

FOSSIL ASSEMBLAGES, MAINLY FORAMINIFERS AND RUDISTS, FROM THE EARLY APTIAN OF SOUTHWESTERN MÉXICO. PALAEOBIOGEOGRAPHICAL CONSEQUENCES FOR THE CARIBBEAN REGION

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ABSTRACT

A caprinid rudist association with *Amphitriscoelus waringi* Harris and Hodson, *Praeacprina* sp. cf. ? *P. pennyi* Harris and Hodson, *Caprina* sp. cf. *C. douvillei* Paquier and ?*Offneria* sp. is reported from Turitzio, State of Michoacán, México. It occurs together with the foraminifera *Palorbitolina lenticularis* (Blumenbach), *Choffatella decipiens* Schlumberger and *Everticyclammina* sp. and the algae *Deloffrella quercifoliipora* Granier and Michaud, *Marinella lugeoni* Pfender and *Arabicodium* sp.

The study of the embryonic apparatuses of the specimens of *Palorbitolina* from this locality indicates an earliest Aptian age for that population.

The presence of *Amphitriscoelus* and the other associated caprinids in México, constitutes evidence supporting the biotic homogeneity of the Caribbean Province during the Early Cretaceous.

Keywords: Orbitolinids, Rudists, Palaeobiogeography, Caribbean Province, Biostratigraphy, Early Aptian, Mexico.

RESUMEN

Se reporta una asociación de rudistas procedente de los biostromas del miembro inferior de la Formación Comburindio que afloran en el Arroyo Los Hornos, al norte de la localidad de Turitzio, 20 Km al sur de la pequeña ciudad de Huetamo, Estado de Michoacán, en el sudoeste de México.

La fauna de rudistas corresponde a los caprinidos *Amphitriscoelus waringi* Harris y Hodson, *Praeacprina* sp. cf. ?*P. pennyi* Harris y Hodson, *Caprina* sp. cf. *C. douvillei* Paquier y ?*Offneria* sp.

Se ha estudiado una muestra para microfauna, tomada entre dos biostromas de rudistas. El elemento más importante son los foraminíferos orbitolinidos pertenecientes a la especie *Palorbitolina lenticularis* (Blumenbach), junto a los también foraminíferos *Choffatella decipiens* Schlumberger y *Everticyclammina* sp., el alga dasicladácea *Deloffrella quercifoliipora* Granier y Michaud, la solenoporácea *Marinella lugeoni* Pfender y la udoteácea cilíndrica *Arabicodium* sp.

El carácter relativamente primitivo de los aparatos embrionarios de los ejemplares de *Palorbitolina lenticularis* estudiados, indica una edad Aptiense inferior basal. Esta edad se atribuye también a la fauna de rudistas.

La presencia en México de *Amphitriscoelus waringi* y los otros caprinidos asociados, reportados también en Cuba y Texas, además de Trinidad y Venezuela, constituye una evidencia en favor de la homogeneidad biótica de la Provincia Caribeña durante el Cretácico inferior.

Palabras clave: Orbitolinidos, Rudistas, Paleobiogeografía, Provincia Caribeña, Bioestratigrafía, Aptiense inferior, México.

INTRODUCTION

The purpose of this paper is to describe a new faunal assemblage of early Aptian age of the Comburindio Formation (Pantoja-Alor, 1993) collected in the hills immediately to the north of the town of Turitzio, 20

Km south of the small city of Huetamo, State of Michoacán (Fig. 1). The fossils described were collected by Pantoja-Alor in 1992, during a project of geological mapping of the region.

The geological evolution of the area was influenced by major tectonic events. These include subduction and volcanism during the Palaeozoic (Ortega-Gutiérrez, 1981),

opening of the Gulf of México, subduction and orogeny during the Mesozoic (Tardy *et al.*, 1992; Monod and Faure, 1992) and truncation and re-initiation of subduction along the southwestern margin of México during the Cainozoic (Pantoja-Alor, 1992c).

The earliest published geological research of the Huetamo region dates back to Hall's (1903) reconnaissance survey. A generalized overview of the geology of this part of México was given by Burckhardt (1930). Pantoja-Alor (1959, 1990, 1992a) established the lithostratigraphic nomenclature and mapped the area. New investigations (García-Barrera and Pantoja-Alor, 1991; Pantoja-Alor, 1990, 1992b) on the biostratigraphy and structure of the San Lucas area (immediately east of Huetamo), have modified and established the stratigraphical sequence and corrected the nomenclature and the tectonic concepts proposed by Johnson *et al.* (1991). Other sources of geological information are unpublished Petróleos Mexicanos (PEMEX) reports (Salazar, 1973; Campa, 1977).

