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Some ammonite genera from the Tithonian of western Cuba and their palaeobiogeographic importance²

(Figs 1–8)

Abstract. Ammonites of the genus *Hybonoticer* Breistroffer, 1947, described here as: *Hybonoticer* (*Hybonoticer*) sp. ex. gr. *beckeri* (Neumayr) and *Hybonoticer* (*Hybonotella*) cf. *mundulum striatulum* Berckhemer & Hölder, derive from Lower Tithonian deposits of the Sierra de los Organos and Sierra del Rosario belts (Guaniguanico terrane, western Cuba). The presence of the genus *Hybonoticer* Breistroffer, 1947, in Cuba, confirms the palaeobiogeographical connections between Spain, Cuba and Mexico during Early Tithonian time, as proposed earlier by the present author. A direct marine connection between Mediterranean Tethys and the proto-Caribbean basin at that time had probably occurred through the "hispanic corridor" *sensu* Westermann (1984). The taxonomic position of the endemic Cuban genera (*Salinites*, *Protancyloceras* - *hondense* type, *Vinalesites*, *Butticeras*, and *Paralytotochites*) is specified. These ammonites can be used only for regional correlation, limited to the Gulf of Mexico (Eastern Mexico and Southern part of the United States) and the Caribbean (Cuba). The new data caused modification of local ammonite biozonation.

Key words: Western Cuba, Tithonian ammonites, biozonation, Tithonian paleobiogeography.

INTRODUCTION

Tithonian deposits have hitherto been recognized in the following provinces of Cuba: Pinar del Río, Havana, Villa Clara, Sancti Spiritus and Camagüey (Imlay, 1942; Judoley & Furrázola-Bermúdez, 1968; Houša, 1974; Houša & Nuez, 1973, 1975; Millán & Myczyński, 1978, 1980; Myczyński, 1989). Tithonian ammonites occur in western Cuba in the Sierra de los Organos and Sierra del Rosario belts of the Guaniguanico terrane (Fig. 1). The Guaniguanico terrane consists of the Sierra de los Organos belt and the Northern and Southern Sierra del Rosario belts (see Iturralde-Vinent, 1994, 1996; Pszczółkowski, 1999). Lithostratigraphic subdivi-

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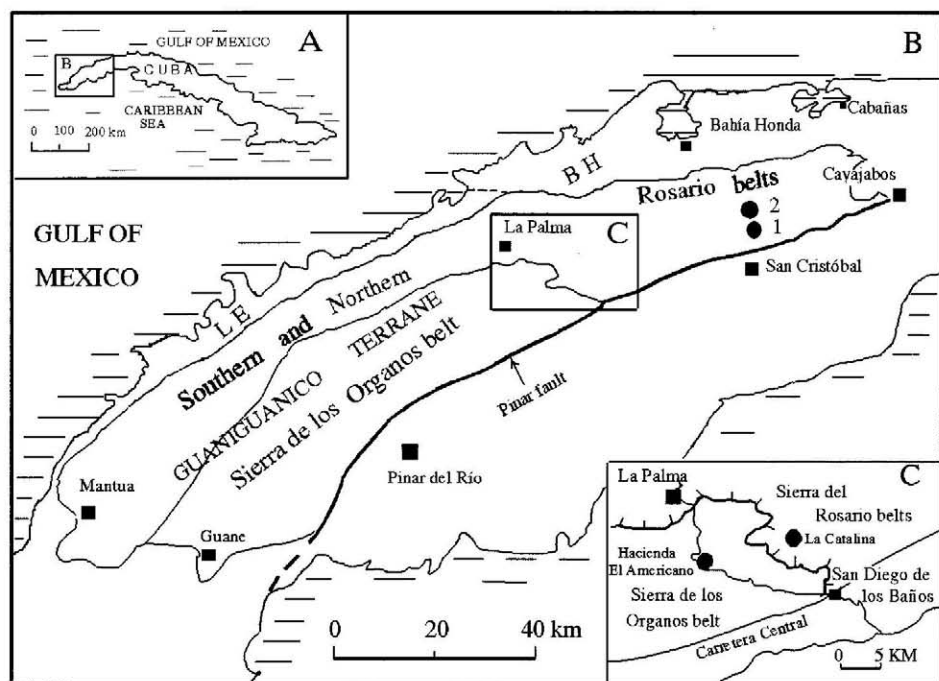


Fig. 1. A. Position of the investigated area of the Pinar del Río province in Cuba; B. Simplified map of the Guaniguanico terrane: 1 – El Toro section; 2 – Cinco Pesos section; Sierra del Rosario belts; LE – La Esperanza belt; BH – Bahía Honda terrane (after Pszczółkowski, 1994a, b); C. Location of the studied sections Hacienda el Americano (Sierra de los Organos) and La Catalina (Sierra del Rosario)

sions of these units were presented by Pszczółkowski (1978, 1994a, b).

The following ammonite species are characteristic for the Tithonian assemblage of western Cuba: *Butticeras butti* (Imlay), *B. antilleanum* (Imlay) and *Paralytobolites caribbeanus* (Imlay). The genera *Vinalesites* Thieuloy, 1966, and *Salinites* Cantú Chapa, 1968, play an essential role in this ammonite assemblage as well. Moreover, *Hybonoticerias* (*Hybonoticerias*) sp. ex. gr. *beckeri* (Neumayr) and *H. (Hybonotella)* cf. *mundulum striatulum* Berckhemer & Hölder described here, are the most important for paleobiogeographic and biostratigraphic correlations of the Kimmeridgian–Early Tithonian fauna. The presence of these ammonites in the Upper Jurassic deposits of western Cuba permits to modify the local ammonite biozonation and to tie it with Europe and Mexico (see Figs 3, 4). This paper presents palaeontological descriptions of the ammonites of the genus *Hybonoticerias*, and redescription of other most important ammonite genera which occur in the Tithonian deposits of the Guaniguanico terrane in western Cuba. A discussion of their significance for the palaeobiogeography of the Caribbean region is also given.

