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CARIBBEAN AMMONITE ASSEMBLAGES FROM UPPER JURASSIC - LOWER CRETACEOUS SEQUENCES OF CUBA²

(Figs 1 - 3; Pl. I)

Abstract. Late Jurassic and Early Cretaceous ammonite assemblages of Western and Central Cuba belong to the paleobiogeographical Caribbean Province. This province existed during the Late Jurassic (since Middle Oxfordian) and the earliest Cretaceous (to the Hauterivian). The ammonites of the Caribbean Province occur in the Upper Jurassic and lowermost Cretaceous sequences of Cuba, northeastern and central Mexico and in the southern United States. Strong biogeographical links between Cuba, Colombia and the Mediterranean Province were established during the Barremian.

Key words: paleobiogeography, ammonites, Cuba, Caribbean Province, Upper Jurassic, Lower Cretaceous.

INTRODUCTION

The opinions expressed in the present paper have been formulated on the basis of the present author's study of ammonites collected in Western Cuba, and on data published by other authors. Paleobiogeographical links of the Cuban Late Jurassic and Early Cretaceous ammonite assemblages were partly analysed in the author's earlier papers (Myczyński, 1976a, 1976b, 1977, 1989; Myczyński & Pszczółkowski, 1990; Myczyński & Triff, 1986). The author gratefully acknowledges the help offered by Ing. J. Triff, from the Institute of Geology and Paleontology MINBAS in Havana, during field work in Cuba. The author expresses his gratitude to Ing. M.A. Iturralde-Vinent (National

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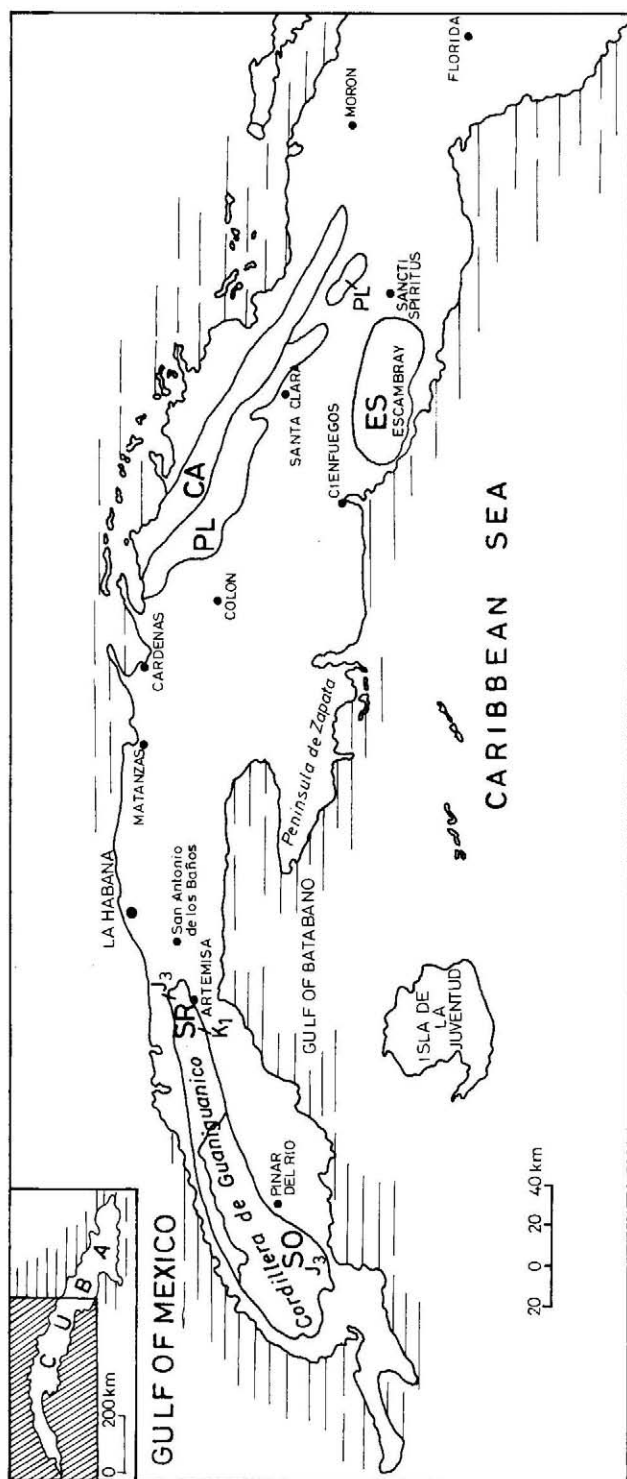


Fig. 1 Location map of the Upper Jurassic - Lower Cretaceous sequences in Cuba

J_3 - ammonite-bearing Upper Jurassic deposits of Sierra de los Organos and Sierra del Rosario (SR) in Cordillera de Guaniguanico in the Pinar del Río Province, Western Cuba; K_1 - ammonite-bearing Lower Cretaceous deposits of Sierra del Rosario; CA - ammonite-bearing Upper Jurassic and Lower Cretaceous deposits of the Camajuaní sequence in the Matanzas Province and Central Cuba; PL - ammonite-bearing Upper Jurassic and Lower Cretaceous deposits of the Placetas sequence in the Matanzas Province and Central Cuba; ES - Upper Jurassic metamorphosed rocks in the Escambray massif (Central Cuba)

