximum preserved length of 39 mm and its diaphysis is short and robust similar to other Protostegidae previously described (Figure 3). The sigmoid shape of the humerus was deformed due to the compaction of the bone during diagenesis. Due to its poor conservation and position, the humerus is not informative, preventing further description of this element.

**Scapula:** In MUZ-3916, both scapulae were preserved but the dorsal process was preserved in only one of them. The best-preserved scapula had a length of 58 mm. The acromion and the dorsal processes form an angle slightly greater than 90°. The distal part of the dorsal process is damaged (Figure 3). MUZ-3917 has a length of 65 mm. The acromion and the dorsal processes are distally damaged (Figure 4). The glenoid fossa was preserved in both scapulae.

The pelvic girdle is partially preserved and semi-articulated and is composed of the following pairs of bones:

**Ilium:** Both ilia are preserved, but one is in poor condition. The ilium is a slender and flat bone with a maximum preserved length of 31 mm. The articular section is expanded and includes flat surfaces to join the pubis and ischium. The posterior process is damaged (Figure 3).

**Ischium:** One ischium is poorly preserved; this bone looks thin. The ischium is nearly vertically oriented, preventing further description of this element (Figure 3).

**Pubis:** Two fragments from both pubes were preserved (Figure 3). On the left pubis, the lateral pubic process is flattened and shows a rounded profile that is also expanded. Between the two fragments of the pubis the thyroid fenestra is observed (Figure 3).

**Costals:** Two costals were preserved and both are associated with their respective ribs. The costals are irregular and fragmented and the body of the rib extends along the ventral surface. The ribs are wide and flat, and it is possible to observe the distal area of the rib that would be insert with the peripherals (Figure 3).

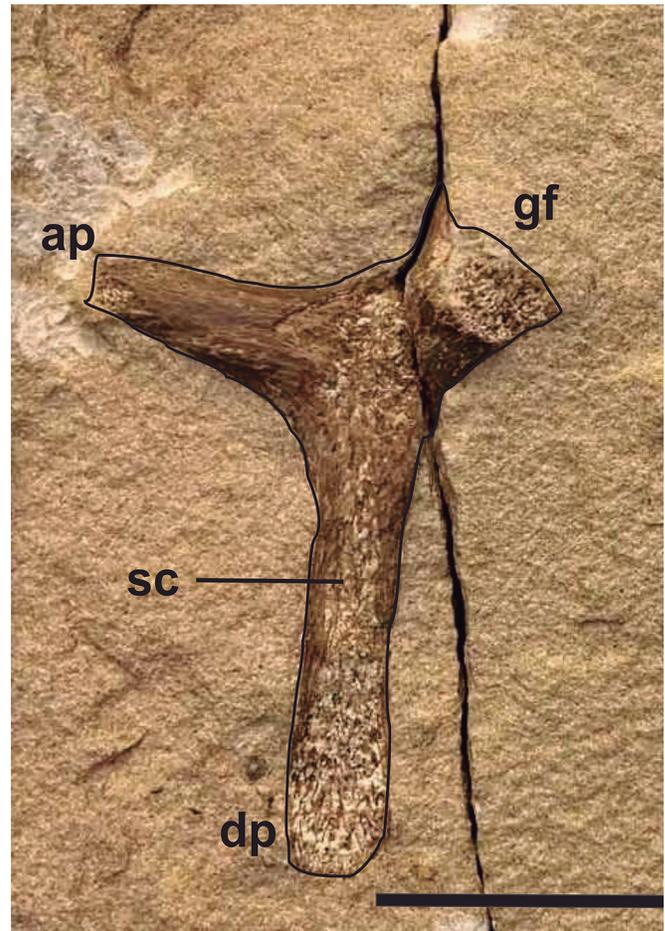
**Peripherals:** Two incomplete peripherals were preserved, articulated with sinuous sutures, and would be rectangular in shape as in other Protostegidae (Figure 3).

**Hypoplastron:** Two poorly preserved fragments are part of this specimen, despite its poor conservation, its characteristic shape is observed (Figure 3).

