

The oldest stratigraphic record of the Late Cretaceous shark *Ptychodus mortoni* Agassiz, from Vallecillo, Nuevo León, northeastern Mexico

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ABSTRACT

In this paper we report the oldest geologic world record of *Ptychodus mortoni*, from the Vallecillo Member (Agua Nueva Formation), at Vallecillo, Nuevo León, northeastern Mexico. The presence of the ammonite *Watinoceras coloradoense*, allows the placement of the sediments of the Vallecillo member within the lower Turonian (*Watinoceras coloradoense* zone). With reference to this new data, the presence of *Ptychodus mortoni* in the Vallecillo member extend the temporal distribution of this species into the earliest Turonian. Also, this study suggests that the utility of this shark species as biostratigraphic control in late Cretaceous sediments should be revised in greater detail.

Key words: *Ptychodus mortoni*, shark, lower Turonian, Late Cretaceous, Vallecillo, Mexico.

RESUMEN

En este artículo se reporta el registro geológico más antiguo de *Ptychodus mortoni*, proveniente del miembro Vallecillo (Formación Agua Nueva), en Vallecillo, Nuevo León, noreste de México. La presencia del ammonite *Watinoceras coloradoense*, permite ubicar a los sedimentos del miembro Vallecillo dentro del Turoniano inferior (zona de *Watinoceras coloradoense*). De acuerdo con estos nuevos datos, la presencia de *Ptychodus mortoni* en el miembro Vallecillo extiende la distribución temporal de esta especie al Turoniano temprano. Además, este estudio sugiere que la utilización de esta especie de tiburón como control bioestratigráfico en sedimentos del Cretácico debe ser revisada en detalle.

Palabras clave: *Ptychodus mortoni*, tiburón, Turoniano temprano, Cretácico Tardío, Vallecillo, México.

INTRODUCTION

Ptychodus is a highly specialized durophagous shark that lived during the Late Cretaceous. It has a characteristic crushing dentition that allowed the shark to feed on hard-bodied preys, such as mollusks (Cappetta, 1987). Remains of this genus have been reported from the Albian to the Maastrichtian nearly worldwide (Johnson and Lucas, 2003).

Ptychodus mortoni is a ptychodontid species that is known from North America, Europe, and Africa (Cappetta, 1987). Blanco *et al.* (2001) and Blanco-Piñón *et al.* (2002) reported a small set of associated teeth of *P. mortoni* from the Turonian deposits in northeastern Mexico, collected in the Vallecillo quarries, state of Nuevo León (Figure 1). Blanco-Piñón *et al.* (2005) determined the age of the deposit as early Turonian, but did not present the details about its stratigraphy. The purpose of this paper is to redescribe the specimen and its stratigraphic occurrence with a special emphasis on the fact that the specimen represents the oldest stratigraphic record for *Ptychodus mortoni*.

SYSTEMATIC PALEONTOLOGY

Class Chondrichthyes Huxley, 1880
 Subclass Elasmobranchii Bonaparte, 1838
 Cohort Euselachii Hay, 1902
 Order incertae sedis
 Family Ptychodontidae Jaekel, 1898
 Genus *Ptychodus* Agassiz, 1835

Ptychodus mortoni Agassiz, 1843

Referred specimen. FCT-341, six associated teeth (Figure 2) presumably from a single shark housed in the Colección Paleontológica at the Facultad de Ciencias de la Tierra (FCT), Universidad Autónoma de Nuevo León, Linares, Nuevo León, Mexico.

Occurrence. A limestone bed in the uppermost part of the Vallecillo Member of the Agua Nueva Formation, at Vallecillo, Nuevo León, northeastern Mexico (Figure 1).

Description. The six teeth vary in size and morphology (Figure 2a). In occlusal view, their shape is roughly rectangular with rounded corners, the anterior margin convex and the posterior one concave (Figure 2a). The length and width of these teeth range from 13 to 15 mm and from 19 to 25 mm, respectively. Their crowns are high and conical, measuring from 10 to 12 mm in crown height. There are about twelve ridges radiating from the apex of the crown, which are intensely branched and grade into a marginal area that is characterized by reticulated pattern (Figure 2c). A series of small cavities are present on the root surface, but other root features are not observable.