GEOLOGICAL SETTING

Most of the southwestern margin of México, south of the Mexican Volcanic Belt is represented by the Guerrero Terrane. It was subdivided into the Huetamo, Iztapa-Zihuatanejo and Teloloapan subterrane (Campa and Coney, 1983). The rocks where the Turitzio fossil assemblage was collected belong to the Huetamo Subterrane. The Guerrero Terrane, a typical island arc, is characterised by magmatic (volcanics and intrusives), volcanoclastic and sedimentary rocks.

A thick Upper Jurassic sequence of conglomerate and sandstone, with interbedded dacite and andesite lava flows, rests with marked angular unconformity on the metamorphic (greenschist facies) rocks of the base-

ment of the Huetamo Subterrane. The Upper Jurassic rocks are covered with marked angular unconformity by sandstone, limestone and red beds with intercalated volcanics of Barremian to Albian age. During the Albian and part of the Cenomanian, large calc-alkaline batholiths were emplaced, uplifting the Mesozoic cover and influencing the sedimentary regime of the area (Pantoja-Alor, 1983), to give rise to a thick sequence of Upper Cretaceous marine and continental red beds.

Local Geology

The Zirándaro Formation (Pantoja-Alor, 1993), of Late Jurassic age, is the lowest mapping unit around the locality of Turitzio. It consists of a thick sequence of turbiditic red beds, formed by breccia, conglomerate, sandstone and siltstone, with intercalated reddish limestone and lava flows of dacitic-andesitic composition. To the south and west it represents marine deltaic and fluvial facies, associated with volcanics that gradually change to the east to flysch-like turbiditic facies of the Angao Formation (Pantoja-Alor, 1959).

The name of Comburindio Formation was informally given by Salazar (1973) to the lower limestone, of Neocomian age, exposed near the rural town of Comburindio. Unfortunately the name was extended to embrace limestones of Albian and Cenomanian age and it needed to be redefined. The best outcrop of the base of this Formation is exposed along the small creek that crosses the town of Comburindio (Fig. 1). The basal part of the unit consists of fine conglomerate, marl and limestone that rests with a marked angular unconformity over the Zirándaro Formation, as shown in the column of Fig. 2.

The Comburindio Formation is divided (Pantoja-Alor, 1993) in two members: a) a lower calcareous and feldspathic sandy member, which is very fossiliferous, with at least four rudist biostromes with interbedded andesitic-dacitic tuffs and lava flows, and b) an upper volcanoclastic and volcanic member, formed by red siltstone, sandstone, volcanic conglomerates and andesite-dacite breccia, tuff and lava flows (Fig. 2). The lower member has a thickness of more than 400 m. A section of 257 m which includes three rudist biostromes of this lower member was measured along the Arroyo Los Hornos, located immediately north of the town of Turitzio.

The deposit of the Comburindio Formation corresponds to a magmatic island arc overlapped, during the Barremian to the Aptian, by a regional transgression on an active subduction margin. The environments for the lower member are marked by a tectonically unstable low angle coastal shelf, with reefal, lagunar and sandy (fan) facies, altered by some volcanic events. The upper member represents different deltaic marine and continental facies in a local transgressive-regressive regime, in an active volcanic event.

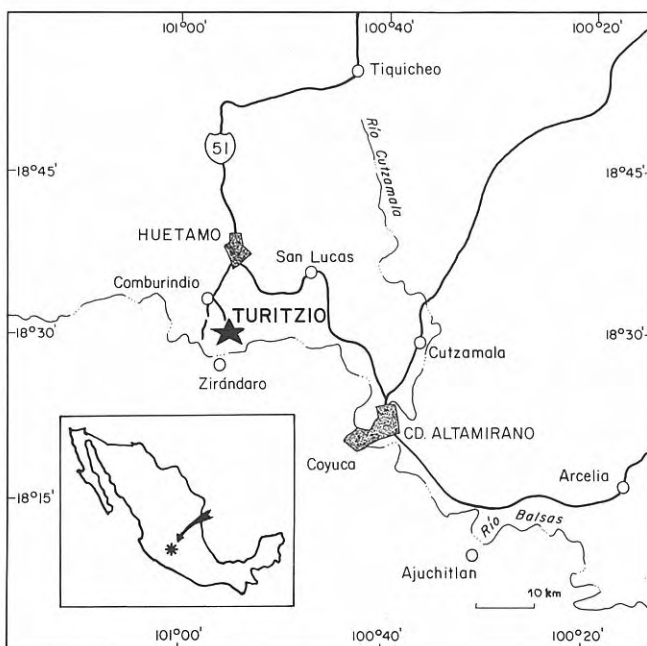


Figure 1. Sketch map showing the localities mentioned in the text.