**Hypoplastron:** This bone is poorly preserved but is possible to observe its moderately digitate structure (Figure 3).

**Xiphoplastron:** It is articulated to the hypoplastron and is a bowed bone (Figure 3).

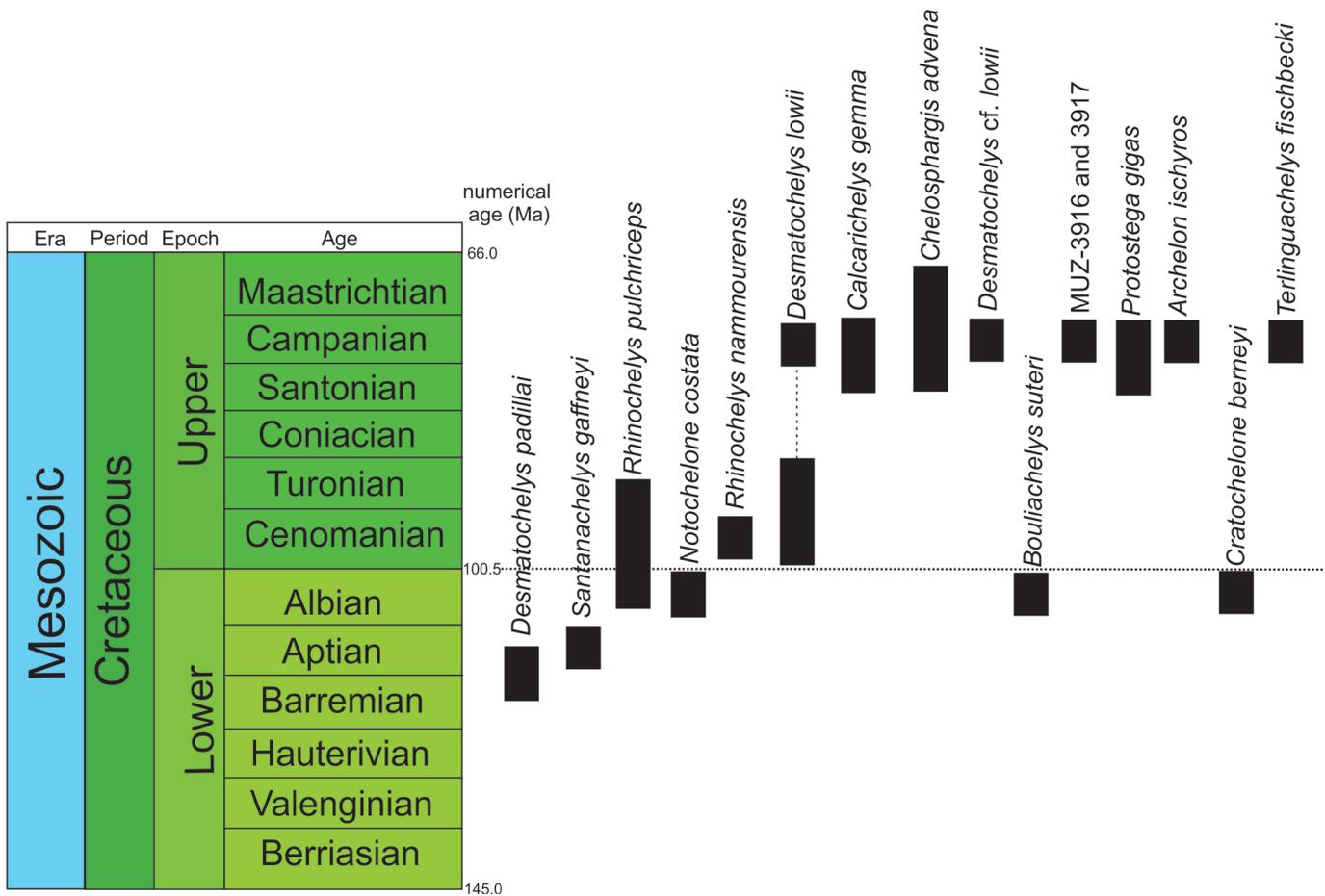
**Remarks:** The Family Protostegidae is an enigmatic group of Lower Cretaceous-Upper Cretaceous sea turtles with worldwide distribution and several representatives from different localities. This group had spectacular-sized sea turtles, such as *A. ischyros*, and *P. gigas*,



**Figure 4:** MUZ-3917 corresponds to a scapula of Protostegidae indeterminate from the Upper Cretaceous (Campanian), San Carlos quarry, Austin Formation, Coahuila, Mexico. ap, acromion process; dp, dorsal process; gf, glenoid fossa; sc, scapula. Scale bar equals 2.5 cm.

medium-sized turtles such as *D. lowii* and small-sized turtles such as *S. gaffneyi*. The greatest richness of Protostegidae turtles occurred along the Western Interior Seaway, in contrast to the possible origin of this group of sea reptiles in South America, with the record of *D. padillai* from the Paja Formation, Lower Cretaceous, Barrerian-Aptian (Cadena and Parham, 2015), and *S. gaffneyi*, from the Santana Formation, Lower Cretaceous, Aptian (Hirayama, 1998) (Figure 5).