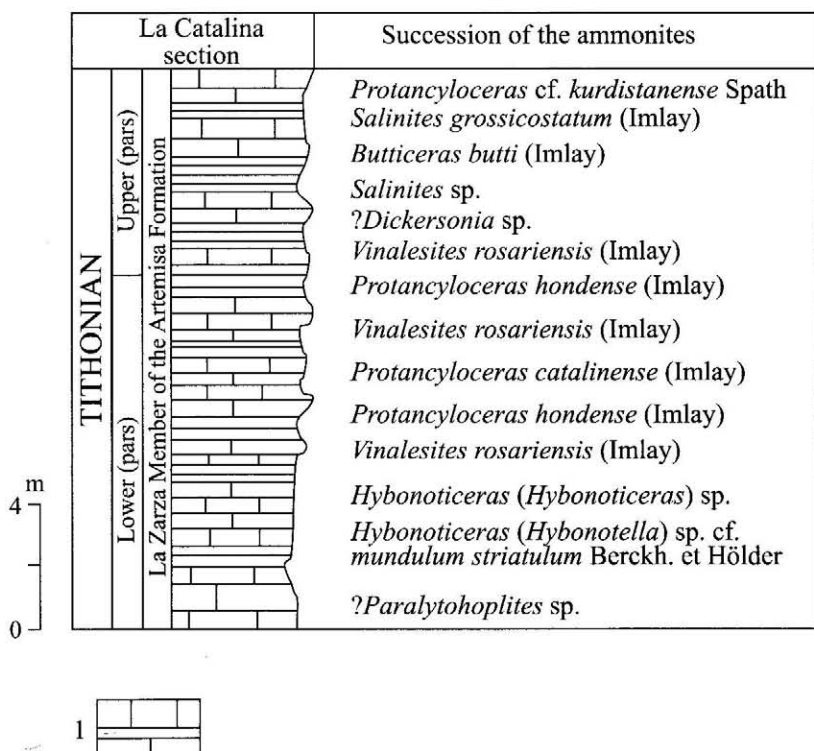


Fig. 2. Succession of Tithonian ammonites in the La Catalina section, 2. 1 – dark-grey, thick-bedded dolomitic, bituminous limestone with intercalations of dark-grey shale

AMMONITES OF THE GENUS *HYBONOTICERAS* BREISTROFFER, 1947, IN THE SIERRA DE LOS ORGANOS AND SIERRA DEL ROSARIO BELTS (WESTERN CUBA)

The ammonites of the genus *Hybonoticeras* Breistroffer, 1947, were hitherto reported from the Upper Kimmeridgian and Lower Tithonian deposits of Southern Germany (Berckhemer & Hölder, 1959), Mediterranean Tethys (Olóriz, 1978; Cecca *et al.*, 1990; Benetti *et al.*, 1990), Pakistan (Fatmi & Zeiss, 1994), Himalaya (Pathak, 1993; Enay & Cariou 1996), Kenia (Verma & Westermann, 1973), Madagascar (Collignon, 1960) and Mexico (Olóriz *et al.*, 1993). The subgenus *Hybonoticeras* (*Hybonotella*) was reported from the Lower Tithonian deposits of Cordillera Betica, Spain, and from the Kimmeridgian–Tithonian boundary beds of Mexico (Olóriz, 1978; Olóriz *et al.*, 1993).

Ammonites of the genus *Hybonoticeras* from Cuba have not been palaeontologically elaborated so far. The presence of this genus in Cuba was only mentioned by Enay (1973). The ammonites of the genus *Hybonoticeras* were found by the present author in the Lower Tithonian deposits exposed in the Sierra de los Organos and Sierra del Rosario belts.

EPOCH	AGE		TITHONIAN AMMONITE BIOZONATION OF SIERRA DE LOS ORGANOS
LATE JURASSIC	TITHONIAN	LATE	DURANGITES-HIMALAYITES-SALINITES
		EARLY	PARALYTOHOPLITES CARRIBEANUS
			PSUDOLISSOCERAS SPP.
			HYBONOTICERAS-MAZAPILITES

Fig. 3. Tithonian ammonite biozonation of Sierra de los Organos

EPOCH	AGE		AMMONITE BIOZONATION OF SIERRA DEL ROSARIO
LATE JURASSIC	TITHONIAN	LATE	DURANGITES-HIMALAYITES-SALINITES
		EARLY	PARALYTOHOPLITES CARRIBEANUS
			PSUDOLISSOCERAS SPP.
			HYBONOTICERAS (HYBONOTELLA)
			PARAKERATINITES

Fig. 4. Tithonian ammonite biozonation of Sierra del Rosario

Genus *Hybonoticer*s Breistroffer, 1947, in the Sierra de los Organos belt

In the Sierra de los Organos belt, the ammonites of the genus *Hybonoticer*s are very scarce. They were collected from the basal part of the Hacienda el Americano section only (Fig. 1), from dark-grey, thick-bedded, shaly, laminated dolomitic limestones with thin shale intercalations, belonging to the El Americano Member of the Guasasa Formation. The ammonites *Hybonoticer*s (*Hybonoticer*s) sp. ex. gr. *beckeri* (Neumayr) derived from the Hacienda El Americano section about 8 m above the boundary of the San Vicente/El Americano members and 1.60 m above the beds containing ammonites of the genus *Mazapilites* Burckhardt, 1919, and *Protancyloceras* Spath, 1924. According to Schweigert *et al.* (1996), the species *Hybonoticer*s (*Hybonoticer*s) *beckeri* (Neumayr) is known only from Upper Kimmeridgian deposits. Occurrence of *Hybonoticer*s (*Hybonoticer*s) sp. ex. gr. *beckeri* (Neumayr) above the ammonite genus *Mazapilites*, indicate a Lower Tithonian age of the *Hybonoticer*s-bearing deposits. In beds above the *Hybonoticer*s-bearing strata, there occur ammonites "*Virgatospinctes*" spp., *Butticeras*

butti (Imlay) and *Butticeras antilleanum* (Imlay) (Myczyński, 1989).³

Genus *Hybonoticer* Breistroffer, 1947, in the Sierra del Rosario belts

In the Sierra del Rosario belts, the ammonites of the genus *Hybonoticer* were collected by the present author and A. Pszczółkowski in the La Catalina section (Figs. 1, 2), western part of Sierra del Rosario. These ammonites were deposited in the Paleontological Museum of the Institute of Geology and Palaeontology in Havana (at present, the Institute of Geology and Palaeontology, MINBAS).