MICROPALAEONTOLOGICAL DATA

The studied sample JP-91-312 is a biomicrite con-

taining abundant larger foraminifers and moreover fragments of bivalved shells, gastropods (mainly small nerineids), echinoderms, algae as well as reniform sponge spicules. Many of the biogenic components are developed as oncoids with a partly laminated cortex.

The most important faunal element are orbitolinid Foraminifera (Pl. 1, Fig. 5) exclusively belonging to *Palorbitolina lenticularis* (Blumenbach). This taxon is characterized (Schroeder 1963) by its megalospheric embryonic apparatus, situated in a central position at the tip

of the test. It consists of a relatively large embryonic chamber, which is covered by a layer of small subepidermal chamberlets and laterally surrounded by a periembryonic ring (Pl. 1, Fig. 4). The diameter of the embryonic chamber (measured below the subepidermal layer) varies between 0.15 and 0.25 mm.

Choffatella decipiens Schlumberger, an agglutinated planispiral and involute form (Pl. 1, Figs. 8-9), showing a subepidermal alveolar layer (Pl. 1, Fig. 6) and large apertures in the median plane (Pl. 1, Figs. 6-7), is also

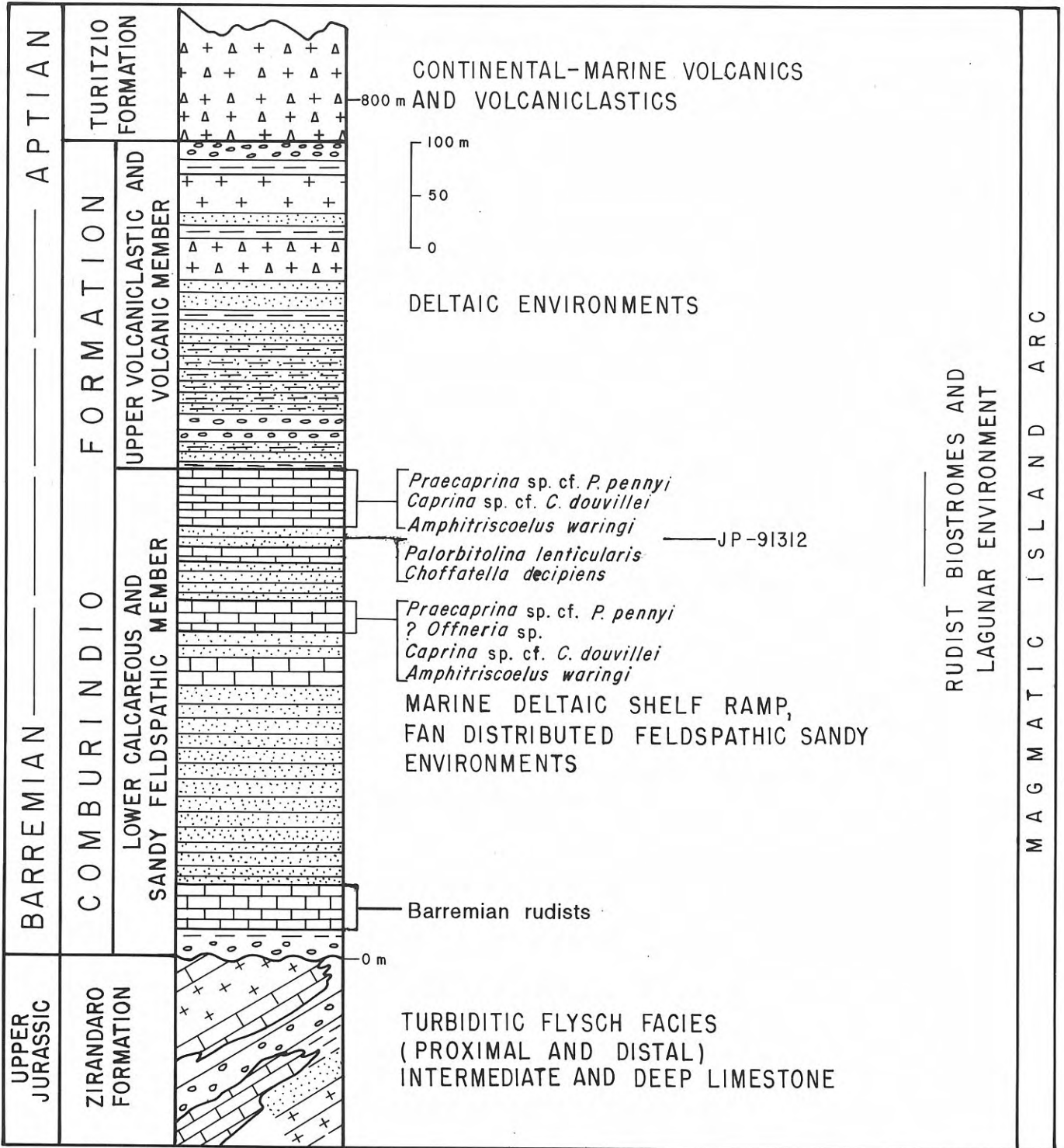


Figure 2. Stratigraphical profile of the Turitzio area with location of the fossiliferous levels studied.