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Paleobiogeographical differentiation of ammonites has been discussed by many authors (Imlay, 1965; Khudoley, 1974; Enay, 1972, 1973; Cariou, 1973; Cariou *et al.*, 1985). It is explained by faunal provinciality, which depended on eco-environment and presence of physical barriers, such as uplifted areas, shallow marine zones, water chemistry and temperature restricting free migration of ammonites. According to Scott (1984) rift zones and related volcanic activity could also act as barriers. By restricting migration, these factors caused differentiation of fauna, and eventually resulted in appearance of endemic ammonite assemblages (e.g. Cariou, 1973; Cariou *et al.*, 1985; Imlay, 1965, 1980; Enay, 1972, 1973, 1980; Enay & Mangold, 1982; Hallam, 1981, 1983; Pożaryska & Brochwicz-Lewiński, 1975; Westermann, 1984; Westermann & Riccardi, 1976, and others).

The paleobiogeographical links between the Cuban ammonite assemblages and ammonites of other areas which belonged to the Caribbean Province during the Late Jurassic and Early Cretaceous, will be shown against background of the Mesozoic sequences of Cordillera de Guaniguanico in Western Cuba, and the Camajuaní, Placetas and Escambray sequences in Central Cuba (Fig. 1). During the Jurassic and Early Cretaceous, these sequences were located in the northwestern part of the Proto-Caribbean basin, along the eastern margin of the Yucatán block (Cordillera de Guaniguanico and Escambray sequences) and the southern edge of the Florida-Bahamas platform (Camajuaní and Placetas sequences) (Fig. 2). Figure 3 shows distribution of the ammonite genera recognized in the Late Jurassic and Early Cretaceous of Cuba against their worldwide distribution.

JURASSIC ZOOGEOGRAPHICAL PROVINCES

For the Upper Jurassic and Lower Cretaceous, Uhlig (1911) distinguished the following provinces and subprovinces: Boreal Province, North-Andean Subprovince, South-Andean Province, Mediterranean-Caucasian Province, Himalayan Province, Ethiopian Subprovince, Maorian Subprovince and Japan Province. At present, there is a distinct tendency to recognize only two realms: Boreal and Tethyan. Within the Tethyan Realm, Enay (1980) distinguished the following zoogeographical provinces: Mediterranean, Caribbean, Far East (Japan), Indopacific (with Ethiopian and southwest Pacific subprovinces) and Andean. This subdivision implies strong expansion and endemic differentiation of the Tethyan fauna during the Jurassic. Currently, Enay's (1980) subdivision is followed by many authors (Enay & Mangold, 1982; Cariou *et al.*, 1985; Meléndez *et al.*, 1988).

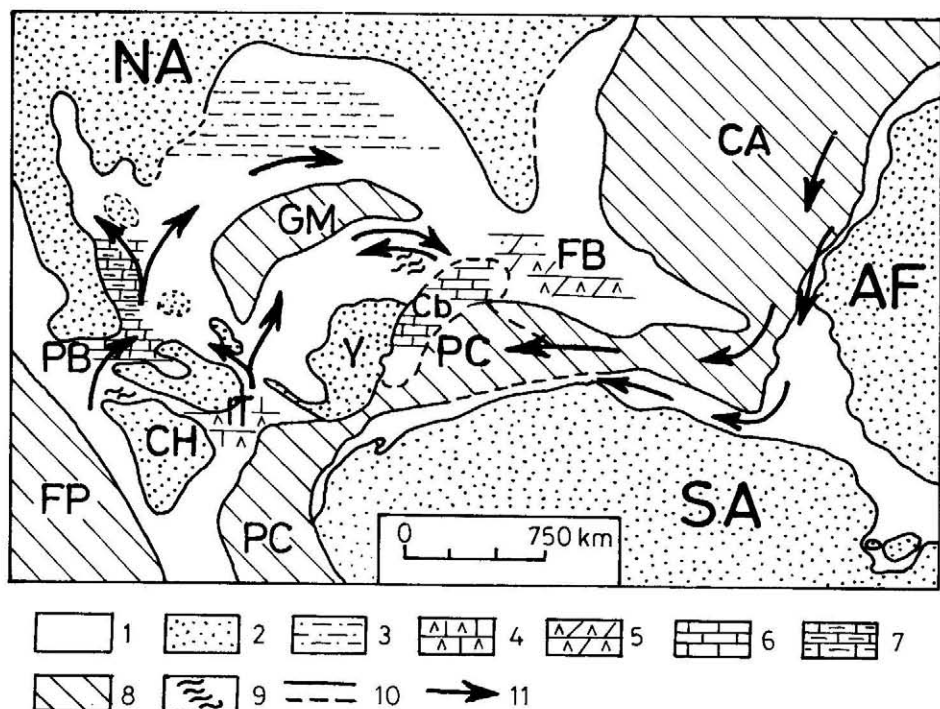


Fig. 2 Reconstruction of the Caribbean and adjacent areas for the Lower Tithonian after Pszczółkowski (1987) and also partly after: Viniegra-O, 1971; Geyer, 1973; Le Pichon *et al.*, 1977; Buffler *et al.*, 1980; Dickinson & Coney, 1980; Imlay, 1980; Ross & Scotese, 1988; Salvador & Green, 1980; Jansa & Wiedmann, 1982; Anderson & Schmidt, 1983; Fourcade *et al.*, 1991

