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ALBIAN GASTROPODS OF THE RUDIST-BEARING MAL PASO FORMATION, CHUMBÍTARO REGION, GUERRERO, MEXICO

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ABSTRACT

The Mal Paso Formation (Albian) consists of more than 750 m of highly fossiliferous sedimentary rocks exposed in the Chumbítaro region, State of Guerrero. The Mal Paso Formation is divided into two members: a lower clastic member that records continental-marine deltaic environment; and an upper calcareous member, that represents an inner lagoonal platform and reef facies. The two members are characterized by strong lithologic changes due to tectonic instability and sea level changes.

The upper part of the lower clastic member contains the following species: ***Otostoma japonicum*** (Nagao), *Purpuroidea* sp., *"Aporrhais"* affinis Coquand, *"Strombus" globulus* Coquand, *"Fusinus"* cf. *"F." absconditus* Coquand, *Mesoglauconia* (*Mesoglauconia*) *burnsi* (Stanton), *Gymnentome* (*Gymnentome*) *paluxiensis* (Stanton), *G.* (*G.*) *zebra* (Gabb), *Cassiope branneri* (Hill), *Pseudomesalia* (*Bicarinella*) *praebicarinata* Akopyan, *"Pyrazus* (*Echinobathra*)" *valeriae* (Verneuil and Loriere), *"Natica" ervyna* d'Orbigny, *"N." gasullae* Coquand, *"N." martinii* d'Orbigny, *Tylostoma* cf. *T. torrubiae* Sharpe, *T.* cf. *T. ovatum* Sharpe, *T. tumidum* Shumard, *Diptyxis luttickei* (Blanckenhorn) and *Polyptyxiella dayi* (Blanckenhorn).

The upper calcareous member within a mid- to high-energy carbonate facies contains the following species: *Tylostoma princeps* White, *Eunerinea pauli* (Coquand), *Diptyxis azteca* (Alencaster), *Diptyxis luttickei* (Blanckenhorn), *D. euphyes* (Felix), *Aptyxiella boehmi* (Blanckenhorn), *Polyptyxiella dayi* (Blanckenhorn), *Multiptyxis prefleuriaui* (Delpey), *Peruviella gerthi* (Olson), *Trochacteon* (*Neocylindrites*) *cumminsi* Stanton, rudist bank caprinids and radiolitids that indicate shallow tropical seas in the Tethyan realm. Allochthonous organisms include nektonic ammonites (*Hypacanthoplites* and *Mortoniceras*).

Key words: Gastropods, Lower Cretaceous, Chumbítaro, Guerrero, SW Mexico, Tethys.

RESUMEN

La Formación Mal Paso (Albiano) consiste en más de 750 m de rocas sedimentarias altamente fosilíferas expuestas en la región de Chumbítaro, estado de Guerrero. La Formación Mal Paso está dividida en dos miembros: el miembro inferior clástico, que representa un ambiente deltaico (continental-marino) y el miembro superior calcáreo, que representa una plataforma interna y facies arrecifales. Los dos miembros están caracterizados por fuertes cambios litológicos debidos a inestabilidad tectónica y modificaciones en el nivel del mar.

La parte superior del miembro clástico contiene las siguientes especies: *Otostoma japonicum* (Nagao), *Purpuroidea* sp., *"Aporrhais"* affinis Coquand, *"Strombus" globulus* Coquand, *"Fusinus"* cf. *"F." absconditus* Coquand, *Mesoglauconia* (*Mesoglauconia*) *burnsi* (Stanton), *Gymnentome* (*Gymnentome*) *paluxiensis* (Stanton), *G.* (*G.*) *zebra* (Gabb), *Cassiope branneri* (Hill), *Pseudomesalia* (*Bicarinella*) *praebicarinata* Akopyan, *"Pyrazus* (*Echinobathra*)" *valeriae* (Verneuil and Loriere), *"Natica" ervyna* d'Orbigny, *"N." gasullae* Coquand, *"N." martinii* d'Orbigny, *Tylostoma* cf. *T. torrubiae* Sharpe, *T.* cf. *T. ovatum* Sharpe, *T. tumidum* Shumard, *Diptyxis luttickei* (Blanckenhorn) y *Polyptyxiella dayi* (Blanckenhorn).