Detailed location of the La Catalina section was given by Imlay (1942, p. 1425) and Myczyński (1989, p. 57, text-fig. 8). In this section, Tithonian deposits of the La Zarza Member of the Artemisa Formation are exposed (Pszczółkowski, 1978; Myczyński, 1989). They consist of dark-grey, thick-bedded, dolomitic, strongly bituminous limestone with intercalations of dark-grey shale. Lower boundary of the Tithonian strata is not well defined due to scarcity of ammonites in the lower part of the section. The first ammonite of the genus ?*Paralytohoplites* sp. (see Fig. 2) comes from the basal part of the section (the specimen is poorly preserved, most probably erroneously identified). The ammonites of the genus *Hybonoticer*, the subgenus *Hybonotella*, were found in the lower part of the section, about 2 m above the bed with ?*Paralytohoplites* sp. One specimen of *Hybonoticer* (*Hybonoticer*) sp., about 120 mm in diameter, derived also from these strata. About 1.5 m higher up, the ammonites *Protancyloceras hondense* (Imlay), *P. catalinense* (Imlay) and *Vinalesites rosariensis* (Imlay) were found. Still higher up in the section, the ammonites *Butticeras butti* (Imlay) and *B. antilleanum* (Imlay) were found. From the uppermost part of the section derived: *Salinites* sp., *Dickersonia* sp. and *Vinalesites rosariensis* (Imlay) – see Fig. 2.

REDESCRIPTION OF THE GENERA *BUTTICERAS* (HOUSÁ ET NUEZ, 1973) AND *PARALYTOHOPLITES* MYCZYŃSKI, 1996

Two species of the genus *Butticeras* Housá and Nuez, 1973: *B. butti* and *B. antilleanum*, were originally described from the Pinar del Río province by Imlay (1942), who attributed these species to the genus *Parodontoceras* Spath, 1923. *B. antilleanum* (Imlay) was also described from Villa Clara province (Quemado de Güines in central Cuba). The most important features of these species are: subovate whorl section, venter narrowly rounded without groove, wide and shallow umbilicus, and moderately dense, low-divided, biplicate, simple ribs on inner whorls. Ribs on outer whorls are simple, strong, distant. These features, as well as the lack of ventral groove, do not conform with the definition of the genus *Parodontoceras* Spath, 1923.

The attribution of both species to the genus *Parodontoceras* Spath, 1923 by Im-

3 It should be noted that co-occurrence of *Mazapilites* and *Hybonoticer* was reported from the Lower Tithonian strata of Mexico (Burckhardt, 1906; Imlay, 1939, 1980; Verma & Westermann, 1973; Olóriz *et al.*, 1993)

lay (1942), was questioned by Houša (1974) and Houša and Nuez (1975). They have selected the species *Parodontoceras butti* Imlay as the type species of the new genus *Butticeras*. Despite this, Imlay (1980) maintained both species in the genus *Parodontoceras* Spath, 1923. Myczyński (1989, 1994a, b) took into consideration poor preservation of the Cuban specimens which mostly occurred as moulds on the top surfaces of limestone layers, when provisionally using the above generic name in parentheses (as "*Parodontoceras*").

The generic revision of the Cuban *Parodontoceras* was given by Myczyński (1996a, b) who compared it with the genus *Parodontoceras* Spath, 1923, *Acuticostites* (Semenov, 1898), *Pavlovia* Ilovaisky, 1917, *Anavirgatites*, Spath, 1925, *Lytohoplites* Spath, 1925, *Pavlovia* (*Acuticostites*)?, and with a specimen "gen et sp. A". (The last two ammonites were described from the Tithonian of Bavaria by Berckhemer & Hölder, 1959.) All these ammonites have ornamentation similar to the Cuban species. Among other features, characteristic simple ribs occur on their outer whorls. Myczyński (1996a) excluded, however, a possibility that the Cuban "*Parodontoceras*" species belonged to any of the above mentioned genera and rejected Verma and Westermann's (1973) suggestion about similarity of these ammonites to the genus *Substeueroceras* Spath, 1923. The attribution of the Cuban specimens to the genus *Butticeras* with "*Parodontoceras*" *butti* as a type species (as proposed by Houša & Nuez, 1973), is thus justified.

Taxonomic revision of the discussed ammonites was done together with a revision of the species *Lytohoplites caribbeanus* Imlay, which has ornamentation on the outer whorls somewhat similar to *Butticeras butti* (Imlay).⁴ The most important features of this species are: subovate whorl section, narrowly rounded venter, wide and shallow umbilicus and moderately dense, simple, acute (triangular) ribs (see Imlay, 1942). Imlay (1942) compared this species to *Lytohoplites vetustoides* (Burckhardt) (see *Hoplites vetustoides* Burckhardt – in Burckhardt, 1903, p. 62, pl. 10, figs 23–25) and concluded that *Lytohoplites caribbeanus* Imlay and *Lytohoplites vetustoides* (Burckhardt) are similar. Burckhardt's species differs, however, markedly in its shell form and sculpture: the ribs of the *L. vetustoides* (Burckhardt) are more distant, wavy, and venter groove is present. This species, as well as other species of the genus *Lytohoplites* described by Burckhardt (1903), were found in the Berriasian strata. The species *L. caribbeanus* Imlay is known in Cuba from the top-most Lower Tithonian strata (Myczyński, 1989).