1 - shallow water seaway; 2 - continental deposits (undivided); 3 - clastic deposits and calcareous clays; 4 - dolomites and evaporites; 5 - dolomites; 6 - shelf limestones; 7 - marine sediments of the South American and African continental shelf and slope; 8 - oceanic crust; 9 - metamorphic and/or plutonic basement; 10 - active faults (continuous lines) and inactive fractures (dashed lines); 11 - hypothetical routes of ammonite migration; AF - Africa; NA - North America; SA - South America; CA - Central Atlantic; Ch - Tithonian deposits of Western Cuba; CH - Chortis Plate; Y - Yucatan; GM - Gulf of Mexico; PC - Proto-Caribbean basin; IT - Istmo de Tehuantepec; FB - Florida-Bahamas Platform; FP - Farallon Plate; PB - Portal de Balsas (Guerrero) strait

The Caribbean Province was proposed by Westermann (1984) and Taylor *et al.* (1984) for the Middle Jurassic. The name "Caribbean Province" refers to the Caribbean region and should not be confused with the Pacific Caribbean plate. Myczyński (1989), based on Tithonian ammonite assemblages, suggested that the Caribbean Province also existed during Late Jurassic and Early Cretaceous times. The Late Jurassic expansion of the Tethyan fauna was clearly the result of the opening of the Proto-Atlantic seaway, named "the Hispanic corri-

dor" by Westermann (1984). This seaway, originally shallow (Hallam, 1983), connected Western Tethys with the East Pacific (Hillebrandt, 1970, 1973; Westermann & Riccardi, 1984; Bartok *et al.*, 1985; Westermann, 1992).

Contrasting opinions were expressed on provenance of the Late Jurassic ammonites in the Caribbean Province: due to migration from either the Pacific (Imlay, 1965; Khudoley, 1974), or the Western Tethys (Enay, 1972; Cariou *et al.*, 1985).

Pessagno & Blome (1986) and Pessagno *et al.* (1987a, 1987b) distinguished three Late Jurassic zoogeographical realms: Austral, Tethyan and Boreal. From the Upper Jurassic of central Mexico (San Pedro del Gallo), these authors recorded a faunal assemblage consisting of radiolarians (*Parvicingula*), bivalves (*Buchia*) and infrequent ammonites characteristic for the Boreal regions. They suggest that some Mexican tectonic terranes were tectonically displaced from the Southern Boreal Province located at 30° of northern latitude. According to Pessagno & Blome (1986) and Pessagno *et al.* (1987a, b, 1993), the Southern Boreal province was a part of the Boreal Realm, and not of the Tethyan one. However in Cuba, the Late Jurassic and Early Cretaceous ammonites of Boreal character are unknown, and only Boreal-type bivalves *Buchia* do occur in the Tithonian sediments of Western Cuba (Myczyński, 1989; Myczyński & Pszczółkowski, 1990).

According to Iturralde-Vinent (1981, 1988), Mesozoic sequences of the Cordillera de Guaniguanico belonged to the Caribbean microcontinent, for which he has recently introduced the name "Guaniguanico Terrane" (Iturralde-Vinent, 1994). In his plate-tectonic reconstruction for the Oxfordian (*op. cit.*, fig. 8), this terrane is located along the eastern margin of the Yucatán block, thus following earlier opinions by Pszczółkowski (1987) and Piotrowska (1992, 1993).

CUBAN AMMONITE ASSEMBLAGES

Oxfordian

(1) The earliest ammonite assemblages in Cuba have been described from the Middle Oxfordian deposits of the Sierra de los Organos and Sierra del Rosario in the Cordillera de Guaniguanico (Nuez, 1972, 1974; Kutek *et al.*, 1976; Myczyński, 1976a, b; Myczyński & Pszczółkowski, 1976; Wierzbowski, 1976). These ammonite-bearing deposits are underlain by deltaic sediments of the San Cayetano Formation (Haczewski, 1976). During the Middle Oxfordian, the supply of terrigenous material ceased, probably as a result of the sea-level rise and marine transgression, and was replaced by carbonate deposits (Haczewski, 1976; Pszczółkowski, 1978, 1981). The earliest ammonite fauna was found in the uppermost part of the San Cayetano Formation of Sierra del Rosario (Myczyński & Pszczółkowski, 1976). It is similar to the slightly younger ammonite assemblages occurring in the

Zacarías Member (Nuez, 1972, 1974; Wierzbowski, 1976) and in the Jagua Vieja Member of the Jagua Formation (Wierzbowski, 1976), as well as in the Francisco Formation of Sierra del Rosario (Kutek *et al.*, 1976; Myczyński, 1976a).