Remarks. Species of the genus *Ptychodus* are identified on the basis of crown shape and cusp morphology (Cappetta, 1987). The teeth of *P. mortoni* are distinguishable from other ptychodontid species by having a high, conical cusp with a series of radial ridges (Cappetta, 1987). This combination of characters is clearly observable in the specimen described here. Teeth of *P. mortoni* from Vallecillo show some morphological variation, which suggests a heterodont dentition. This condition along with the fact that Vallecillo teeth have a sharp cusp tip differentiates from the dentition of *P. cyclodontis* Mutter, Iturralde-Vinent y Carmona, 2005, which is the only other ptychodontid species with radial ridges on its tooth cusps.

DISCUSSION

Figure 3 summarizes the stratigraphic range and geographic distribution of *Ptychodus mortoni*. The species is known from upper Turonian through lower Maastrichtian deposits. In Europe and Africa, *P. mortoni* is uncommon but has been reported from the middle to upper Coniacian

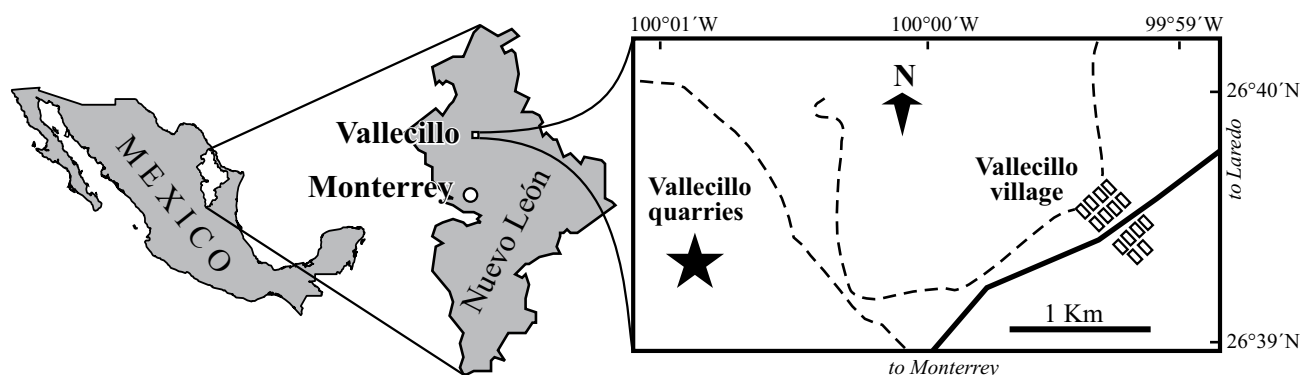


Figure 1. Locality map showing the Vallecillo quarries and the Vallecillo village, state of Nuevo León, northeastern Mexico.