very frequent in the studied sample. Some other random sections of arenaceous foraminifera can be assigned to the genus *Everticyclammina* Redmond.

Algae are mainly represented by the dasycladacean *Deloffrella quercifoliipora* Granier and Michaud (Pl. 1, Figs. 2-3). This geographically and stratigraphically widespread taxon was first described from the Kimmeridgian-Portlandian of Poblado Catorce (frontier area between the states of Veracruz and Oaxaca, SE México); it was also recorded from the Upper Berriasian and Hauterivian of Switzerland and SE France, the Hauterivian and Barremian of the Pyrenees, the Barremian of the Elburz Range (Iran) (Granier and Michaud, 1987), and recently from the Portlandian-Lower Aptian of Senegal (Granier, 1992).

The sample also contains relatively small thalli of the solenoporacean species *Marinella lugeoni* Pfender (Pl. 1, Fig. 11). Cylindrical Udoteaceae showing a largely recrystallized cortical zone, but without a calcified medullar zone, probably belong to the genus *Arabicodium* Elliott (Pl. 1, Fig. 10).

AGE OF THE *Palorbitolina* BEDS

Palorbitolina lenticularis (Blumenbach) is the most important taxon for dating the beds with *Amphitriscoelus waringi*. According to Schroeder (1963), this foraminifer is geographically widespread in the Old World Tethys, and ranged from the late Barremian to the earliest late Aptian. During this time interval the sizes of the megalospheric embryo continuously increased and can be used for a more exact dating. The relatively primitive embryonic apparatuses of *Palorbitolina* from the hills of Turitzio (sample JP-91-312) indicate an earliest Aptian age for that population.

Palorbitolina lenticularis was already described and figured by Meza (1980) from several localities of México: Anticlinal of Characo (Guerrero), P. Oballos (Coahuila), S. Cadena (Durango) and Los Humeros (Puebla). Orbitolinids described by Ayala-Castañares (1960) from the Morelos Formation near Mal Paso (Huetamo region, Michoacán) under the name *Orbitolina morelensis* n. sp. belong to *Orbitolina* (*Mesorbitolina*) *texana* (Roemer) (not identical with *O. texana* in the sense of Douglass 1960; see Schroeder 1979), and to *O. (M.) gr. subconcava* Leymerie (some paratypes; = *O. texana* in

the sense of Douglass). This association is vastly younger than the *Palorbitolina* population from the hills of Turitzio and indicates a late Aptian-early Albian age (Schroeder in Schroeder and Neumann, 1985).

In the New World "*Orbitolina lenticularis*" has been reported from Venezuela (Dietrich 1924), Colombia (Kars-ten 1858), and Texas (Douvillé 1900). It is difficult, however, to determine whether these forms are conspecific with *Palorbitolina lenticularis*, as no structural details are given. True *P. lenticularis* was described by Sen Gupta and Grant (1971) from the Flemish Cap (western North Atlantic) under the name *Orbitolina conoidea* Gras (= *P. lenticularis*; see Schroeder 1963). An exact age was not given, and the reported range of "*O. conoidea*" communicated by Sen Gupta and Grant (1971) ("Neocomian to Cenomanian, with the maximum development in Aptian") has been obsolete for a long time. The highly developed embryonic apparatuses of the specimens figured by these two authors (1971, Fig. 3) indicate, that the age of the Flemish Cap material is final early Aptian to earliest late Aptian. Schroeder and Cherchi (1979) have described *Palorbitolina lenticularis* associated with "*Paleodictyoconus*" *arabicus* (Henson), from the Grand Banks continental rise in the northwestern Atlantic (DSDP Leg 43, Site 384). Embryonic apparatuses of the specimens from this latter locality are more primitive than those from Flemish Cap, but obviously more developed than the embryos of the *Palorbitolina*s from the hills of Turitzio. Therefore, the Mexican material, including the forms figured by Meza (1980, Pl. 1-2), can actually be regarded as the oldest *Palorbitolina* populations of the New World.