The Middle Oxfordian ammonite assemblages are dominated by Perisphinctidae (*Vinalesphinctes* and related genera) and Ochetoceratinae, while Euaspidoceratinae and Oppeliidae are less frequent. Some of the taxa characteristic for Western Cuba do also occur in Mexico and Chile (Wierzbowski, 1976). According to this author, Cuban and European Perisphinctidae may represent related parallel lineages. Meléndez (in Meléndez *et al.*, 1988) presented a hypothesis on relatively rapid evolution of the European Perisphinctidae, which migrated to the Proto-Caribbean and Andean regions.

Olóriz (in Olóriz *et al.*, 1990) claims, that the ammonites belonging to the subgenus *Praeataxioceras* Atrops are closely related to the Caribbean ammonites included in the genus *Discosphinctes* Dacqué ("*D.*" *carribeanus* Jaworski = *P. (Planites) virgultus* Quenstedt var. *carribeana* n. var. Jaworski). However, assignment of these ammonites to the genus *Discosphinctes* is questionable (see Wierzbowski, 1976 and Meléndez & Myczyński, 1987).

Atrops (1982) created the subgenus *Praeataxioceras* of the genus *Orthosphinctes* for the European ammonites known as *Orthosphinctes virgultus* (Quenstedt), with the type species *Orthosphinctes laufenensis* (Siemiradzki). Olóriz (in Olóriz *et al.*, 1990) assumes that the densely ornamented Perisphinctidae with polygyre ribs, known from the marginal areas of the North American plate, and from the Caribbean, belong to the subgenus *Praeataxioceras*.

Cuban ammonites included within the genus "*Discosphinctes*" have such ornamentation. It is also similar to that of the ammonites belonging to subgenera *Perisphinctes* (*Cubasphinctes*) and *P. (Antiloceras)*. The Cuban Perisphinctidae could therefore be classified within the European genus *Orthosphinctes*. Such interpretation is, however, seriously weakened by the fact, that in Europe, the oldest representatives of the subgenus *Orthosphinctes* (*Praeataxioceras*) appear in the Late Oxfordian *Bimammatum* Zone (Atrops, 1982), or even in the topmost part of this zone, together with the ammonites assigned by Meléndez (1989) to the genus *Cubaspidoceras* Myczyński, 1976.

According to Wierzbowski (1976), the genus *Orthosphinctes* is not known from Cuba. The faunal horizon containing Perisphinctidae is of Middle Oxfordian age in the Pinar del Río Province (Wierzbowski, 1976; Myczyński, 1976a). Representatives of the subgenus *Perisphinctes* (*Cubasphinctes*) and the genus "*Discosphinctes*" occur below the horizon with *Mirosphinctes* and *Euaspidoceras*, and therefore below the younger horizon with *Mirosphinctes* and *Cubaspidoceras*. One cannot exclude the possibility that ammonites belonging to the subgenus *Praeataxioceras* appeared earlier in the Proto-Caribbean basin than in Europe. Another possibility implies a much wider stratigraphic range (Oxfordian - Early Tithonian) of the ammonites with similar type of ornamentation (Olóriz, 1978; Olóriz *et al.*, 1990).