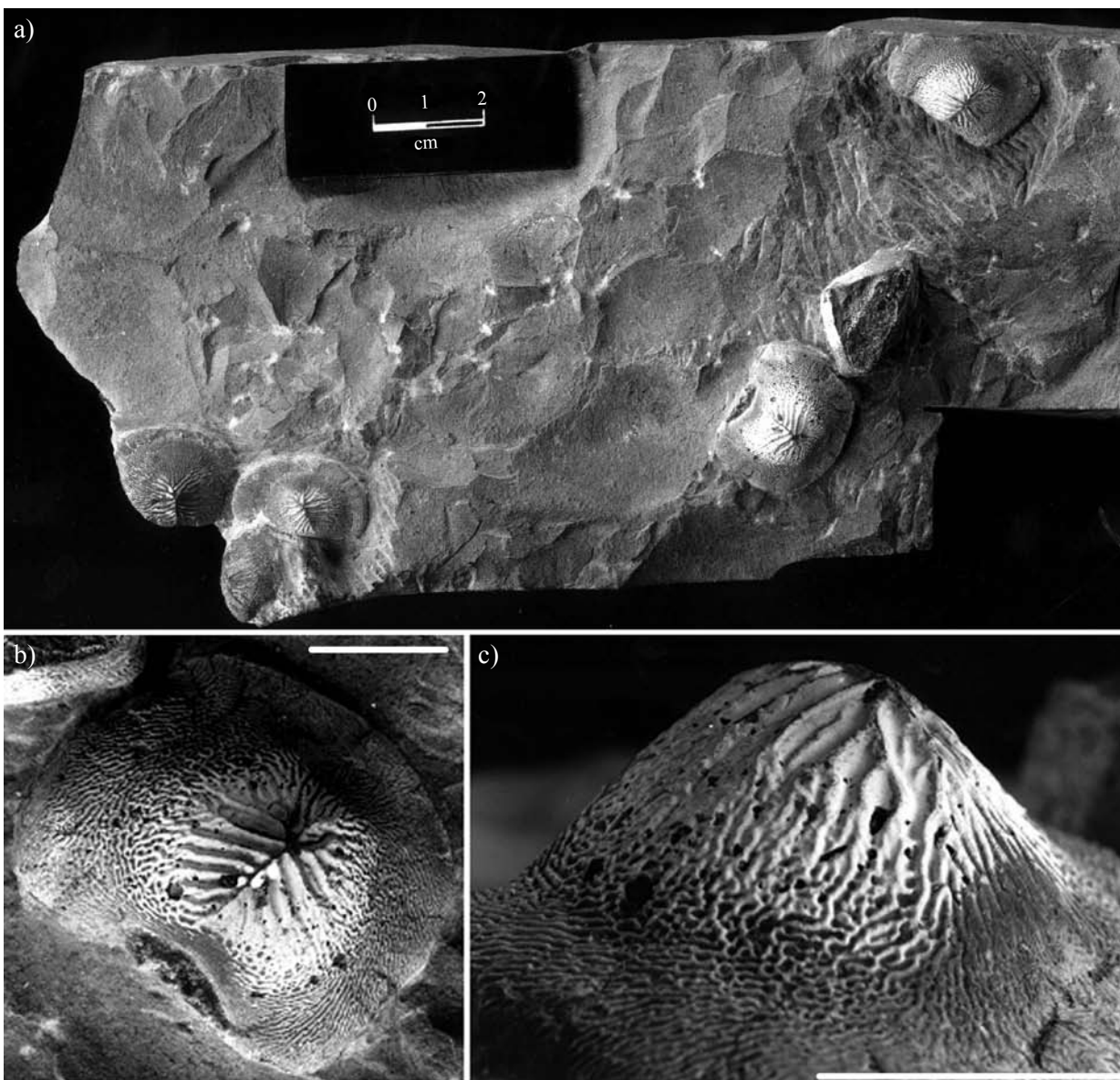


Figure 2. Teeth of *Ptychodus mortoni* (FCT-341) from the Vallecillo Member of the Agua Nueva Formation in Vallecillo, Nuevo León, northeastern Mexico. a: General view; b: Occlusal view of individual teeth; c: Lateral view. Scalbar in Figures 2b and 2c = 5 mm.

of Belgium (Herman, 1977), England (Woodward, 1887, 1889), and Italy (D'Erasmus, 1922). In Africa, *P. mortoni* is known only from the Itombe Formation (upper Turonian) at the Cuanza Basin, in Angola (Antunes, 1961; Antunes and Cappetta, 2002). In the U.S., *P. mortoni* has been reported from Coniacian-Campanian deposits in the Gulf region (e.g., Alabama, Mississippi) and the Western Interior (e.g., Texas, New Mexico, Kansas, South Dakota and Wyoming) (Williston, 1900; Applegate, 1970; Cappetta, 1987; Williamson *et al.*, 1989; Williamson and Lucas, 1990; Welton and Farish, 1993; Williamson *et al.*, 1993; Cicimuri, 1998; Brito and Janvier, 2002; Johnson and Lucas, 2003; Everhart and Caggiano, 2004). In Mexico, *P. mortoni* has been described previously from upper Turonian rocks of