El miembro superior calcáreo representa una facies carbonatada de energía media a alta, y contiene las siguientes especies: *Tylostoma princeps* White, *Eunerinea pauli* (Coquand), *Diptyxis azteca* (Alencaster), *Diptyxis luttickei* (Blanckenhorn), *D. euphyes* (Felix), *Aptyxiella boehmi* (Blanckenhorn), *Polyptyxiella dayi* (Blanckenhorn), *Multiptyxis prefleuriaui* (Delpey), *Peruviella gerthi* (Olson), *Trochacteon* (*Neocylindrites*) *cumminsi* Stanton, bancos de rudistas caprínidos y radiolítidos que indican mares someros, tropicales en el dominio del Tethys. Los organismos alóctonos incluyen amonites (*Hypacanthoplites* y *Mortoniceras*).

Palabras clave: Gasterópodos, Cretácico Inferior, Chumbítaro, Guerrero, México SW, Tethys.

INTRODUCTION

The Mesozoic rocks of southwestern Mexico are poorly known. At the end of the Jurassic and beginning of the Cretaceous a great transgression created epicontinental seas with a far greater extension than previously known in Mexico. The boundaries of the Tethyan realm vary with time as discussed by Sohl (1987). It has been equated with the latitudinal limits in distribution of algal-coral, coral-rudist, or rudist dominated organic framework building during the Albian. During the Early Cretaceous, the Pacific margin of Mexico was significantly modified by intense volcanism and tectonic activity (Pantoja-Alor, 1992b).

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A first presentation of the geology of the region was made by Aguilera (1896). The first published paper on the Huetamo region is a reconnaissance study (Hall, 1903). An overview of the Mesozoic geology of Mexico also included the States of Michoacán and Guerrero (Burckhardt, 1930). Pantoja-Alor (1959) mapped an area that includes the Huetamo and San Lucas valleys, and also established the lithostratigraphic nomenclature. Subsequent studies (de Cserna, 1978; Salazar, 1983) contributed to the knowledge of the stratigraphy of the region. Johnson and collaborators (1991) discussed the stratigraphy and tectonics of the San Lucas Anticlinorium. New information on the age of the Mal Paso Formation was also published by Pantoja-Alor (1992a).

After the discovery of Albian invertebrate fossils in the Mal Paso Formation (Pantoja-Alor, 1959), several paleontological studies have been published (Ayala-Castañares, 1960; Buitrón, 1973, 1981; Buitrón and Rivera-Carranco, 1985; García-Barrera and Pantoja-Alor, 1991; Pantoja-Alor, 1992c; González-Arreola *et al.*, 1996; Buitrón and Pantoja-Alor, 1994; Pantoja-Alor *et al.*, 1994; Filkorn and Pantoja-Alor, 1995; Alencáster and Pantoja-Alor, 1995, 1996; Buitrón, 1996).

The purpose of this paper is to report a remarkable gastropod faunal assemblage of middle-late Albian age, from the Mal Paso Formation.

Location

The town of Chumbítaro is located 13 km north of Ciudad Altamirano, both in the State of Guerrero, and about 40 km southeast of the town of Huetamo, State of Michoacán, SW Mexico (Figures 1 and 2).