G E N U S	WESTERN TETHYS	GUANIGUANICO SEQUENCES		PLACETAS SEQUENCE	CAMAJUANI SEQUENCE	MEXICO	COLOMBIA	ARGENTINA	PAKISTAN
		Sierra de los Organos	Sierra del Rosario						
<i>Pseudolissoceras</i>	•	•	•	•	•	•			
<i>Hildoglochiceras (Salinites)</i>	—	•	•	•?	•?				
<i>Mazapilites</i>	—	•			•				
<i>Protancyloceras</i>	•	•	•	•	•	•	•		
<i>Vinalesites</i>	—	•	•	•	•				
<i>Kossmatia</i>	•	•				•			
<i>Berriasella</i>	•	•?				•		•	•
<i>"Paradontoceras"</i>	—	•	•	•	•			•	
<i>Lytrochilites</i>	—	•	•	•	•			•	
<i>Corongoceras</i>	•	•	•			•		•	
<i>Himalayites (Micracanthoceras)</i>	•	•	•			•		•	
<i>Dickersonia</i>	—				•				
<i>Durangites</i> ①	•	•	•	•	•				
<i>Phyllopachyceras</i>	•		•		•				
<i>Euphyllloceras</i>	•		•		•				
<i>Calliphyllloceras</i>	•	•							
<i>Lytoceras</i>	•	•	•			•		•	•
<i>Eulytoceras</i>	•			•?					
<i>Diasaloceras</i>	•		•						
<i>Protetragonites</i>	•		•						
<i>Eotetragonites</i>	•		•						
<i>Leptotetragonites</i>	•				•				
<i>Neolissoceras</i>	•				•		•		•
<i>Aconeceras</i>	•	•?			•				
<i>Macroscephites</i>	•		•			•			
<i>Bochianites</i>	•		•			•			•
<i>Crioceratites</i>	•		•	•		•		•	
<i>Balearites</i>	•		•		•			•?	
<i>Paracrioceras</i>	•		•?						
<i>Shastiacrioceras</i>	—		•?						
<i>Parancyloceras</i>	•		•?	•			•?		
<i>Karsteniceras</i>	•		•?						
<i>Acriceras</i>	•		•?	•					
<i>Leptoceras</i>	•		•			•	•		
<i>Colchidites</i>	•		•				•		
<i>Meteroceras</i>	•		•	•					
<i>Pseudothurmannia</i>	•		•						
<i>Nemihoplites</i>	•		•						
<i>Anahamulina</i>	•		•	•					
<i>Namulina</i>	•		•				•		
<i>Namulinites</i>	•		•			•			
<i>Ptychoceras</i>	•		•?						
<i>Neutonoceras</i>	•		•?						
<i>Nemibaculites (?)</i>	•		•						
<i>Epitriceras</i>	•			•		•			
<i>Eliaella</i>	•		•			•		•	•
<i>Dicostephanus</i>	•		•			•		•	•
<i>Mexicanoceras</i>	—		•			•			
<i>Thurmanniceras</i>	•		•			•		•	
<i>Eodesmoceras</i>	•		•			•			
<i>Barremites</i>	•		•			•			
<i>Leopoldia</i>	•		•					•	•
<i>Eubaynella</i>	•					•			
<i>Eodesmoceras</i>	•		•	•					
<i>Melchiorites</i>	•			•		•		•	
<i>Plesiospitidiscus</i>	•		•			•			
<i>Epitidiscus</i>	•		•				•		
<i>Melcodiscus</i>	•		•						
<i>Estieridiscus</i>	•		•				•		
<i>Micklesia</i>	•		•						
<i>Pulchellia</i> ②	•		•			•	•		

Fig. 3 List of the ammonite genera recorded in the Upper Jurassic and the Lower Cretaceous deposits of Cuba, compiled from the present author's own data and published results of other authors (Judolet & Furrázola-Bermúdez, 1968; Kanchev *et al.*, 1978; Furrázola-Bermúdez *et al.*, 1981)

1 — Tithonian ammonites; 2 — Early Cretaceous ammonites

(2) The Late Oxfordian ammonite assemblage is known from the Pimienta Member of the Jagua Formation (Sierra de los Organos - Myczyński, 1976a), from the upper part of the Francisco Formation and from the basal strata of the Artemisa Formation in the Sierra del Rosario (Kutek *et al.*, 1976). This assemblage, including the genus *Mirosphinctes*, Euaspidoceratinae (mainly *Cubaspidoceras*) and Oppeiliidae, occupies the highest stratigraphic position in the Oxfordian deposits of Western Cuba. The ammonite *Taramelliceras* (*Metahaploceras*) sp. (Pl. I: 4 - 6) also occurs in this assemblage; this is the first *Taramelliceras* found in the Oxfordian of Cuba. The scarcity of the Late Oxfordian ammonites is a phenomenon characteristic for the whole area of Western Cuba, and was related to the marine regression in the Caribbean region (Imlay, 1942).

During Middle Oxfordian, the northwestern part of the narrow Proto-Caribbean basin was probably connected with the eastern part of Mexico, as indicated by similarity of fauna, mainly ammonites (Burckhardt, 1906, 1912, 1919-21; Imlay, 1939, 1942, 1980; Wierzbowski, 1976; Rangin, 1977; Alencaster, 1984). The Oxfordian carbonate deposits of Western Cuba are the equivalent of the Zuloaga Formation in Mexico (Olóriz *et al.*, 1990). The genera "*Discosphinctes*", *Cubaochetoceras*, and *Perisphinctes* (*Antilloceras*) are common for Western Cuba and Mexico (Wierzbowski, 1976). Rangin (1977) recorded "*Discosphinctes*" *caribbeanus* (Jaworski), characteristic for the Oxfordian of Cuba, from the Sonora Province in Mexico. This species has also been found in the Oxfordian Smackover Formation of Louisiana and Texas, as well as in California and southwestern Oregon (Imlay, 1961, 1980).

A connection between the Proto-Caribbean basin and the Andean Province during the Oxfordian was possible. The following ammonite genera characteristic for the Oxfordian of Western Cuba, do also occur in Chile: *Perisphinctes* (*Vinalesphinctes*), *P.* (*Subvinalesphinctes*), *Cubaochetoceras* (Wierzbowski, 1976), "*Discosphinctes*", *Cubaspidoceras* and *Mirosphinctes* (Förster & Hillebrandt, 1984; Myczyński & Brochwicz-Lewiński, 1981; Chong *et al.*, 1984; Meléndez & Myczyński, 1987; Gygi & Hillebrandt, 1991).