The generic revision of *Lytohoplites caribbeanus* Imlay revealed obvious difference between morphologic features of this species and the diagnosis of the genus *Lytohoplites* Spath, 1925 (in Arkell *et al.*, 1957). The most important features of this species, which are at variance with the diagnosis of the genus *Lytohoplites*, are: absence of intercalary ribs, absence of tubercles (clavi) on ventral border of shell, and lack of ventral groove. For these reasons, the species *Lytohoplites caribbeanus* Imlay was excluded from the genus *Lytohoplites* Spath, 1925, and classified as the

4 The original name of the species *Lytohoplites caribbeanus* was corrected by Myczyński (1989) to *Lytohoplites caribbeanus*.

new genus *Paralytotohoplites* (see Myczyński, 1996a, b). This genus clearly differs from all comparable ammonite genera by a characteristic simple ribbing. The European ammonites similar to *Paralytotohoplites carribeanus* (Imlay), described previously as *Pavlovia* (*Acuticostites*)?, and described as "gen. et sp. A" from the Tithonian of Bavaria by Berckhemer & Hölder (1959), have been attributed by Schweigert and Zeiss (1998) to the new genus *Berckhemeria*, with *Berckhemeria scherzingeri* as its type-species. According to these authors, the genus *Berckhemeria* is probably an ancestor of the Early Tithonian heteromorph ammonites (*Protancyloceras*, Spath, 1924), representing a microconch of the poorly-known ammonite *Presimoceras heteromorphum* (Quenstedt). Both taxa were attributed to the family Passendorferiinae Melendez, 1989. According to Schweigert and Zeiss (1998), the most important features, which differ the genus *Berckhemeria* from the genus *Paralytotohoplites*, are: small dimension of *Berckhemeria*, and coronate cross-section on inner whorl of *Paralytotohoplites*. The last feature is, however, not conspicuous on the holotype (see Imlay, 1942, p.1453, pl. 7, figs 1-9). In the opinion of Schweigert and Zeiss (1998), the coronate cross-section of inner whorl in *Paralytotohoplites* suggests its affiliation with the *Corongoceras* group.

REDESCRIPTION AND SYSTEMATIC POSITION OF THE TITHONIAN GENERA: *SALINITES*, *PROTANCYLOCERAS* AND *VINALESITES*

Genus *Salinites* Cantú Chapa, 1968

The genus *Salinites* Cantú Chapa, 1968, was created by Cantú Chapa (1968), with its type-species *Salinites grossicostatum* Imlay – a species first described by Imlay (1939) from the Tithonian of Mexico. According to Cantú Chapa (1968), attribution of the latter ammonite to the genus *Hildoglochiceras* Spath, 1924, was erroneous because its features do not agree with the definition of the latter genus, and essentially differ from its type-species *Hildoglochiceras latistrigatum* Uhlig. The ammonites of the genus *Salinites* are almost involute, have keeled venter and suture similar to those of the Early Cretaceous genus *Aconeceras* (Cantú Chapa, 1968). One of the principal differences between the American and the Himalayan representatives of the genus *Hildoglochiceras* is the presence of a keeled venter in the latter. The venter in *Hildoglochiceras latistrigatum* (Uhlig) is not keeled but narrow and acute (see Arkell *et al.* 1957). *Hildoglochiceras kobelli* (Oppel), another species of this genus, has a keel on the venter (see Oppel, 1863, pl. 76, figs 1a-c, 2a-b).

The Himalayan representatives of the genus *Hildoglochiceras* were described from the Lower or Middle Tithonian deposits (Oppel, 1863; Collignon, 1960; Krishna, 1981; Olóríz & Tintori, 1991; Enay & Cariou, 1996), while the Cuban and Mexican forms occur in the Upper Tithonian and Berriasian strata (Myczyński, 1989; Adatte *et al.*, 1996).

The genus *Salinites* Cantú Chapa, 1968, was initially accepted by Imlay and Herman (1984). However, a controversy still exists about classification of the Mexican "hildoglochiceratids": Imlay (1980) used the name *Hildoglochiceras* in his de-

scription of the Mexican Tithonian ammonites; Stevens (1990) and Riccardi (1991) did not agree with the suggestions of Cantú Chapa (1968), and retained these ammonites within the genus *Hildoglochiceras*; Myczyński (1989, 1994a, b) has included all the Cuban and the Mexican representatives of the genus *Hildoglochiceras* in the subgenus *Salinites* Cantú Chapa, 1968. The latter proposal was accepted by Adatte *et al.* (1992, 1996).

Callomon (1992) accepted the two species described by Imlay (1939) as *Hildoglochiceras alamense* and *H. inflatum* as belonging to the genus *Hildoglochiceras* Spath, 1924. According to Enay (in Enay & Cariou, 1997) one must be careful to use the Himalayan and/or Indo-Malagasian generic names, *Hildoglochiceras* and *Kossmatia*, for the species from Mexico, Cuba and California.

In the opinion of the present author, the differences observed between the genera *Hildoglochiceras* Spath, 1924, and *Salinites* Cantú Chapa, 1968, which include an almost involute shell, keeled venter and different suture line in *Salinites*, justify maintenance of the latter as a separate genus, as proposed by Cantú Chapa (1968).

Olóriz (1992) and Cecca (1999) recognized the genus *Salinites* Cantú Chapa, 1968, and characterized it as an endemic form occurring in the Tithonian deposits of Mexico and Cuba. It seems thus justified to treat *Salinites* as the genus limited to the proto-Caribbean basin and Mexico (see Cantú Chapa, 1989, and Fig. 8, this paper), especially so as the ammonites of this genus are unknown from Spain and along the Pacific coast of the North and South America. Nevertheless, forms similar to the genus *Salinites* were reported from Lower Tithonian strata (Pseudolissoceras zitteli Zone) of Putiatin Island (Far East Russia, southern Primorye) by Sey *et al.* (1992, pl. 90, figs 5, 6, 10-12, 15). The latter ammonites, determined as *Glochiceras jollyi* (Oppel), have ornamentation and shell shape similar to some representatives of the genus *Salinites*, as described and illustrated by Myczyński (1989, p. 86, pl. III, figs 10, 13, 15, 16).