Until now, the fossil record of sea turtles in Mexico is limited, especially that of Protostegidae, even with the recent reports of turtle findings in different localities in Mexico (e.g., Agua Nueva and Eagle Ford formations). These new reports have remained without any formal description, which has limited our knowledge of this group of sea turtles. Therefore, the formal reports that have been made in recent years are essential, such as the case of *Desmatochelys* cf. *D. lowii* (López-Conde *et al.*, 2019), which is currently considered the first record of a sea turtle (Protostegidae) for Mexico.



**Figure 5:** Geochronological range of members of the family Protostegidae present in the fossil record. Taxa are illustrated according to their time-range occurrence.

## 5. Discussion

Specimens MUZ-3916 and MUZ-3917 were collected near the occurrence of *Desmatochelys* cf. *D. lowii*. The morphological characteristics of the postcranial elements suggest that these specimens represent an indeterminate Protostegidae. This taxonomic assignment is supported by:

Peripherals serrate to strongly digitate on their interior borders (Wieland, 1909), the hyoplastron-hyoplastron moderately digitate to strongly digitate (Wieland, 1909), and the xiphiplastron is a bowed bone (Wieland, 1909). Therefore, the isolated fragments that have been collected should not be underestimated, as they provide important information that helps to understand the different taxonomic groups, in this case those of the sea turtles Protostegidae.

Although these specimens were collected in the Austin Formation where *Desmatochelys* cf. *D. lowii* was previously described it is not possible for us to assign it to this same taxon due to the absence of fully preserved specimens, and for now, the fossils should be considered as Protostegidae indeterminate, due to morphological characteristics of the postcranial elements.

## 6. Conclusions

The Family Protostegidae were sea turtles and are known from the Barremian to Maastrichtian. Its main representatives were distributed along the Western Interior Seaway and their distribution, according to the fossil record, could be cosmopolitan.

The paleobiogeographical importance of these new remains, along with *Desmatochelys* cf. *D. lowii*, is that they correspond to the southernmost records of Protostegidae along the Western Interior Seaway. Protostegidae have an important stratigraphic range from the Lower Cretaceous (Barremian) to the Upper Cretaceous (Maastrichtian) and their fossil remains have been collected from localities on most continents (Figure 5).

New turtles collected from the Eagle Ford Formation in the Venustiano Carranza quarry were preliminarily assigned to new Protostegidae turtle specimens. With the future description of these new specimens, new knowledge will be added about the anatomy, paleogeography, and the phylogenetic relationships of this enigmatic group of sea turtles.