Some ammonite taxa, well-known from Cuba, have also been reported from Ellsworth Land, Antarctica (Quilty, 1970). Ammonites belonging to the Cuban genus *Cubaspidoceras* were recorded from Western Tethys (Chong *et al.*, 1984; Meléndez, 1989). The northwestern part of the Oxfordian Proto-Caribbean basin belonged to the zoogeographical Caribbean Province (the Mesozoic biota of the Gulf of Mexico-Caribbean region *sensu* Scott, 1984).

Kimmeridgian

Facies change due to shallowing is marked in the Late Oxfordian deposits of the Cordillera de Guaniguanico (Pszczółkowski, 1978). Massive carbonates of the Kimmeridgian San Vicente Member accumulated on a shallow bank, while limestones of the lower part of the

Artemisa Formation were deposited in less agitated (and deeper?) water. Infrequent fish debris occurs in the southern sequence of Sierra del Rosario, but ammonites are so far missing from the Kimmeridgian carbonate rocks of Western Cuba. During the Kimmeridgian, shallow seaway connected the Proto-Caribbean basin with Gulf of Mexico (Pszczółkowski, 1987, fig. 3).

In northeastern and central Mexico, the Kimmeridgian grey to black, bedded limestones and marly shales belonging to the La Caja and La Casita formations yielded ammonites of the following genera: *Idoceras*, *Ataxioceras*, *Nebrodites* and *Procraspedites* (Olóríz *et al.*, 1990). These deposits accumulated in deeper and/or less restricted basin than the coeval carbonates of Western Cuba.

Tithonian

In the stratigraphic sequences of the Cordillera de Guaniguanico, a facies change from shallow-water to deeper-water deposits occurred during Early Tithonian. In the Sierra de los Organos, the earliest Tithonian ammonites belong to the genera: *Mazapilites*, *Haploceras*, *Neochetoceras*, *Pseudolissoceras*, *Protancyloceras*, *Aulacosphinctoides*, and others (Judoley & Furrázola-Bermúdez, 1968; Houša, 1974; Myczyński, 1989). In the Sierra del Rosario, the oldest Early Tithonian ammonite assemblage contains a few taxa only (*Parakeratinites* sp. and *Schaireria* sp.).

Ammonites of worldwide distribution have been recorded in late Early Tithonian limestones: *Protancyloceras* sp. (aff. *P. gracile*), *Glochiceras* (*Lingulaticeras*), *Simoceras* and *Simocoscoceras* (Imlay, 1942; Myczyński, 1989, 1990; Myczyński & Pszczółkowski, 1994). Endemic ammonites, not known outside the Caribbean region, do also occur in the Lower Tithonian deposits of Western Cuba: *Phylloceras pinarensis* Imlay, "*Subplanites*" *cubensis* Chudoley et Furrázola-Bermúdez, *Lytohoplites caribbeanus* Imlay, "*Parodontoceras*" *butti* Imlay, "*Parodontoceras*" *antilleum* Imlay and *Vinalesites rosariensis* Imlay (Imlay, 1942; Judoley & Furrázola-Bermúdez, 1968; Myczyński, 1989). Bivalves of the genus *Buchia*, characteristic for the Boreal Realm, occur together with these ammonites (Myczyński & Pszczółkowski, 1994). Relatively high proportion of the Tethyan taxa in the Early Tithonian fauna of Western Cuba, leads to the conclusion that migration of ammonites from Western Tethys to the Proto-Caribbean basin took place at this time (Myczyński, 1989).

An important change of faunal assemblage occurred in the Caribbean Province during the early Late Tithonian. In the Upper Tithonian deposits of Western Cuba prevail ammonites of endemic character for Cuba or of Pacific origin: *Hildoglochiceras* (*Salinites*), "*Haploceras*", *Dickersonia*, "*Parodontoceras*", *Vinalesites*, *Corongoceras*, *Kossmatia*, and *Micracanthoceras*. Six of these genera are com-

mon for Cuba, Mexico and the southern United States (Cantú Chapa, 1968, 1976; Imlay, 1980; Alencaster, 1984; Myczyński, 1989; Myczyński & Pszczółkowski, 1990). The bivalves *Buchia* also occur in the Upper Tithonian deposits of these areas. The migration of fauna from the Western Tethys to the Caribbean region via the Proto-Atlantic seaway was probably restricted during the Late Tithonian (Fig. 2).

At the end of the Tithonian, wide distribution of radiolarian microfacies in the Cordillera de Guaniguanico sequences indicates deepening of sedimentary basin in Western Cuba (Myczyński & Pszczółkowski, 1994). Ammonites become infrequent in limestones of the latest Tithonian age; they belong mainly to the genera *Protancyloceras* and *Vinalesites* (Myczyński, 1977; Myczyński & Triff, 1986). The genera *Suarites*, *Acevedites* and *Wichmanniceras*, occurring in the latest Tithonian deposits of Mexico (Cantú Chapa, 1976), have not been recorded from Cuba.