RUDISTS

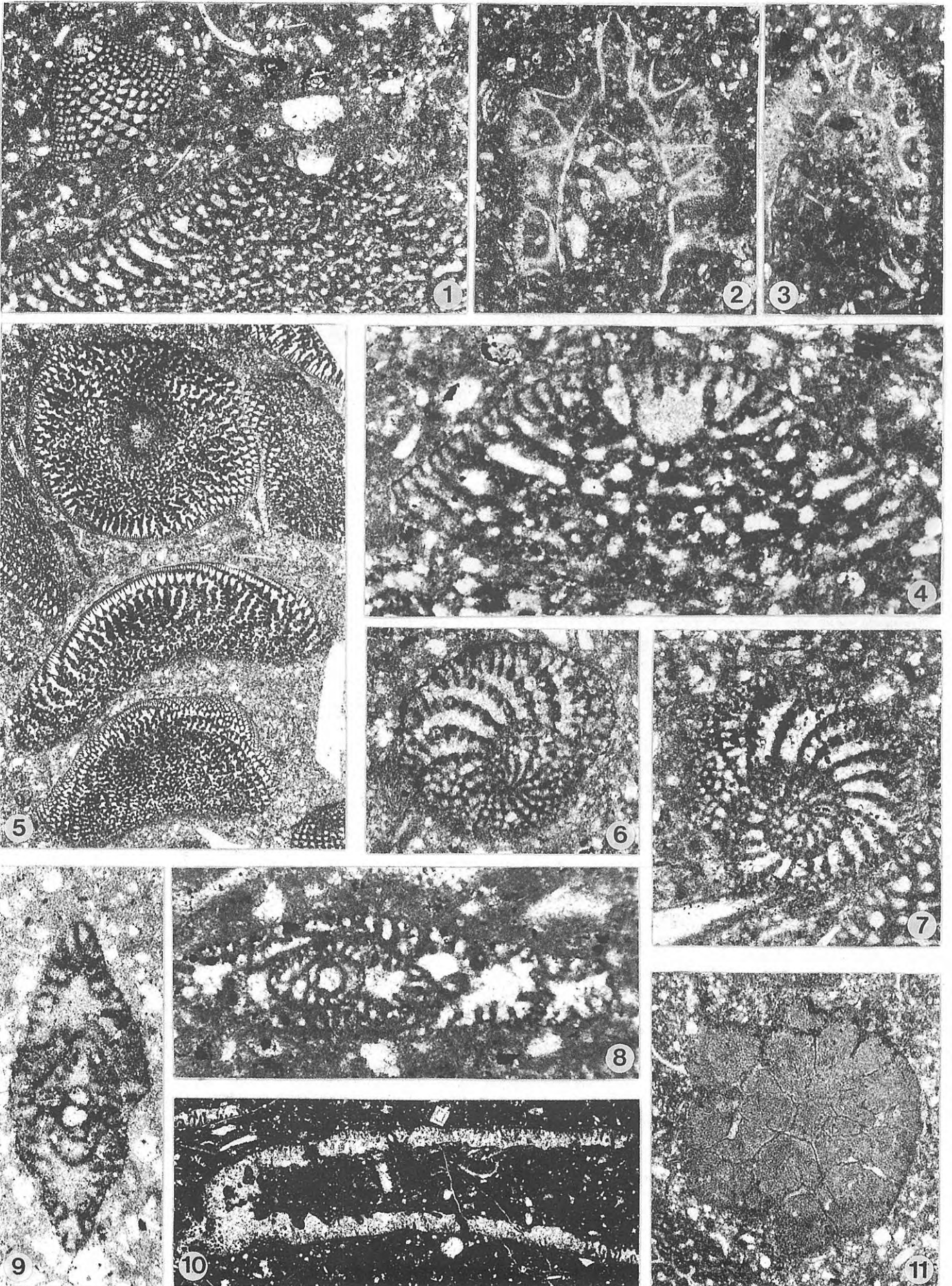
The fauna associated with *Palorbitolina lenticularis* consists of rudists of the family Caprinidae which are: *Amphitriscoelus waringi* Harris and Hodson, *Praecaprina* sp. cf. ?*P. pennyi* Harris and Hodson, *Caprina* sp. cf. *C. douvillei* Paquier and ?*Offneria* sp.

Amphitriscoelus waringi Harris and Hodson (Pl. 2, Figs. 4-8) is a small to medium size species, very variable in shape. Usually the valves are found separated and broken, with the exterior eroded. However, the internal structure is very well preserved and shows clearly all the features of the genus and the species. Both

Plate I

Larger Foraminifera and Algae from the Lower Aptian Comburindio Formation of Turitzio, near Huetamo (Michoacán, México). All slides are housed in the collections of the Geologisch-Paläontologisches Institut der Universität, Frankfurt a. Main.