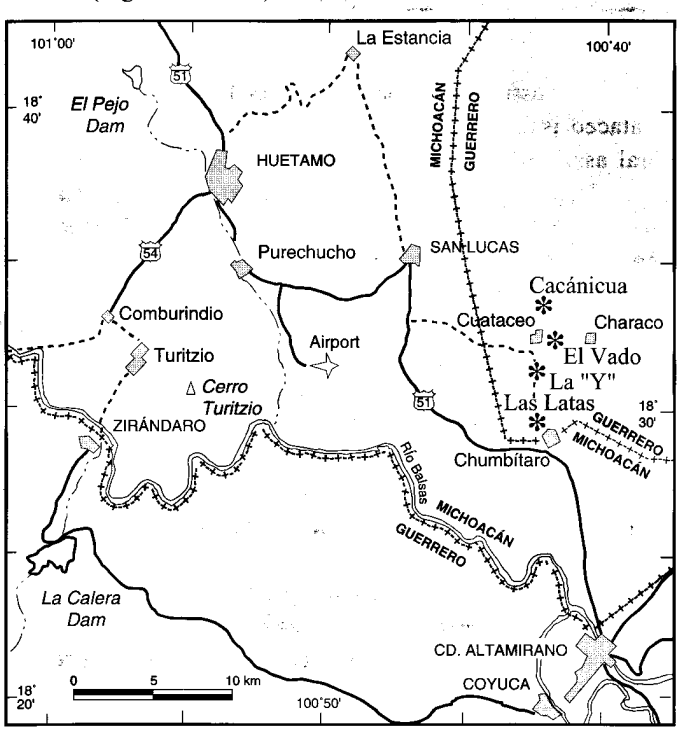

Figure 1. Location map of the Chumbítaro region, southwestern Mexico.

LOCAL STRATIGRAPHY

The Mal Paso Formation was named by Pantoja-Alor (1959) to designate a 750-1,000-m-thick sequence of marine clastic rocks and carbonates that conformably overlie platform limestones of El Cajón Formation (Pantoja-Alor, 1990, 1992a), and are in turn overlain by deltaic clastic rocks of the Cutzamala Formation (Campa-Uranga, 1978).

The lithology makes possible the subdivision of the Mal Paso Formation into two different lithostratigraphic and depositional units: a lower deltaic clastic member and an upper reefal and lagoonal member. The section measured on Federal Highway 51 (Figure 1) shows that the basal unit of the lower clastic member consists of a sequence of medium- to thick-bedded, yellowish quartz-feldspathic and lithic sandstones, which contain fossil wood fragments and logs; then it changes to a thick- to massive polymictic conglomerate made of cobbles and boulders of limestone and less igneous and metamorphic clasts. The matrix is red sand. The sequence continues with medium-bedded, red claystone, siltstone and sandstone with an interbedded 20-m-thick biostrome (wackestone-packstone) with abundant *Toucasia.* Resting on the limestone, there is a succession of red claystone, siltstone and sandstone grading up to coarse fluvial polymictic conglomerate composed of cobbles and boulders of volcanic rocks, limestone, fossil wood fragments and logs.

The upper carbonate member of the Mal Paso Formation is paleontologically important. The basal beds are formed of calcareous quartzo-feldspathic, medium-bedded gray sandstone with some intercalations of siltstone, claystone and limestone.

The upper beds change to marl and thin-bedded, yellowish, argillaceous limestone. The sandstone unit gradually changes to a rhythmic sequence of thin to massive banks of shale and sandstone that change to yellowish, argillaceous limestone (biogenic mudstone) (Figure 3).

BIOSTRATIGRAPHY

Although the collected fossils are extremely diverse, only the group of Gastropoda was studied in detail. Other faunas contained in this formation were only briefly described.

Scleractinian corals have been discovered by Pantoja-Alor (1990) at several stratigraphic horizons in the upper calcareous member. At least 13 coral species occur in beds of the Mal Paso Formation at Las Latas locality, immediately north of Chumbítaro (Filkorn and Pantoja-Alor, 1995). Some of these corals have been tentatively identified as *Astrocoenia, Stylosmilia, Latimeandra, Dendrastea, Phylocoenia* and *Actinastrea.*

In the vicinity of Chumbítaro the middle-late Albian echinoids are very abundant in the back-reef lagoon facies of the upper calcareous member. García-Barrera and Pantoja-Alor (1991) identified the following species: *Tetragramma malbosii, T. variolare, Phymosoma mexicanum, Heteraster mexicanus, Washitaster bravoensis* and *Holectypus* sp. The