Genus *Protancyloceras* Spath, 1924

An extensive description, phylogeny scheme, and worldwide distribution of the genus *Protancyloceras* Spath, 1924, was given by Wierzbowski (1990). According to him, exist four evolution lineages of this genus. The first one began with *Protancyloceras guembeli* (Opp.), evolving through the species *P. passendorferi* (Wierzbowski), and *P. gracile* (Opp.), to the genus *Vinalesites* Thieuloy, 1966. The second one began with forms close to the species *P. gracile* (Opp.), ending with the genus *Leptoceras* Uhlig. The third one began with *P. guembeli* (Opp.), evolving through *P. kurdistanense* Spath to *P. punicum* Arn.-Saget. The fourth one may be traced within *Protancyloceras hondense* group. Relation of the latter lineage to other *Protancyloceras* lineages is unclear. The lineage from *Protancyloceras guembeli* (Opp.) to the genus *Vinalesites* Thieuloy, 1966, is most important for Cuban representatives of these genera.

In Cuba, the genus *Protancyloceras* Spath, 1924, occurs in five Tithonian ammonite horizons. One of them – with *Protancyloceras* sp. aff. *P. gracile* (Oppel) – is

represented in the Lower Tithonian strata of the Sierra de los Organos belt (Myczyński, 1989; Myczyński & Pszczółkowski, 1990).

Protancyloceras hondense (Imlay) and *P. catalinense* (Imlay) are the most characteristic protoancyloceratids in the Tithonian deposits of Cuba. These ammonites appear in Upper Tithonian strata of the Sierra de los Organos belt (Hacienda el Americano section) and in Lower Tithonian limestones of the Sierra del Rosario belts (Myczyński & Pszczółkowski, 1994). According to Imlay (1942), both species are interconnected by transitional forms. Barthel and Geyssant (1973) and Myczyński (1977) suggested their unification under a better known specific name *P. hondense* (Imlay). Similar ammonite species were reported from the Tithonian of Mexico by Kellum (1937), Imlay (1980), Cantú Chapa (1968), and Adatte *et al.* (1992, 1996).

Protancyloceras cf. *kurdistanense* Spath was found in Upper Tithonian strata of western Cuba (La Catalina section in the Sierra del Rosario) – (see Myczyński, 1977). *Protancyloceras* (?) sp. *A* (Veloz Formation, Sierra de Camaján, Camagüey province) – a form somewhat similar also to *Vinalesites rosariensis* (Imlay) – was figured by Myczyński (1989).

Genus *Vinalesites* Thieuloy, 1966

The genus *Vinalesites* Thieuloy, 1966, was established by Thieuloy (1966) with the type-species *Hamulina* ? *rosariensis* Imlay, 1942. The genus *Pseudoanahamulina* Judoley et Furrázola-Bermúdez, 1968, was created by Judoley and Furrázola-Bermúdez (1968) for the species *Hamulina* ? *rosariensis* Imlay: this is a younger synonym of the genus *Vinalesites* Thieuloy, 1966. In Sierra del Rosario, *Vinalesites rosariensis* (Imlay) appears together with the Early Tithonian ammonites (see Imlay, 1942; Myczyński & Pszczółkowski, 1994). In the Hacienda El Americano section, this species appears only in the Upper Tithonian strata, in a thin bed above deposits with *Protancyloceras hondense* (Imlay) and *P. catalinense* (Imlay) – see Myczyński (1989). Outside Cuba, ammonites similar to *Vinalesites* Thieuloy, 1966, were reported from the early Late Berriasian of Mexico, together with *Protancyloceras* aff. *catalinense* (Imlay) and *Hildoglochiceras* (*Salinites*) cf. *alamense* Imlay (see Adatte *et al.*, 1996).

PALAEOBIOGEOGRAPHIC AND STRATIGRAPHIC VALUE OF *HYBONOTICERAS* AND THE REDESCRIBED TITHONIAN AMMONITE GENERA

The worldwide distribution of the genus *Hybonoticeras* Breistroffer, 1947, is a very important factor for global palaeobiogeographic and biostratigraphic correlations of the Tithonian strata. This genus is especially useful in correlation of strata at the Kimmeridgian–Tithonian boundary and for stratigraphic subdivision of the Lower Tithonian deposits (see Berckhemer & Hölder, 1959; Olóriz, 1978; Enay & Cariou, 1996, 1997). According to Enay and Cariou (1996), the genus *Hybonoticeras* occurs in Kachh (India) and Nepal, but is unknown from the remaining part

of the Indo-Southwest Pacific province.

The presence of the genus *Hybonoticer* in the Lower Tithonian deposits of western Cuba facilitated chronostratigraphic correlations between Spain, and Mexico, and other regions in which this genus is known to occur. According to Berckheimer and Hölder (1959) and Olóriz (1978), ammonites of the subgenus *Hybonoticer* (*Hybonotella*) indicate the latest Kimmeridgian and the base of Early Tithonian (see also Olóriz *et al.*, 1993). Ammonites of this subgenus found in the La Catalina section indicate the lowermost Tithonian age of the strata with *Hybonotella*. Ammonites attributed to *Hybonoticer* (*Hybonoticer*) sp. gr. *beckeri* (Neumayr) were found above those of the genus *Mazapilites*; this indicates a Lower Tithonian age of the basal part of the Hacienda El Americano section.