Early Cretaceous

Early Cretaceous ammonites are known in Cuba from the Sierra del Rosario, Camajuaní, Placetas and Zaza sequences (Fig. 1). The Camajuaní and Placetas sequences crop out in the Matanzas Province of Western Cuba (Myczyński & Triff, 1986), and in the Villa Clara, Sancti Spiritus and Camagüey Provinces of Central Cuba (Imlay, 1942; Furrázola-Bermúdez *et al.*, 1964; Shopov in Kantchev *et al.*, 1978). Early Cretaceous ammonites are frequent in the Sierra del Rosario (northern sequence), but are rather poorly preserved (Myczyński, 1977). Ammonites are rare in the Lower Cretaceous pelagic limestones of the Sierra de los Organos sequence.

Berriasian ammonites are infrequent in the Sierra del Rosario, and, starting from the latest Tithonian, heteromorph forms are dominant in the poor assemblage of this age. These ammonites belong to the genera *Protancyloceras* and *Leptoceras* (Myczyński, 1977), the latter genus being frequent in the Lower Cretaceous deposits of the Mediterranean Province (Wiedmann, 1980, 1988).

Ammonites are infrequent in the Valanginian and Hauterivian deposits. In the Sierra del Rosario, the Valanginian ammonites are represented by the genera *Bochianites*, *Kilianella*, *Thurmanniceras* and *Olcostephanus*. The bivalves of the genus *Buchia* are present in the deposits of Valanginian age. The following ammonite genera occur in the Hauterivian pelagic limestones: *Moutoniceras*?, *Pseudothurmannia* and *Mexicanoceras*.

The Barremian assemblage contains abundant ammonite genera, mainly *Phyllopachyceras*, *Lytoceras*, *Protetragonites*, *Macroscaphites*, *Hamulinites*, *Hamulina*, *Anahamulina*, *Crioceratites*, *Paracrioceras*,

Acriceras, *Colchidites*, *Hemihoplites*, *Spitidiscus*, *Pulchellia* and *Nicklesia* (Myczyński, 1977; Myczyński & Triff, 1986).

The Early Cretaceous ammonites, collected in the Sierra del Rosario, are generally similar to the ammonite assemblages known from the Camajuaní and Placetas sequences in the Matanzas Province and Central Cuba. The genera *Eulytoceras*, *Leptotetragonites*, *Neolissoceras*, *Parancyloceras*, *Uhligia*, *Heteroceras*, *Spiticeras*, *Subsaynella*, *Oosterella*, *Melchiorites* and *Astieridiscus* have been recorded in Central Cuba and in the Matanzas Province (Shopov in Kantchev *et al.*, 1978; Myczyński & Díaz in Piotrowska *et al.*, 1981; Myczyński & Triff, 1986), but are not known from the Sierra del Rosario. Generally poorer preservation of fauna from Sierra del Rosario may partly explain this difference in composition of the compared Early Cretaceous ammonite assemblages. The rich Barremian ammonite assemblage of Cuba is similar to the coeval European fauna.

The following ammonites were found in the Berriasian deposits of the Mazatepec, Puebla (Mexico): *Subthurmannia dominguense* Cantú Chapa, *S. mazatepense* Cantú Chapa, *Spiticeras* sp., *Berriasella* aff. *zacatecana* Imlay and *Groebericeras poblanense* Cantú Chapa (see Cantú Chapa, 1976). The last taxon is known only from Argentina, Mexico and Kurdistan.

From the Valanginian and Hauterivian deposits of the Taraises and Las Vegas formations in Mexico, the following ammonite taxa were recorded (see Imlay, 1937, 1938, 1980; Cantú Chapa, 1976; Cooper, 1981; Young, 1988; González-Arreola *et al.*, 1992): *Bochianites thieuloides* Cantú Chapa, *Thurmanniceras novihispanicus* Imlay, *Mexicanoceras neohispanicus* (Böse), *M. rarituberculatum* Imlay, *Neolissoceras bejucense* Cantú Chapa, *N. semisulcata* Cantú Chapa, *Distaloceras nodosum* Imlay, *Acanthodiscus magnificus* Imlay, *Olcostephanus atherstoni* (Sharpe), *O. baini baini* (Sharpe), *O. coahuilensis* Imlay, *O. quadriradiatus* Imlay, *O. durangensis* Cantú Chapa, *Karakaschiceras biassalense* (Karakasch), *Maderia*, *Kilianella*, *Bejucoceras*, *Saynoceras*, and *Subastieria*. Three genera - *Bejucoceras*, *Maderia* and *Mexicanoceras* - are endemic. The other genera have a worldwide distribution, but in Mexico some of them are represented by endemic species and subspecies.

The presence of *Mexicanoceras* and *Thurmanniceras novihispanicus* Imlay in the pre-Barremian deposits of Cuba is significant, because these taxa have been recorded for the first time in the Taraises Formation of Mexico (Imlay, 1937; Gonzalez-Arreola *et al.*, 1992). The ammonites assigned to the genera *Macroscaphites*, *Protancyloceras*, *Bochianites*, *Hamites*, *Olcostephanus*, *Mexicanoceras*, *Thurmanniceras*, *Spiticeras*, *Oosterella* and *Pulchellia* are common for both Cuba and Mexico. The genus *Pulchellia* is poorly represented in Mexico (Cantú Chapa, 1968), while the ammonites belonging to this genus are abundant in the Barremian of Colombia (Bürgli, 1956). Cuba and Colombia share the following ammonite genera: *Crioceratites*, *Shastiacrioceras*, *Parancyloceras*, *Leptoceras*, *Hamulina*, *Olcostephanus*

(*Rogersites*), *Colchidites*, *Thurmanniceras*, *Berriasella*, *Kilianella*, *Oosterella*, *Spitidiscus*, *Holcodiscus*, *Nicklesia* and *Pulchellia*.