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|---------|--|-----|--|
| 1, 4, 5 | <i>Palorbitolina lenticularis</i> (Blumenbach).—1: Axial section (below on the right) and tangential section (above on the left), both showing the embryonic apparatus (sample JP-91-312-A, slide 201-1), X 40.—4: Axial section through a young specimen showing the large embryonic chamber surrounded by the periembryonic ring (sample JP-91-312-A, slide 201-1), X 100.—5: Random sections (sample JP-91-312-B, slide 202-1), X 15. | 6-9 | <i>Choffatella decipiens</i> Schlumberger.—6: Oblique sub-equatorial section (sample JP-91-312-A, slide 201-4), X 60.—7: Equatorial section (sample JP-91-312-B, slide 202-2), X 60.—8: Axial section (sample JP-91-312-A, slide 201-2), X 100.—9: Axial section (sample JP-91-312-A, slide 201-1), X 100. |
| 2, 3 | <i>Deloffrella quercifoliipora</i> Granier and Michaud.—Oblique sections (sample JP-91-312-A, slide 201-4), X 40. | 10 | <i>Arabicodium?</i> sp. Axial section (sample JP-91-312-A, slide 201-3), X 15. |
| | | 11 | <i>Marinella lugeoni</i> Pfender (sample JP-91-312-B, slide 202-1), X 40. |



valves present a big, subpentagonal body cavity with the ventral margin, the largest, lacking canals. There are five to seven, large, rectangular to subrounded posterior pallial canals in a single row, separated by thin simple septa; along the antero-dorsal margin there is a row of smaller, more numerous and rounded pallial canals. A large anterior accessory cavity is present in each valve.

When *Amphitriscoelus* was discovered in the island of Trinidad, its age was doubtful (Harris and Hodson, 1922). In 1944, in the nearby region of northeastern Venezuela, the same fauna of rudists was found together with species of bivalves and corals, which were studied respectively by Imlay and by Wells (*In* Hedberg and Pyre, 1944), who considered the age as early Aptian because of the great similarity with the Urgonian faunas of France. This age was confirmed by Masse and Rossi (1987) in a study of the foraminifers and calcareous algae of the Taguarumo Member of the Barranquín Formation, in Serranía del Interior of northeastern Venezuela. They also found *Amphitriscoelus waringi* and other caprinids in several localities.

Praeacprina sp. cf. ?*P. pennyi* Harris and Hodson (Pl. 2, Figs. 1-3) is a very big species, abundant and well preserved in the Huetamo region. The wall is very thick and the internal structure is different in each valve. The left valve, of rounded outline, is convex and coiled, and presents a few (from five to eight) big, oval to rectangular pallial canals in a single row in both, the posterior and the anterior margins, and a big trigonal body cavity with the ventral side, the longest, devoid of canals and provided, near the anterior margin, of a longitudinal angular projection ("cordon" or "saillie" of Paquier, 1905) which is a characteristic feature of *Praeacprina* and *Pachytraga* (Paquier, 1905). The right valve is cylindro-conical, with a large body cavity and elongated anterior and posterior accessory cavities.

?*Praeacprina pennyi* Harris and Hodson from Trinidad is similar to the Mexican species, although not so big. The medium sized Mexican specimens are very like the biggest specimens of Trinidad in external shape and also in the internal features described by the au-

hors. The assignment of the specimens of Trinidad to *Praeacprina* by Harris and Hodson (1922) was doubtful due perhaps to its large size in comparison with the other species of the genus, and also because the specimens are broken and badly preserved as a result of recrystallization. It is our consideration that they may correspond to the Mexican species.

Praeacprina varians Paquier, from the Urgonian of France, although somewhat similar to the Mexican species in general shape, apart from being much smaller, differ because it presents a remarkable ventral depression with rounded keels in each side in both valves; besides, internally, the anterior and posterior canals are smaller, more numerous (from 13 to 15 in each row) and pyriform, and the smaller body cavity has a short ventral margin.

Caprina sp. cf. *C. douvillei* Paquier (Pl. 2, Figs. 9-11) is the most abundant rudist of the Huetamo region. It is a small to medium size species, similar to *Caprina douvillei*, described by Paquier (1905) from the upper Urgonian beds of Le Rimet, near Grenoble, France. This species has been found also in the Lower Aptian Sligo Formation of Texas (Skelton, 1982; Young, 1984).

Another species, distinguished now as ?*Offneria* sp. (Pl. 2, Figs. 12, 13), is well preserved and frequent. It differs from the known *Offneria* species, because the pallial canals are more regular in shape and size, with very few transversal septa; in longitudinal sections the tabulae of the pallial canals are present, but they are few and amply separated. It could be a new species of this genus or else a new genus closely related to *Offneria*.