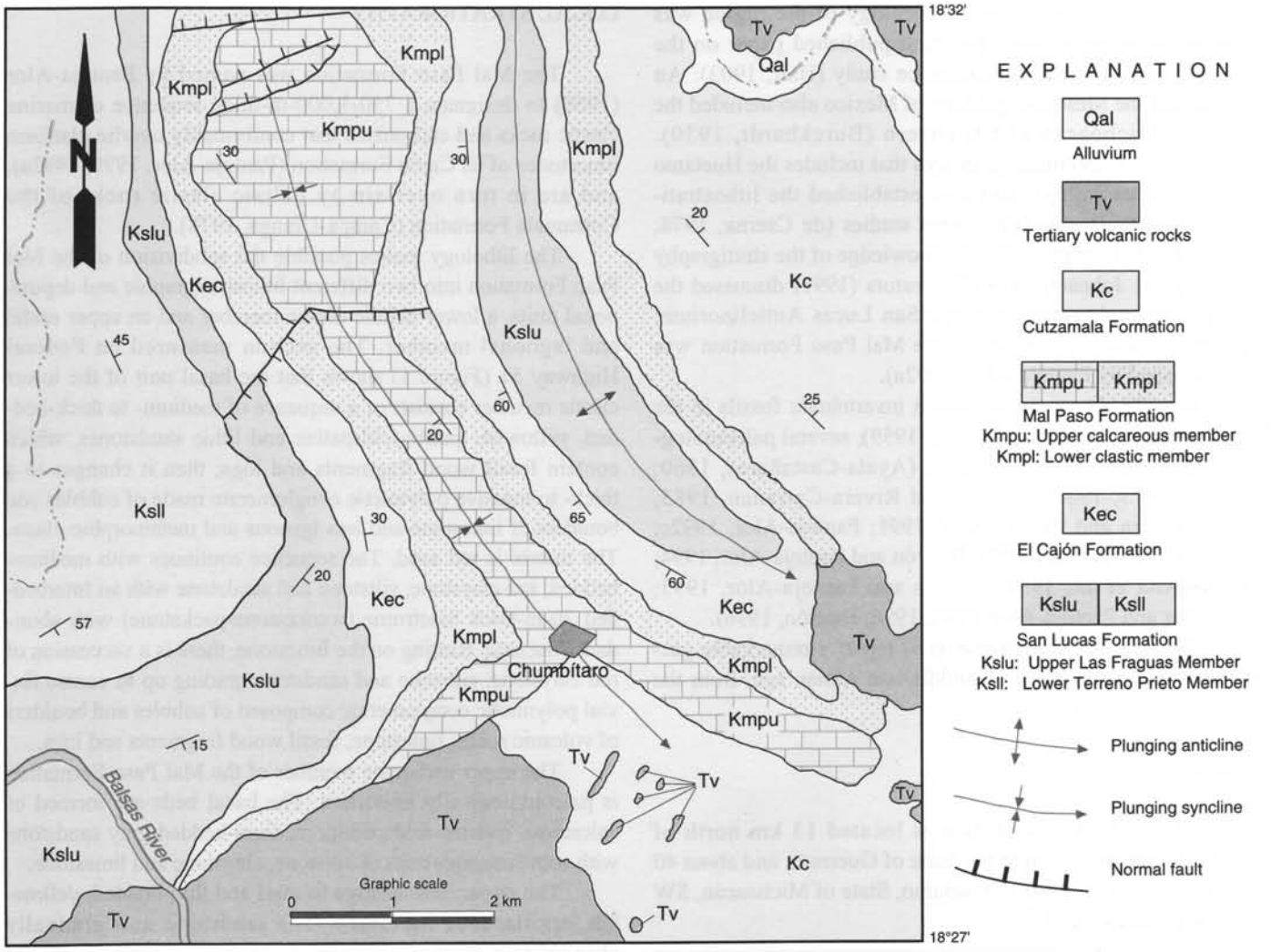

Figure 2. Geologic map of the Chumbítaro region (after Pantoja-Alor, 1993).

ammonite *Mortoniceras* of middle to late Albian age was collected from the same beds.

The Mal Paso Formation also yielded diverse assemblages of bivalves, among them *Neithea* sp., *Chondrodonta munsoni*, *Cyprimeria texana, Cucullaea symondsi, Curvostrea* cf. *C. crenulimargo* and *Ostrea* sp. Interstratified rudist biostromes (framestones to boundstones) contain *Caprina, Caprinuloidea, Immanitas, Radiolites* and *Toucasia.* The early Albian ammonite *Hypacanthoplites plesiotypicus* was collected from the basal quartzo-feldspathic sandstone of the lower clastic member.