Coahuila, northeastern Mexico (González-Barba *et al.*, 2001), the Turonian Agua Nueva Formation in Xilitla, state of San Luis Potosí, central Mexico (Maldonado-Koerdel, 1956), and the lower Maastrichtian Mexcala Formation in the state of Guerrero (Alvarado-Ortega *et al.*, 2004).

At the Vallecillo locality, the rock exposure consists of at least 2 m of a homogeneous sequence of laminated pink marlstone beds (Blanco *et al.*, 2001, Blanco-Piñón *et al.*, 2002). Towards the top of the section, the sequence grades into a monotonous, alternating gray-pinkish limestone and brown shale with a bed thickness varying from 10 to 20 cm. The *Ptychodus* specimen was collected from the uppermost part of the Vallecillo Member. The presence of the ammonite *Watinoceras coloradoense* Henderson (Blanco-Piñón *et al.*,

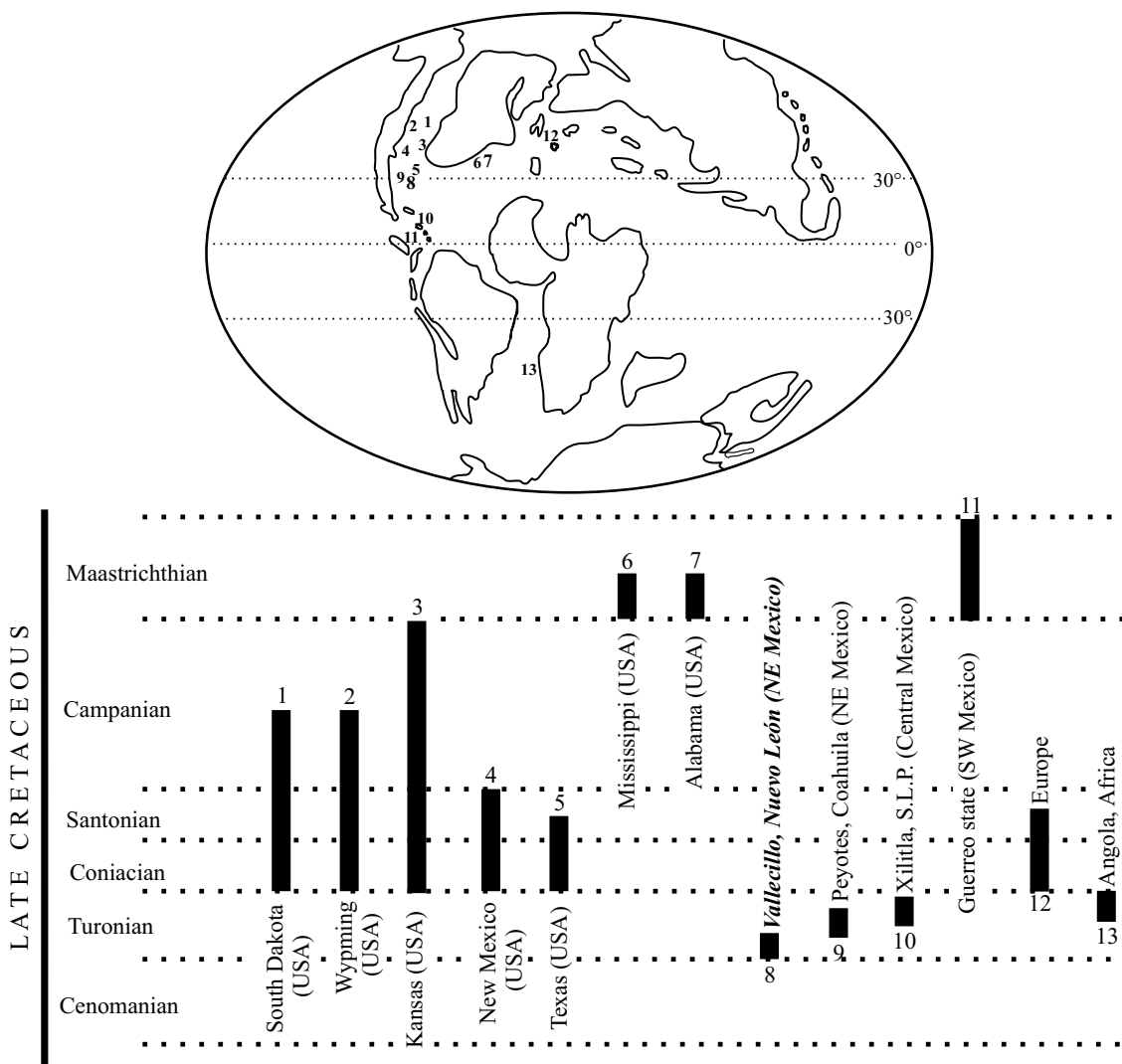


Figure 3. Stratigraphic range and geographic distribution of *Ptychodus mortoni*.

2005) in the Vallecillo Member places this rock to be lower Turonian. This age assignment concomitantly marks the oldest known fossil record for *Ptychodus mortoni*. According to Gradstein *et al.* (1995), taxon range for *W. coloradoense* spans approximately from 93.5 to 92.6 million years.

According to its previously reported temporal distribution, remains of *Ptychodus mortoni* were considered as index fossils that signify the age range of Coniacian–Maastrichtian (see Johnson *et al.*, 2002; Johnson and Lucas, 2003; Williams and Lucas, 2005). However, the specimen described here unequivocally confirms the presence of *P. mortoni* during the early Turonian. The extended chronostratigraphic range makes the species less useful as a biostratigraphical marker.