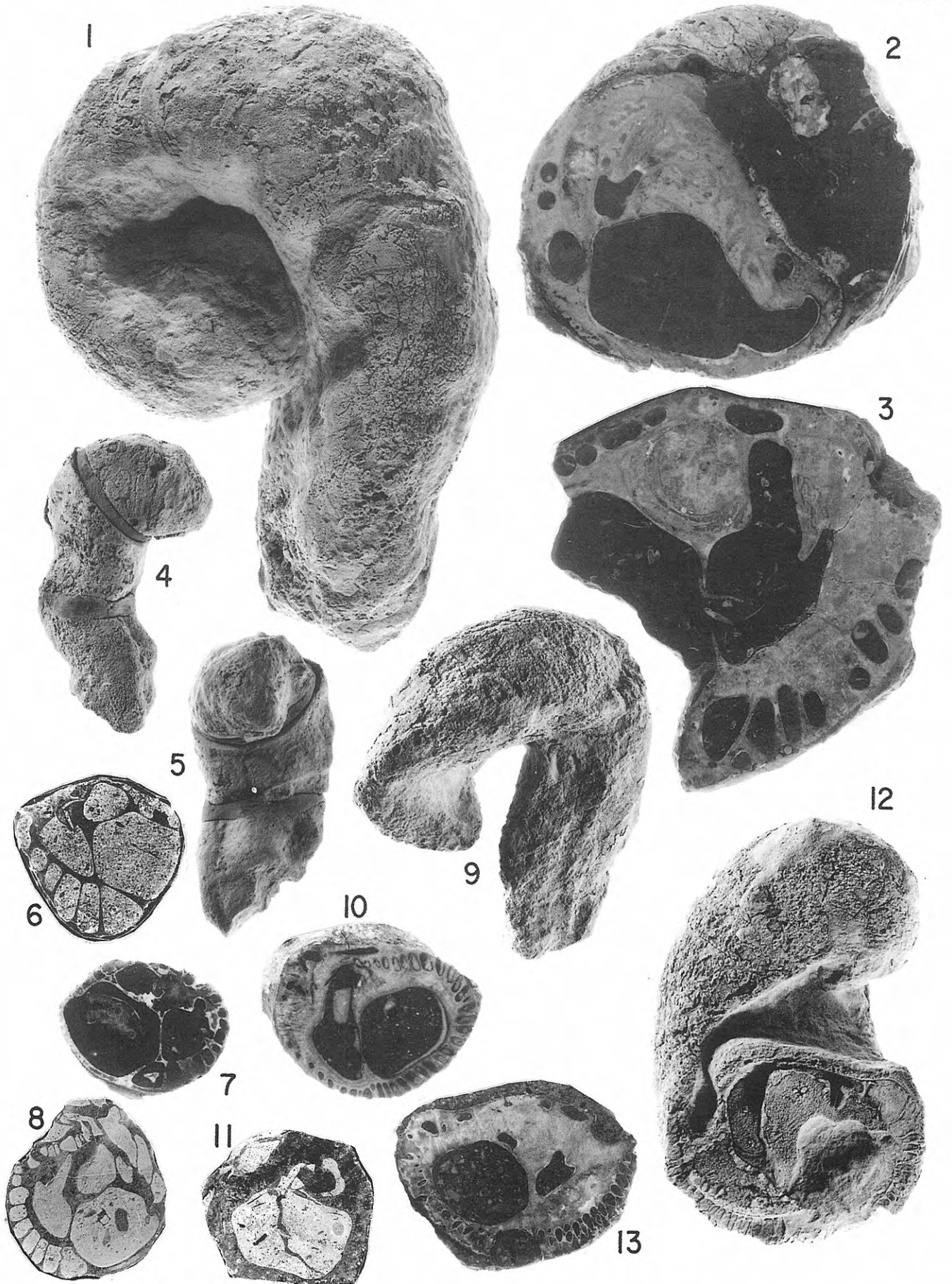
PALAEOBIOGEOGRAPHICAL CONSIDERATIONS

The discovery of *Palorbitolina lenticularis* and *Amphitriscoelus waringi* associated with other caprinids in the lower Aptian of the Huetamo region gives rise to some palaeobiogeographic considerations.

Plate II

Rudists from the Lower Aptian Comburindio Formation of Turitzio, near Huetamo (Michoacán, México). All specimens are housed in the collections of the Instituto de Geología, Universidad Nacional Autónoma de México (acronym IGM).