The Albian gastropod faunas of the Mal Paso Formation are closely allied to the "coralline facies" (Sohl, 1971, 1987) of the other Lower Cretaceous formations of the Huetamo region. The development of the Albian gastropod fauna of the Chumbítaro strata is based initially on the Lower Cretaceous assemblages of Comburindio, San Lucas and El Cajón Formations. Diversification of the old realm and appearance of new groups began mainly in the Barremian, and reached a climax in the upper calcareous member (late Albian) of the Mal Paso Formation.

The gastropod fauna of the Las Latas and Mal Paso-Cuataceo is common in *Radiolites-Caprinuloidea-Neithea*-coral association typical of back reef lagoonal facies, that grades laterally to lagoonal shales and near shore siliciclastics. The taxa in the Mal Paso Formation have been divided here into two groups.

The most prominent and diverse group of gastropods in the Mal Paso Formation is Nerineacea (*Polyptyxiella dayi* [Blanckenhorn], *Aptyxiella boehmi* [Blanckenhorn], *Multiptyxis prefleuriaui* [Delpey], *Diptyxis luttickei* [Blanckenhorn], *D. euphyes* [Felix], *D. azteca* [Alencaster] and *Eunerinea pauli* [Coquand]). The Nerineacea group begins in the Jurassic with a heritage of high diversity that shows a slight decline in the Barremian, but it reaches a peak (diversity) during the Albian-Cenomanian.

In summary, the taxa of group one (Proconulinae, Chilodontinae, *Pileolus,* Nerineacea) are the lineages that were common elements of the Jurassic corallien faunas; they formed the nucleus of the Early Cretaceous Tethyan gastropod assemblages (as common to dominant elements), and became extinct at the end of the Cretaceous period. The taxa of group two