Presence of the genus *Hybonoticer* in the Lower Tithonian deposits of Spain and Mexico (see Imlay, 1939; Olóriz 1978; Olóriz *et al.*, 1993), confirm palaeobiogeographic connections between Spain, Cuba and Mexico during the Early Tithonian. A connection between Spain and the proto-Caribbean basin during Early Tithonian, probably occurred through the "hispanic corridor" *sensu* Westermann (1984). According to Enay and Cariou (1996), lack of the genus *Hybonoticer* in peripheral part of the Indo-Southwest Pacific province, indicates that migration route of these ammonites to the proto-Caribbean basin could not happen around the Gondwanaland. However, the presence of a microconch or juvenile representative of the genus *Hybonoticer* in the Tithonian deposits of the Antarctic (Witham & Doyle, 1989), is not compatible with the above idea.

As the ammonites of the genus *Salinites* are here treated as American homeomorphs of the genus *Hildoglochicer*, their value for palaeobiogeographic correlations is lessened. These ammonites are, however, of value for biostratigraphic and palaeobiogeographic correlations in the Gulf region (Eastern Mexico and southern part of the United States) and the Caribbean (Cuba) (see Imlay & Herman, 1984). It is very interesting that distribution of the genus *Salinites* around the Gulf of Mexico, as shown by Cantú Chapa (1989, fig. 17) and in Fig. 8 (this paper), is not disturbed by a hypothetical Walper Megashear line proposed by Pessagno *et al.* (1993). The ammonites of the remaining genera, such as: *Butticeras*, *Paralytotochoplites*, *Salinites* and *Vinalesites*, are endemic, known so far from Eastern Mexico and/or Cuba only. They are important for local (Cuban and Mexican) biostratigraphic and palaeobiogeographic correlation. The same applies also to the genus *Paralytotochoplites*, formerly attributed to the genus *Lytotochoplites*.

According to Schweigert and Zeiss (1998), there is no relation between of the Bavarian ammonite taxon *Berckhemeria scherzingeri* Schweigert & Zeiss, 1998, and morphologically similar representatives of the genus *Paralytotochoplites* Myczyński, 1996, from Cuba. According to Cecca (1999), isolation of platforms produced some endemic genera, particularly during Late Tithonian, such as *Suarites* in Mexico, *Salinites* in Mexico and Cuba, and *Vinalesites*, *Butticeras* and *Dickersonia* in Cuba.

SYSTEMATIC DESCRIPTION

All specimens here described are housed in the Institute of Geological Sciences, Polish Academy of Sciences, 00-818 Warsaw, Twarda 51/55, Poland.

The classification of the Jurassic Ammonoidea as proposed by Arkell *et al.* (1957) was adopted. The following abbreviations have been used: D – maximum diameter; H – whorl height; O – umbilical width; H/D – whorl height/shell diameter; O/D – umbilical diameter/shell diameter.

Superfamily **Perisphinctaceae** Steinmann, 1890

Family **Aspidoceratidae** Zittel, 1895

Subfamily **Hybonoticeratinae** Olóriz, 1978

Genus **Hybonoticer** Breistroffer, 1947

Subgenus **Hybonoticer** Breistroffer, 1947

Hybonoticer (*Hybonoticer*) sp. ex. gr. *beckeri* (Neumayr, 1873)

(Fig. 5: I)

Material: Two poorly preserved specimens (A-25-1 B and A-25-2 B).

Dimensions: A-25-1B; D – 77.0 mm; H – 26.0 mm; O – 30.0 mm; H/D – 34%; O/D – 39%; A-25-2B; D – 29.0 mm; H – 10.0 mm; O – 12.0 mm; H/D – 34%; O/D – 42%.

Description: Specimens incomplete, flattened and evolute. Specimen A-25-1B is of medium size (D – 81.5 mm), with broad umbilicus (39%). Neither ventral groove nor periumbilical tubercles are visible, however a keel on ventral part of shell is present. Ribs very straight, radial, simple, some bifurcating. Outermost part of shell has ribs showing a tendency to weakening. No data on whorl section and suture line, are available.

Remarks: The specimens are somewhat similar to *Hybonoticer* (*Hybonoticer*) *beckeri harpephorum* (Neumayr, 1873), as illustrated by Neumayr (1873, p. 203; pl. 39, figs 4-5), and by Berckhemer and Hölder (1959, p. 28, pl. 4, fig. 16). The above cited specimens, were recently put into synonymy of the species *Hybonoticer harpephorum* (Neumayr, 1873) by Schweigert *et al.* (1996). Poor preservation of our specimens does not permit their exact specific identification, although shell structure, character of ribs, ornamentation and presence of keel, permit generic and subgeneric identification.

Occurrence: The specimens were found in the El Americano Member of the Guasasa Formation (black, micritic limestone) of the Sierra de los Organos (western Cuba). This is the first identification of the genus *Hybonoticer* Breistroffer, 1947, in the Tithonian deposits of Cuba. The taxon *Hybonoticer* (*Hybonoticer*) *beckeri harpephorum* (Neumayr, 1873) – *Hybonoticer* (*Hybonoticer*) *harpephorum* (Neumayr) *sensu* Schweigert *et al.* (1996) – is known from the Upper Kimmeridgian strata (see Olóriz, 1978; Schweigert *et al.*, 1996). The taxon *Hybonoticer* (*Hybonoticer*) sp. cf. *H. (H.) beckeri harpephorum* (Neu-

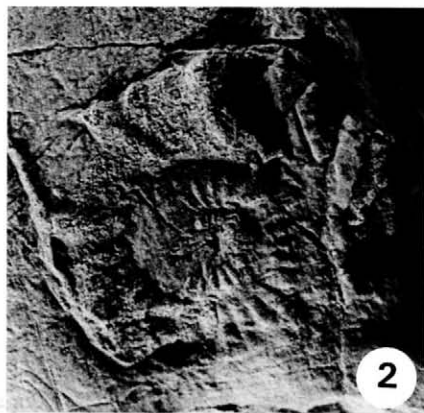


Fig. 5. 1 – *Hybonoticerias* (*Hybonoticerias*) sp. gr. *beckeri* (Neumayr, 1873), specimen A - 25 -1 B, Hacienda El Americano section, Sierra de los Organos, Pinar del Río province, Lower Tithonian, x 1; 2 – *Hybonoticerias* (*Hybonotella*) cf. *H. (H.) mundulum striatulum* Berckhemer & Hölder, 1959, specimen LC - 1. La Catalina section, Sierra del Rosario, Pinar del Río province, Lower Tithonian, x 2

mayr), was also reported from Upper Kimmeridgian ?–Lower Tithonian strata of Spain by Olóriz (1978). Specimens of *Hybonoticerias* (*Hybonoticerias*) sp. ex. gr. *beckeri* (Neumayr) were found above the strata with *Mazapilites* in Mexico and western Cuba; that indicates their Early Tithonian age.