In Cuba and Argentina, the following ammonite genera are present: *Crioceratites*, *Paracrioceras* (?), *Olcostephanus*, *Thurmanniceras*, *Spiticeras*, *Berriasella* and *Leopoldia*. A few genera, such as *Neolisoceras*, *Bochianites*, *Olcostephanus* and *Thurmanniceras*, are known both in Cuba and Pakistan.

The above presented data points out, that the Cuban Early Cretaceous ammonites are related to the fauna of the Mediterranean Province (Nikolov, 1987) and Colombia (Hass, 1960), as well as to the coeval ammonite assemblages of Mexico and the southern United States (Imlay, 1937, 1980; Muñoz, 1964). The Berriasian - Hauterivian ammonites of Cuba, Mexico and the southern United States belonged to the same zoogeographic province. This was the Caribbean Province, connected to the Mediterranean Province via the Proto-Atlantic seaway (Geyer, 1973; Westermann, 1984, 1992) and to the Pacific Ocean. Recognition of the Caribbean Province during the late Early Cretaceous is difficult due to the Tethyan faunal expansion during Barremian time. Nevertheless, Scott (1986) distinguished his Aptian Caribbean Province on the basis of distribution of the bivalves of the genus *Protocardia*.

CONCLUDING REMARKS

The Upper Jurassic-Lower Cretaceous sequences of Cordillera de Guaniguanico in Western Cuba were laid down in a sedimentary basin located at the eastern margin of the Yucatán block (Fig. 2), as suggested by some authors (Pszczółkowski, 1987; Iturralde-Vinent, 1994). During the Late Jurassic and Early Cretaceous, this part of the Proto-Caribbean basin was connected, through the southeastern Gulf of Mexico, with the southern United States and the northeastern and central parts of Mexico. The ammonites recorded from these areas belonged to the paleobiogeographical Caribbean Province. The faunal links between Western Cuba and the southern United States and Mexico were strong during the Oxfordian, Tithonian and at the beginning of the Early Cretaceous. Endemic taxa, characteristic for the Caribbean Province, developed during these times. In addition, some ammonites of the Andean provenance are known in the Oxfordian and Late Tithonian of the Caribbean Province. From the Barremian, the Early Cretaceous ammonites of Western Cuba were more closely related to the Colombian fauna than to that of Mexico. Strong paleobiogeographical links between Cuba, Colombia and the Mediterranean Province were established during Barremian time.

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Ryszard Myczyński

KARAIBSKIE ZESPOŁY AMONITOWE W SUKCESJACH JURY GÓRNEJ I KREDY DOLNEJ KUBY

Streszczenie

Górnojurajskie i dolnokredowe zespoły amonitowe zachodniej i środkowej Kuby należały do paleobiogeograficznej prowincji karaibskiej, która istniała w późnej jurze (od środkowego oksfordu) do wczesnej kredy (do hoterywu włącznie). Zespoły amonitowe prowincji karaibskiej występują w górnojurajskich i wczesno-dolnokredowych utworach Kuby, północnego i środkowego Meksyku oraz południowej części Stanów Zjednoczonych. W baremie zaznaczyły się wyraźne związki biogeograficzne pomiędzy Kubą, Kolumbią i prowincją medyterańską.

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EXPLANATIONS OF PLATE

Plate I

- 1 — *Perisphinctes (Antilloceras)* sp., Jagua Formation (Jagua Vieja Member), Middle Oxfordian, Sierra de los Organos; $\times 1$
- 2 — *Cubaspidoceras* sp., Jagua Formation (Pimienta Member), Hoyo de la Sierra outcrop, Sierra de los Organos, Upper Oxfordian (? Hypsellum Subzone); $\times 1.5$
- 3 — *Mirosphinctes pinarensis pinarensis* Myczyński, 1976, specimen nr 2225, Jagua Formation (Pimienta Member), Mogote La Mina outcrop, Sierra de los Organos, Upper Oxfordian (? Hypsellum Subzone); $\times 2.5$
- 4-6 — *Taramelliceras (Metahaploceras)* sp.; specimen No. LP-1; shell diameter $D = 30$ mm, whorl height $H = 15$ mm, whorl width $E = 11$ mm, umbilical diameter $O = 3$ mm, $H/D = 0.50$, $E/D = 0.36$, $O/D = 0.10$; Jagua Formation (Pimienta Member), Mogote Pancho Luis outcrop, Sierra de los Organos, Upper Oxfordian (? Hypsellum Subzone); $\times 0,3$