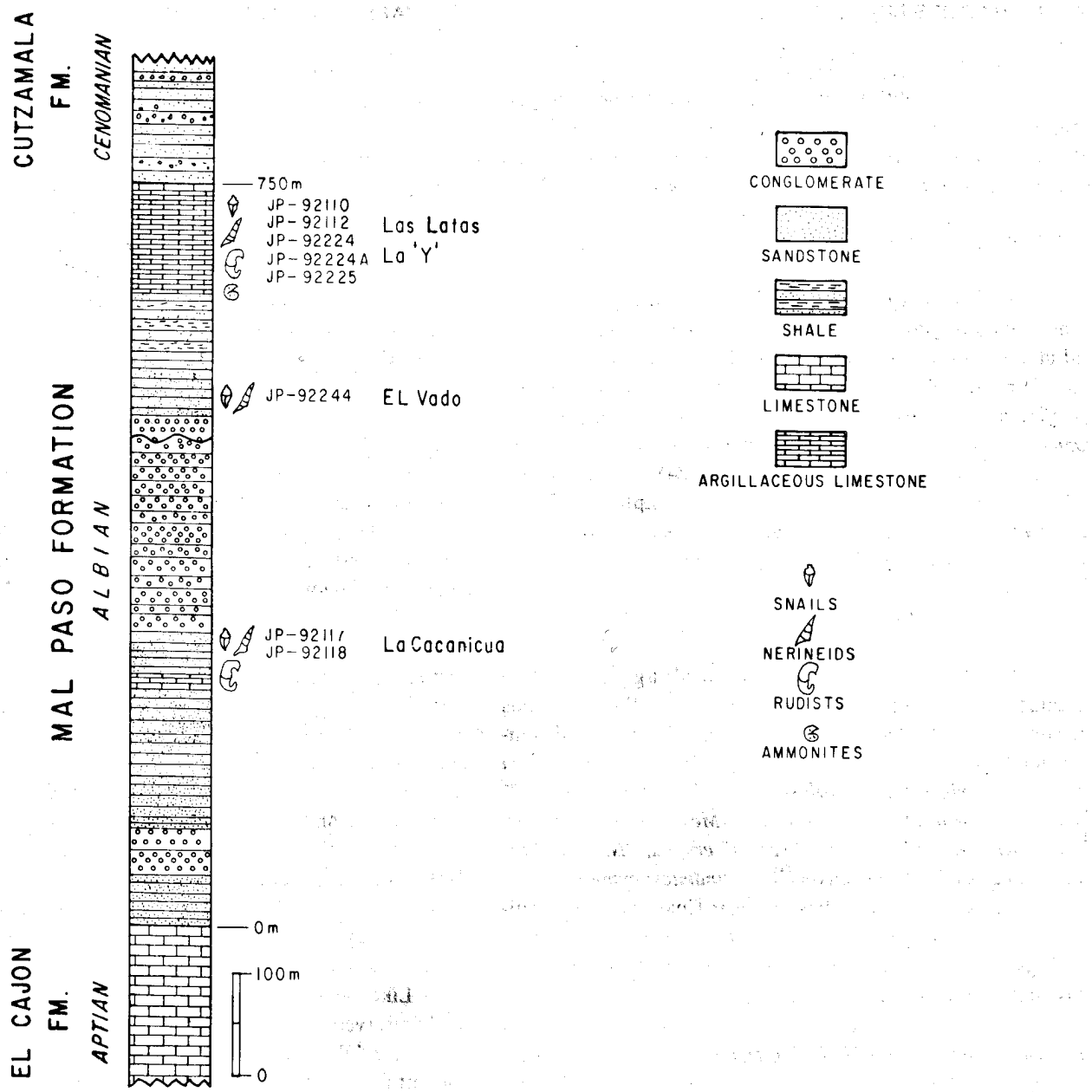

Figure 3. Stratigraphic position of gastropods and other fossils in the Mal Paso Formation.

(*Trajanella*-Cassiopidae and Actaeonellidae) consist of generic to family level categories that originated in the Early Cretaceous, and became highly diverse in the middle Cretaceous with a few exceptions; they decline in diversity and become extint in the Late Cretaceous. As it happens in taxa of group one, taxa in group two are commonly, individually abundant, and is the case of *Peruviella gerthi* (Olson), *Trochacteon (Neocylindrites) cumminsi* (Stanton) and *Mesoglauconia (Mesoglauconia) burnsi* (Stanton), *Gymnentome (Gymnentome) paluxiensis* (Stanton), *G. (G.) zebra* (Gabb), *Cassiope branneri* (Hill) and *Pseudomesalia (Bicarinella) praebicarinata* Akopyan. The latter group may dominate local assemblages to an extent that their concentrated shells form beds.

In conclusion, the two groups outlined above show some special characteristics. They consist primarily of forms most commonly associated with faunas in shallow water environments adjacent to coral or rudist framework structures typical of the Cretaceous tropical seas.

Taxa in group one arrived in the Cretaceous scene as naturally developed lineages, having already undergone a long history of diversification, and commonly showing little subsequent change. Taxa in group two had no such a long history but generally show rapid rates of diversification (Sohl, 1971, 1987). Gastropod assemblages of group three, which are restricted to the Upper Cretaceous, do not exist in the Mal Paso Formation.

FOSSILIFEROUS LOCALITIES

Abbreviation: JP-Jerjes Pantoja.

The four localities in the Chumbítaro area where the gastropods were discovered by Pantoja-Alor (1992a, 1993). All the outcrops correspond to the Mal Paso Formation and are exposed along the Mal Paso Syncline (Figure 1).