Subgenus **Hybonotella** Berckhemer et Hölder, 1959

Hybonoticerias (*Hybonotella*) cf. *H. (H.) mundulum striatulum* Berckhemer et Hölder, 1959

(Figs 5: 2; 6)

Material: One incomplete specimen (LC-1) with somewhat obliterated sculpture.

Dimensions: D = 24 mm; H = 8.5 mm; O = 9 mm; H/D = 35%; O/D = 37%.



Fig. 6. *Hybonoticerias* (*Hybonotella*) cf. *H. (H.) mundulum striatulum* Berckhemer & Hölder, 1959, specimen LC-1. La Catalina section, Sierra del Rosario, Pinar del Río province, Lower Tithonian. Natural size

Description and remarks: Small specimen (mould 24 mm in diameter) with low umbilical wall and broad umbilicus. Whorl section subquadrate, whorl sides somewhat flattened and slightly convex near peristome. Ventral side not visible. Ornamentation consisting of single, radial and prominent ribs, numerous on internal whorls, and strong, distant, on the last half of outer whorl. Strong ribs beginning somewhat below umbilical margin and ventrolateral tubercles with slightly rursiradiate long spines. Suture line not preserved.

The specimen appears to be somewhat similar to *Hybonoticerias* (*Hybonotella*) *mundulum striatulum* Berckhemer et Hölder, 1959, as described and figured by Berckhemer and Hölder (1959, p. 36, pl. 5, figs 20, 21) and Olóriz (1978, p. 365, pl. 33, figs 4, 5, 7, text-fig. p. 369). Presence of long ventrolateral spines is a characteristic feature for

this subspecies (see Berckhemer & Hölder, 1959). However, poor preservation and obliterated ornamentation makes it impossible to assignate the specimen to comparable subspecies with certainty. It differs also from the latter by stronger, more distant ribs on the last half of outer whorl. Our specimen differs in ornamentation from other subspecies of *Hybonotella mundulum* (Oppel) (see Berckhemer & Hölder, 1959; Olóriz, 1978), and also from the *Hybonoticerias* (*Hybonotella*) sp. as figured by Olóriz *et al.* (1993 p. 280, pl. 2, fig. 6). It is possible that the specimen here described represents a new subspecies of *Hybonotella mundulum* (Oppel).

Occurrence: This specimen was found in the limestones of the Artemisa Formation, La Zarza Member, in the La Catalina section, Sierra del Rosario. The subspecies *Hybonoticerias* (*Hybonotella*) *mundulum striatulum* Berckhemer & Hölder, 1959, occurs in the uppermost Kimmeridgian and the basal Lower Titho-

nian strata. The subgenus *Hybonoticer* (*Hybonotella*) sp. was described from the uppermost Kimmeridgian strata (upper part of the Beckeri Zone), of the Cuencamé (Durango, Mexico).

Family ?**Himalayitidae** Tavera, 1985
Subfamily ?**Himalayitinae** Spath, 1923
Genus **Butticeras** Houša & Nuez, 1973
Type species: *Parodontoceras butti* Imlay, 1942

Butticeras butti (Imlay, 1942)

(Fig. 7: 1)

1942 *Parodontoceras butti* Imlay; Imlay, p. 1454, pl. 7, figs 10-12

1973 *Butticeras butti* (Imlay); Houša & Nuez, p. 18

1994b "*Parodontoceras*" *butti* Imlay; Myczyński, p. 294, pl. 1, fig. 1b

Material: One specimen 13363/3.

Dimensions: D = 32 mm; H = 12 mm; O = 15 mm; H/D = 37%; O/D = 47%.

Description: Specimen incomplete. Whorl section subovate, venter narrowly rounded. Umbilicus wide and shallow. Ornamentation of inner whorls invisible. Simple, distant, strong ribs dominate on outer whorl; they begin at umbilical margin. Some of them are probably biplicate.

Remarks: The specimen here described agrees well with the description of the species *Butticeras butti*, as given by Imlay (1942), differing only by the presence of some biplicate ribs on outer whorls.

Occurrence: The specimen was found by A. Pszczółkowski in the El Toro section, limestone of the Artemisa Formation, La Zarza Member, Lower Tithonian.

Butticeras antilleanum (Imlay, 1942)

(Fig. 7: 2)

1942 *Parodontoceras antilleanum* Imlay; Imlay, p. 1455, pl. 8, figs 4-9

1973 *Butticeras antilleanum* (Imlay); Houša & Nuez, p. 18

1994 "*Parodontoceras*" *antilleanum* Imlay; Myczyński & Pszczółkowski, p. 12, fig. 4

Material: One specimen LZ-11.

Dimensions: D = 40 mm; H = 17 mm; O = 10 mm; H/D = 42%; O/D = 25%.

Description: Specimen incomplete. Whorl section subovate, venter narrowly rounded. Umbilicus narrow and shallow. Ornamentation of inner whorls invisible. Outer whorl ornamented by simple, biplicate, dense, slightly prorsiradiate ribs, which begin at umbilical margin. Constrictions not visible.

Remarks: The specimen here described agrees well with description of the species *Butticeras antilleanum* as given by Imlay (1942).