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## References

- Agassiz, L. (1849). Remarks on crocodiles of the green sand of New Jersey and on *Atlantochelys*. *Proceedings of the Academy of Natural Sciences of Philadelphia*, 4, 169.
- Batsch, A. J. (1788). *Versuch einer Anleitung, zur Kenntniss und Geschichte der Thiere und Mineralien*. Akademische Buchhandlung.
- Cadena, E. A., & Parham, J. F. (2015). Oldest known marine turtle? A new protostegid from the Lower Cretaceous of Colombia. *PaleoBios*, 32, 1–42. <https://doi.org/10.5070/P9321028615>
- Carbot-Chanona, G., Rivera-Velázquez, G., Jiménez-Hidalgo, E., & Reynoso, V. H. (2020). The fossil record of turtles and tortoises (Testudines) of Mexico, Central America and the Caribbean Islands, with comments on its taxonomy and paleobiogeography: a bibliographic review. *Revista Mexicana de Ciencias Geológicas*, 37(3), 269–283. <https://doi.org/10.22201/cgeo.20072902e.2020.3.1581>
- Carrasco, B. V. (1963). Estratigrafía de la parte Superior del Grupo Austin en Jiménez Coahuila (México). *Revista del Instituto Mexicano del Petróleo*, 1(2), 18–25.
- Carrasco, B. V. (1969). Amonitas del Campaniano inferior del Norte de Coahuila. *Boletín de la Sociedad Geológica Mexicana*, 30(2), 144–151.
- Collins, J. I. (1970). The chelonian *Rhinochelys seeley* from the upper cretaceous of England and France. *Palaeontology*, 13, 355–378.
- Cope, E. D. (1868). On the origin of genera. *Proceedings of the Academy of Natural Sciences of Philadelphia*, 20, 242–300.
- Cope, E. D. (1872). A description of the genus *Protostega*, a form of extinct Testudinata. *Proceedings of the American Philosophical Society*, 12, 422–433.
- Danilov, I. G., Obratsova, E. M., Arkhangelsky, M. S., Ivanov, A. V., & Averianov, A. O. (2022). *Protostega gigas* and other sea turtles from the Campanian of Eastern Europe, Russia. *Cretaceous Research*, 135, 105196. <https://doi.org/10.1016/j.cretres.2022.105196>
- Elliott, D. K., Irby, G. V., & Hutchinson, J. H. (1997). *Desmatochelys lowi*, a marine turtle from the Upper Cretaceous. In J.M. Callaway, & E.M. Nicholls (Eds.), *Ancient Marine Reptiles* (243–258). Academic Press. <https://doi.org/10.1016/B978-012155210-7/50014-4>
- Hay, O. (1908). *The fossil turtles of North America* (vol. 75). Carnegie Institution of Washington Publication.
- Hirayama, R. (1998). Oldest known sea turtle. *Nature*, 392(6677), 705–708. <https://doi.org/10.1038/33669>
- Hooks, G. E. (1998). Systematic revision of the Protostegidae, with a redescription of *Calcarichelys gemma* Zangerl, 1953. *Journal of Vertebrate Paleontology*, 18(1), 85–98. <https://doi.org/10.1080/0274634.1998.10011036>
- Ifrim, C., Stinnesbeck, W., & Frey, E. (2007). Upper Cretaceous (Cenomanian-Turonian and Turonian-Coniacian) open marine plattenkalk deposits in NE Mexico. *Neues Jahrbuch für Geologie und Paläontologie – Abhandlungen*, 245(1), 71–81. <https://doi.org/10.1127/0077-7749/2007/0245-0071>
- Joyce, W. G., Parham, J. F., & Gauthier, J. A. (2004). Developing a protocol for the conversion of rank-based taxon names to phylogenetically defined clades names, as exemplified by turtles. *Journal of Paleontology*, 78(5), 989–1013.
- Kear, B. P., & Lee, M. S. Y. (2006). A primitive protostegid from Australia and early sea turtle evolution. *Biology Letters*, 2(1), 116–119. <https://doi.org/10.1098/rsbl.2005.0406>
- Lehman, T. M., & Tomlinson S. L. (2004). *Terlinguachelys fischbecki*, a new genus and species of sea turtle (Chelonioidae: Protostegidae) from the Upper Cretaceous of Texas. *Journal of Paleontology*, 78(6), 1163–1178. <http://www.jstor.org/stable/4094943>
- López-Conde, O. A., & Alvarado-Ortega, J. (2017). Estudio sobre la diversidad de tortugas del Mesozoico de México [Summary]. In *Libro de Resúmenes del XV Congreso Nacional de Paleontología de la Sociedad Mexicana de Paleontología*, ed. J. A. Moreno Bedmar, 80.
- López-Conde, O. A., Sterli, J., Chavarría-Arellano, M. L., Alvarado-Ortega, J., & Porras-Múzquiz, H. (2018). The first records of Protostegidae in Mexico (Late Cretaceous) [Poster presentation]. In *78th Annual Meeting of Society of Vertebrate Paleontology*. Albuquerque, NM, USA.
- López-Conde, O. A., Sterli, J., Alvarado-Ortega, J., Chavarría-Arellano, M. L., & Porras-Múzquiz, H. (2019). The first record of *Desmatochelys* cf. *D. lowii* from the Late Cretaceous (Campanian) of Coahuila, Mexico. *Journal of South American Earth Sciences*, 94, 102204. <https://doi.org/10.1016/j.jsames.2019.05.020>
- López-Conde, O. A., Chavarría-Arellano, M. L., Porras-Múzquiz, H., & Alvarado-Ortega, J. (2020). Una nueva tortuga Protostegidae del Cretácico Tardío de Coahuila, México [Summary]. In *1er Congreso Colombiano de Paleontología*, 45.
- López-Conde, O. A., Chavarría-Arellano, M. L., Porras-Múzquiz, H., & Alvarado-Ortega, J. (2022). Restos de una tortuga marina provenientes de la Formación Austin (Cretácico Superior), Coahuila, México [Summary]. In *Memorias del XVII Congreso Nacional de Paleontología de la Sociedad Mexicana de Paleontología*. Hermosillo, Sonora, ed. J. A. Moreno Bedmar, 61.
- Nicholls, E. L., Tokaryk, T. T., & Hills, L. V. (1990). Cretaceous marine turtles from the Western Interior Seaway of Canada. *Canadian Journal of Earth Sciences*, 27(10), 1288–1298. <https://doi.org/10.1139/e90-138>
- Nicholls, E. (1992). Note on the occurrence of the marine turtle *Desmatochelys* (Reptilia: Chelonioidae) from the Upper Cretaceous of Vancouver Island. *Canadian Journal of Earth Sciences*, 29(2), 377–380. <https://doi.org/10.1139/e92-033>
- Parham, J., Hilton, R. P., & Göhre, E. S. (2003). The oldest turtle from California and other new records of Late Cretaceous sea turtles from the Chico Formation. *PaleoBios*, 23(1), 24–28.
- Parris, D. C., Daeschler, E. B., Gilmore, E. S., Poole, J. C., & Pellegrini, R. A. (2012). Two halves make a holotype: two hundred years between discoveries. *Proceedings of the Academy of Natural Sciences of Philadelphia*, 163, 85–89.
- Reeside, B. J. (1927). *The Cephalopods of the Eagle Sandstone and Related Formations in the Western Interior of the United States*. (Report-Professional Paper 151). United States Government Printed office. <https://doi.org/10.3133/pp151>
- Sato, T., Konishi, T., Hirayama, R., & Caldwell, M. W. (2012). A review of the Upper Cretaceous marine reptiles from Japan. *Cretaceous Research*, 37, 319–340. <https://doi.org/10.1016/j.cretres.2012.03.009>
- Servicio Geológico Mexicano (2008). *Cartas Geológico-Mineras: Carta Ciudad Acuña H14-7* [Mapa]. Escala 1:250,000.
- Shumard, B. F. (1860). Descriptions of new Cretaceous fossils from Texas. *Transactions of the Academy of Science of the Saint Louis*, 1, 590–610.
- Silva-Martínez, L. E., Blanco-Piñón, A., & León-González, J. A. (2014). Equinoideos del Cretácico Tardío del Norte de Coahuila, México. *Boletín de la Sociedad Geológica Mexicana*, 66(2), 377–395.
- Stinnesbeck, W., Ifrim, C., Schmidt, H., Rindfleisch, A., Buchy, M.-C., Frey, E., González-González, A., Vega, F. J., Cavin, L., Keller, G., & Smith, K. T. (2005). A new lithographic limestone deposit in the Upper Cretaceous Austin Group at El Rosario, County of