LAS LATAS LOCALITY

This locality is situated immediately north of Chumbítaro (Figures 1, 2). In this place, samples were collected at various stratigraphic levels within the upper calcareous member: (sample JP-92110) *Polyptyxiella dayi, Multiptyxis prefleuriaui, Diptyxis luttickei, Diptyxis titania, Diptyxis azteca, Eunerinea pauli, Tylostoma ovatum, Mesoglauconia (Mesoglauconia) burnsi;* (sample JP-92224) *Diptyxis azteca* (Alencaster), *Aptyxiella boehmi;* and (sample JP-92225) *Nododelphinula hiraigensis, "Pyrazus (Echinobathra)" valeriae, Eunerinea euphyes, Multiptyxis prefleuriaui.*

MAL PASO-CUATACEO

Mal Paso-Cuataceo is located along the road to Cuataceo, about 5 km north of Chumbítaro. Fossils in this locality were collected at the same stratigraphic level and similar lithology (sample JP-92112): *Polyptyxiella dayi, Eunerinea azteca, Eunerinea titania, Tylostoma* cf. *T. globosum , T.* cf. *T. ovatum, T. princeps, Mesoglauconia (Mesoglauconia) burnsi* (Stanton), *"Natica" alcibari, "Natica" ervyna, "N." gasullae, Peruviella gerthi, Trochacteon (Neocylindrites) cumminsi.*

The other two localities are near Cuataceo. The stratigraphic position of these strata is correlative with the middle and upper part of the lower clastic member of the Mal Paso Formation, as shown in Figure 3.

EL VADO AND CACÁNICUA LOCALITIES

Along the dirt road to Characo, 200 m east of Cuataceo, a 1.5-m-thick lenticular fossiliferous limestone, and red sandstone and conglomerate are exposed. The fossiliferous limestone rests on silty sandstone which contains *Orbitolina*. The fossil assemblage collected in La Cacánicua limestone (sample JP-92244) contains: *Otostoma japonicum, "Natica" ervyna, "N." gasullae, "N." martinii, Tylostoma* cf. *T. ovatum, T.* cf. *T. torrubiae, T. tumidum, Purpuroidea* sp., *Mesoglauconia (Mesoglauconia) burnsi, Gymnentome (Gymnentome) zebra, G. (G.) paluxiensis, Cassiope branneri, Pseudomesalia (Bicarinella) praebicarinata; Eunerinea pauli* is the best preserved and more varied of all the described fossils. This collection was obtained from red, calcareous beds of siltstone and sandstone cropping out in a small ravine, 300 m north of Cuataceo, at the eastern flank of the Mal Paso Syncline.

THE PALEOECOLOGY OF THE CHUMBÍTARO REGION

The Albian fossil community of the Chumbítaro region is mainly an association of cassiopid, "naticid", tylostomid, nerineid gastropods, boring sponges, echinoids, rudists and few corals (*Astrocoenia, Stylosmilia, Latimeandra, Dendrastea, Phylocoenia, Actinastrea*) that were deposited *in situ.* Allochthonous organisms include nektonic ammonites (*Hypacanthoplites plesiotypicus, Mortoniceras* sp.).

Of the two members recognized in the studied area, the deltaic sandstone facies was characterized by the presence of abundant cassiopids: *Mesoglauconia (Mesoglauconia) burnsi, Gymnentome (Gymnentome) paluxiensis, G. (G.) zebra, Cassiope branneri, Pseudomesalia (Bicarinella) praebicarinata;* naticids: *Tylostoma* cf. *T. ovatum, T.* cf. *T. torrubiae, T. tumidum, T. princeps, "Natica" ervyna, "N." gasullae "N." martinii;* fusinids: *"Fusinus"* cf. *"F." absconditus,* aporrhaids *"Aporrhais" afinnis, "Strombus" globulus;* nerineids: *Diptyxis luttickei, Diptyxis azteca, Eunerinea pauli, Multiptyxis prefleuriaui*; nerinellids: *Aptyxiella boehmi, Polyptyxiella dayi*; itieriids: *Peruviella gerthi,* actaeonellids *Trochacteon (Neocylindrites) cumminsi;* boring sponges: *Entobia cretacea* (Buitrón and Pantoja-Alor, 1994); endocyclic echinoids *Tetragramma malbosii, T. variolare, Phymosoma mexicanum*; exocyclic echinoids: *Heteraster mexicanus, Washitaster bravoensis, Holectypus* sp., a few malacostracan crustaceans, and sparse bivalves (*Neithea* sp., *Chondrodonta munsoni, Cyprimeria texana, Cucullaea symondsi, Curvostrea* cf. *C. crenulimargo* and *Ostrea* sp.).