- 1-3 *Praeacprina* sp. cf. ? *Praeacprina pennyi* Harris and Hodson.—1: Both valves, anterior view (specimen IGM-6446, sample JP-91-304), X 0.66.—2: Left valve cross section showing the body cavity with its anterior projection, also the posterior accessory cavity and a few pallial canals (specimen IGM-6447, sample JP-91-304), X 0.75.—3: Incomplete left valve, cross section, apical view showing the posterior accessory cavity, both teeth and posterior and anterior pallial canals (specimen IGM-6449, sample JP-91-304), X 1.
- 4-8 *Amphitriscoelus waringi* Harris and Hodson.—4: Both valves, lateral view (specimen IGM-6366, sample JP-90-235), X 1.—5: Dorsal view (same specimen), X 1.—6: Left valve cross section (specimen IGM-6367, sample JP-91-303) X 1.—7: Right valve cross section (specimen IGM-6368, sample JP-91-303), X 1.—8: Left valve cross section (specimen IGM-6363, sample JP-92-354), X 1. In all cross sections, the pentagonal body cavity, posterior and anterior accessory cavities and posterior and anterior pallial canals are clearly shown.
- 9-11 *Caprina* sp. cf. *Caprina douvillei* Paquier.—9: Both valves (specimen IGM-6448, sample JP-91-264), X 1.—10: Left valve cross section (specimen IGM-6450, sample JP-91-267), X 1.—11: Right valve (same specimen) X 1.
- 12-13 ?*Offneria* sp.—12: Left valve, apertural view (specimen IGM-6452, sample JP-92-330), X 1.—13: Left valve cross section, apical view (specimen IGM-6451, sample JP-92-330) X 1.



The foraminiferal genus *Palorbitolina* was distributed worldwide on carbonate platforms of the Tethys Realm during the late Barremian - earliest late Aptian interval. Recent studies have shown (Schroeder, 1993), that *Palorbitolina* originated from *Valserina* Schroeder and Conrad 1968, a relatively small orbitolinid genus showing an eccentrically situated embryonic apparatus. *Valserina* was spread during the late Hauterivian - early Barremian only over a relatively restricted area of SW Europe (Jura Mountains, Subalpine Chains, Provence, eastern Pyrenees, Sardinia) characterizing, together with other endemic genera ("association a *Valserina*"), a special bioprovince (Cherchi and Schroeder, 1973). However, the worldwide geographical extension of the Tethyan carbonate platforms at the Barremian/Aptian boundary was favourable for the distribution of *Palorbitolinas*, which also reached the American continent during the early Aptian.

Although the presence of *Amphitriscoelus* was unconspicuously recorded in Texas by Perkins (*in* Dechaseaux *et al.*, 1969, p. N790), that notice was ignored by many palaeontologists, since this information was not published in any other way. Therefore, before 1992 it could be believed that the *Amphitriscoelus* assemblage was only present in a small area of Trinidad and northeast Venezuela.

Masse and Rossi (1987) reported the presence in Venezuela of the alga *Hensonella dinarica*, of "African" affinity, as well as the absence there of typically European microfossils. On this assumptions, they postulated that the Caribbean paleobiogeographical Province was separated in the early Aptian into a Southern province containing an endemic rudist fauna and microfossils with "African" affinity, and a Northern province that would comprise the Mexican, Texan and probably the Atlantic Bahamian regions, with a fauna of rudists, corals and bivalves, with predominantly European influence.

Recently, a Lower Aptian rudist fauna which includes *Amphitriscoelus waringi*, *Caprina douvillei*, *Offneria* sp. and ?*Pachytraga* sp. was discovered in the northeast flank of Cuba, in outcrops of a margin facies of the Bahamian Carbonate Platform in the Gibara area (Rojas *et al.*, 1992).

The presence of *Amphitriscoelus* in Mexico, Cuba and Texas, together with other rudists also present in Trinidad and Venezuela, associated with a diverse fauna of European affinity, greatly weakens the Masse and Rossi's hypothesis, and at least concerning the rudists, constitutes evidence supporting the biotic homogeneity of the Caribbean Province during the early Cretaceous.

ACKNOWLEDGEMENTS

This research is part of a continuing effort of the Instituto de Geología, UNAM, with the financial support (D112-903504) of Consejo Nacional de Ciencia y Tecnología (CONACYT), for the study of the stratigraphy and structural relations of the Huetamo region, State of Michoacán, México. The worthy suggestions of the reviewers J. P. Masse and P. W. Skelton and the editor M. A. Lamolda improved the paper. We greatly appreciate their interest.

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Manuscrito recibido: 20 de septiembre, 1993
 Manuscrito aceptado: 2 de mayo, 1994