- Múzquiz, Coahuila, northeastern Mexico. *Revista Mexicana de Ciencias Biológicas*, 22(3), 401–418.
- Taff, B. J. (1892). Reports on the Cretaceous area north of the Colorado River. *Annual Report of the Geological survey of Texas*, 3, 267–379.
- Tong, H., Hirayama, R., Makhoul, E., & Escuillie, F. (2006). *Rhinochelys* (Cheloniidea: Protostegidae) from the Late Cretaceous (Cenomanian) of Nammoura, Lebanon. *Atti della Società italiana di scienze naturali e del Museo civico di storia naturale di Milano*, 147(1), 113–138.
- Wieland, G. R. (1896). *Archelon ischyros*: a new gigantic cryptodire testudinate from the Fort Pierre Cretaceous of South Dakota. *American Journal of Science*, 2(12), 399–412.
- Wieland, G. R. (1900). Some Observations on Certain Well-Marked Stages in the Evolution of the Testudinate Humerus. *American Journal of Science*, 9(54), 413–424.
- Wieland, G. R. (1909). Revision of the Protostegidae. *The American Journal of Science*, 27(158), 101–130.
- Williston, S. M. (1894). *A new turtle from the Benton Cretaceous*. *Kansas University Quarterly*, 3, 5–18.
- Young, K. (1963). *Upper Cretaceous Ammonites from the Gulf Coast of the United States*. The University of Texas, Austin, Bureau of Economic Geology.
- Zangerl, R. (1953). The vertebrate fauna of the Selma Formation of Alabama. Part III. The turtles of the family Protostegidae. *Fieldiana Geology Memoirs*, 3, 59–133.
- Zangerl, R., & Sloan, R. E. (1960). A new specimen of *Desmatochelys lowi* (Williston), a primitive cheloniid sea turtle from the Cretaceous of South Dakota. *Fieldiana Geology*, 14, 7–40.