The cassiopids have been associated with the shallow facies of the Cretaceous epicontinental tropical seas (Mennessier, 1984; Cleevely and Morris, 1988), and the excellent preservation of their shells suggests that they were buried *in situ* with almost no evidence of transport.

Like the other invertebrates, the spatangoid echinoids are well preserved. Their infaunal habits indicate an autochthonous deposit, and their feeding preferences (plant and animal debris) support the interpretation of a shallow marine deposit (García-Barrera and Pantoja-Alor, 1991).

Within the calcareous lagoonal facies, the nerineids, actaeonellids and rudists are predominant. These organisms were widely distributed across the tropical and subtropical Tethyan domain in the Cretaceous. These mollusks have been associated to the continental shelf, reefal lagoons and even as open sea environments where waters were still shallow, warm clear and with normal salinity. This invertebrate fauna was an important fraction of the benthonic community. Nerineids that show large and thick shells (*e.g., Diptyxis euphyes, Diptyxis azteca, Eunerinea pauli*) are particularly indicative of epifaunal habits on firm bottom; however, some taxa can also be semi-infaunal, like the Family Nerinellidae *(Polyptyxiella dayi*) characterized by thin and slender shells. In this case, half of the organisms lived in the sediments, with very little displacement in search of their nourishment (mostly plant materials) (Vaughan, 1988).

Most nerineids, rudists and other shells in the Chumbítaro fauna show interesting borings. These perforations are similar to those produced by clionid sponges in the shells of recent mollusks or in hard calcareous bottom. These sponges are characteristic of tropical seas with normal salinity and are considered as part of infrashore biocenosis (Buitrón and Pantoja-Alor, 1994).

Evidently, the productivity of the deposit was high enough to foster the diversity and the extensive development of the fauna. Large numbers of specimens locally formed rudist and nerineid banks.

The interpretation of the lithological and paleontological data suggests an internal platform of the lagoonal type for the upper member. The lower member is a muddy-sandy deltaic facies with abundant gastropods.

CONCLUSIONS

The Albian fossil community of the Chumbítaro region is mainly an association of cassiopids: *Mesoglauconia (Mesoglauconia) burnsi* (Stanton), *Gymnentome (Gymnentome) paluxiensis* (Stanton), *G. (G.) zebra* (Gabb), *Cassiope branneri* (Hill), and *Pseudomesalia (Bicarinella) praebicarinata* Akopyan); "naticids": *"Natica" ervyna* d'Orbigny, *"N." gasullae* Coquand, *"N." martinii* d'Orbigny, *Tylostoma* cf. *T. torrubiae* Sharpe, *T.* cf. *T. ovatum* Sharpe, *T. tumidum* Shumard, *T. princeps* White; and nerineids-nerinellids: *Diptyxis luttickei* (Blanckenhorn), *Diptyxis azteca* (Alencaster), *D. euphyes* (Felix), *Eunerinea pauli* (Coquand), *Aptyxiella boehmi* (Blanckenhorn), *Multiptyxis prefleuriaui* (Delpey) and *Polyptyxiella dayi* (Blanckenhorn).

The upper calcareous member within a mid- to high-energy carbonate facies contains itiierids: *Peruviella gerthi* (Olson); acteonellids: *Trochacteon (Neocylindrites) cumminsi* Stanton; rudist bank caprinids, and radiolitids, boring sponges : *Entobia cretacea*; echinoids: *Tetragramma malbosii, T. variolare, Phymosoma mexicanum*; exocyclic echinoids: *Heteraster mexicanus, Washitaster bravoensis, Holectypus* sp.; and some corals: *Astrocoenia, Stylosmilia, Latimeandra, Dendrastea, Phylocoenia, Actinastrea* that were deposited *in situ*. Allochthonous organisms include nektonic ammonites: *Hypacanthoplites plesiotypicus, Mortoniceras* sp.

The fossil community of the Mal Paso Formation developed in a lagoonal and deltaic environment associated with the formation of several barrier reefs, that in turn were displaced by eustatic variations during the development of onlap and offlap facies in active Albian-Cenomanian tectonic events.

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