Occurrence: The specimen was found by A. Pszczółkowski in the Cinco Pesos

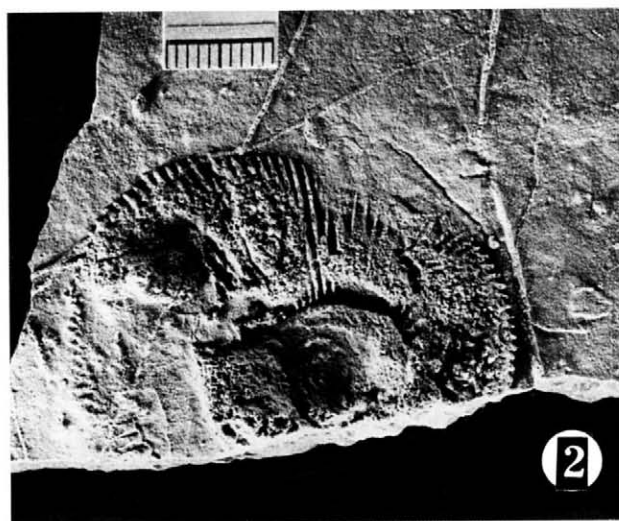


Fig. 7. 1 – *Butticeras butti* (Imlay), specimen 13363/3, limestone of the Artemisa Formation (El Toro section), Sierra del Rosario, Pinar del Río province, Lower Tithonian (collected by A. Pszczółkowski), x 1; 2 – *Butticeras antilleanum* (Imlay), specimen LZ - 11, Cinco Pesos section, Sierra del Rosario, Pinar del Río province, Lower Tithonian (collected by A. Pszczółkowski), x 1

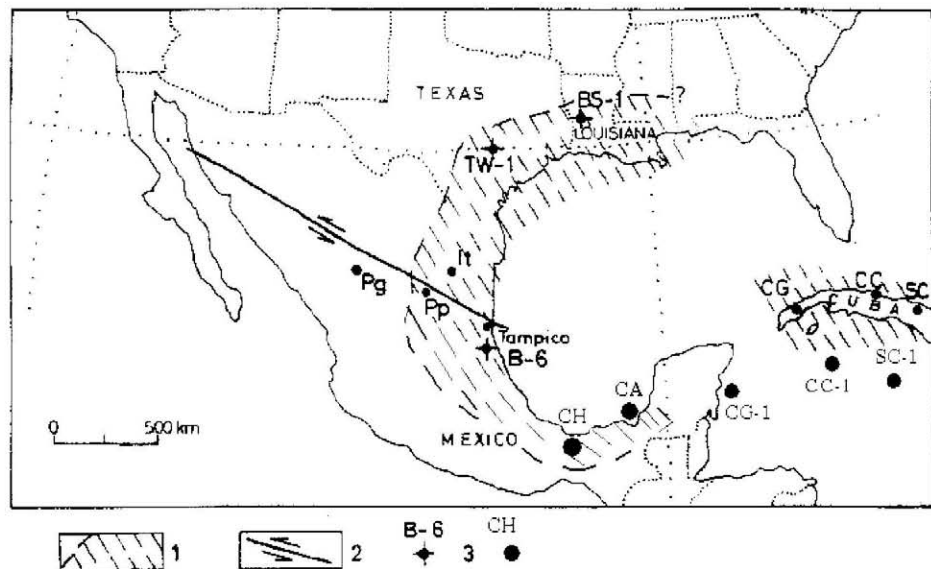


Fig. 8. Location map showing the occurrence of Upper Tithonian genus *Salinites* Cantú Chapa, 1968, in the Gulf of Mexico and the Caribbean region (modified from Cantú Chapa, 1989, and the author's unpublished data from Cuba). CG – Guaniguanico terrane (western Cuba); CC – Camajuani and Placetas sequences (central Cuba), after Iturralde-Vinent *et al.* (1981); Kantchev *et al.* (1978) and Myczyński (1989); SC – Sierra de Camaján (Camagüey province, central Cuba) after Iturralde-Vinent (1994) and Myczyński (1989); TW – Texaco White No 1 borehole, after Imlay & Herman (1984); BS – Schell Boise Southern No 1 borehole, after Imlay & Herman (1984); B6 – Bejuco 6 borehole, after Cantú Chapa (1976); It – Nuevo Leon after Adatte *et al.* (1992); CH – Chinameca borehole, after Cantú Chapa (1989); CA – Campeche borehole, after Cantú Chapa, 1989; CG-1 – hypothetical pre-tectonic location of the original sedimentation basin of Cordillera Guaniguanico; CC-1 – hypothetical pre-tectonic location of the sedimentation basin of the Camajuani belt, after Pszczółkowski (1987) and Iturralde-Vinent (1994); SC-1 – hypothetical pre-tectonic location of the original sedimentation basin of the Sierra de Camaján sequence (Camagüey province, central Cuba); I – Area of known occurrence of the genus *Salinites*; 2 – Walper Megashear after Pessagno *et al.* (1993); 3 – boreholes

section, limestone of the Artemisa Formation, La Zarza Member, Lower Tithonian.

CONCLUSIONS

(1) The presence of the ammonites of the genus *Hybonoticerias* Breistroffer, 1947, in the Lower Tithonian deposits of the Guaniguanico terrane of the Sierra de los Organos and Sierra del Rosario belts, is important for biostratigraphic and palaeobiogeographic correlation. It is confirmed that connection between Spain and proto-Caribbean basin in the earliest Tithonian occurred directly through the "hispanic corridor" *sensu* Westermann (1984). Local Early Tithonian ammonite biozoo- nation has been modified herein because of the presence of *Hybonoticerias* in western Cuba (see Figs 3, 4).

(2) Of the proto-Caribbean and Mexican endemic ammonite genera *Vinalesites*,

Butticeras and *Paralytotochoplites* and *Salinites*, only the latter genus may be used for regional correlation between Gulf of Mexico (Eastern Mexico and southern part of the United States) and Cuba (see Fig. 8).

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