According to Blanco (2003) and Blanco *et al.* (2005), the Vallecillo Member was deposited in the outer part of a platform under anoxic/dysoxic conditions probably related to the late Cenomanian – early Turonian oceanic anoxic event (OAE-2). Besides *Ptychodus mortoni*, the fossil fauna

of the Vallecillo Member includes unidentified lamniform sharks (Blanco *et al.*, 2005), *Nursallia gutturosum* and other unidentified pycnodontid as well as undetermined pachycormid fish. Teleostean fish are represented by *Vallecillichthys multivertebratum* (Ichthyodectiformes), *Goulimimichthys roberti* and *Araripichthys* sp. (Pachyrhizodontiformes *sensu* Cavin, 2001) (Blanco and Cavin, 2003); *Robertichthys riograndensis* and *Rhynchodercetis regio* (Dercetidae) (Blanco-Piñón and Alvarado-Ortega 2005, 2006); as well as *Tselfatia formosa* (Tselfatiiformes) (Blanco and Cavin, 2003). Reptiles are represented by non-determined turtles (Blanco *et al.*, 2001) and a plesio-pedal mosasaur (Jacobs *et al.*, 2005). Invertebrates are represented by the ammonites *Watinoceras coloradoense* (Blanco-Piñón *et al.*, 2005), *Mammites*, *Spathites* and *Collignonoceras* (Blanco *et al.* 2001); as well as bivalves of the genus *Inoceramus* (Blanco 2003). Among the groups enlisted above, inoceramids are the only shelled macroinvertebrates that could have served as prey taxa for *Ptychodus mortoni*, rather than

ammonites or vertebrates such as the reptiles and the fishes. According to Cappeta (1987), the dentition of pattern of *Ptychodus mortoni* was capable of crushing shelled mollusk such as small inoceramids. Kauffman (1972) suggested this hybodontid shark species could attack small inoceramids rather than adults based on the presence of coprolite-like structures composed by crushed fragments of immature inoceramids. Until now, no evidence of attack of *Ptychodus mortoni* sharks on ammonites has been reported.

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