

Short note

Clypeasteroids (Echinodermata: Echinoidea) From the Cretaceous In Mexico?

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ABSTRACT

It is currently considered that the origin of the order Clypeasteroida occurred during the Cretaceous, with the stem group that includes the families Faujasiidae, Plasiolampadidae, Conoclypeidae, and Oligopygidae. Nevertheless, there are taxonomic reports of Cretaceous echinoids from Mexico, which also include species of the Echinarachniidae and Mellitidae families. The present paper reviews and updates the records of the Cretaceous clypeasteroids in Mexico. Specimens belonging to the order Clypeasteroida were located in national and international collections, which also provided taxonomic and paleobiogeographic data. Three species, *Hardouinia aequorea*, *Hardouinia potosiensis*, and *Phyllobrissus burckhardti*, are illustrated and cataloged in two of the 11 genera in family Faujasiidae. The previous records of families Echinarachniidae and Mellitidae are incorrect, coinciding with the current hypothesis on the origin of the Clypeasteroida order. Invalid catalog numbers published for the type series of *Encope michoacanensis* were corrected according to the Colección Nacional de Paleontología database.

Keywords: Faujasiidae, *Hardouinia aequorea*, *Hardouinia potosiensis*, *Phyllobrissus burckhardti*, *Encope michoacanensis*.

RESUMEN

Actualmente se considera que el origen del orden Clypeasteroida se dio durante el Cretácico, con el grupo basal que incluye las familias Faujasiidae, Plasiolampadidae, Conoclypeidae y Oligopygidae. Sin embargo, hay reportes taxonómicos sobre los equinoideos del Cretácico en México que también incluyen especies de las familias Echinarachniidae y Mellitidae. En el presente trabajo se revisan y actualizan los registros de clypeasteroideos del Cretácico en México. Con una revisión bibliográfica exhaustiva se localizaron ejemplares del orden Clypeasteroida albergados en colecciones nacionales e internacionales, de los que se provee información taxonómica y paleobiogeográfica. Tres especies, *Hardouinia aequorea*, *Hardouinia potosiensis* y *Phyllobrissus burckhardti*, son ilustradas y catalogadas en dos de los 11 géneros de la familia Faujasiidae. Los registros previos de las familias Echinarachniidae y Mellitidae son incorrectos, coincidiendo con la hipótesis actual del origen del orden Clypeasteroida. Se corrigen los números de catálogo publicados para la serie tipo de *Encope michoacanensis* de acuerdo con la base de datos de la Colección Nacional de Paleontología.

Palabras clave: Faujasiidae, *Hardouinia aequorea*, *Hardouinia potosiensis*, *Phyllobrissus burckhardti*, *Encope michoacanensis*.

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1. Introduction

Alexander Agassiz (1874) created the order Clypeasteroida to include the burrowing flat sea urchins, commonly named sand dollars. These costal worldwide inhabitants have an important fossil record along the Cenozoic, including some important index species (Mooi, 1987). The origin and composition of clypeasteroids has been debated for decades.

Durham (1955) and Seilacher (1979) pointed out that the family Fibulariidae, previously named by Duncan (1889), includes the oldest clypeasteroids; hence, the order Clypeasteroida arose in the Early Cretaceous (Table 1). Contrary, Kier (1962), and later Smith (1984), thought that the late Paleocene genus *Togocyamus* Oppenheim, 1915, from West Africa, was the first clypeasteroid representative; consequently, this order is entirely restricted to the Cenozoic.

The paleontological age estimates, based on older fossils for the origin of order Clypeasteroida using molecular clocks (Smith *et al.*, 2006), are 100–105 Ma (Albian, Cretaceous). This statement supports the study of the post-Paleozoic echinoids phylogeny (Kroh and Smith, 2010), which reveals the monophyletic nature of Clypeasteroida, including 4 and 17 taxa as stem and crown families, respectively. Here again, the origin of this order is pulled back to the Cretaceous because the extinct family Faujasiidae, erected by Lambert, 1905 (now involving the family Stigmatopyginae Smith and Wright, 2000), includes Cenomanian representatives (Table 1).

The composition and relationships of the Clypeasteroida have not been fully determined constitute problematic and unfinished tasks. Kroh and Smith (2010) published the most comprehensive phylogenetic study of this group. These authors claimed, although weakly supported, that the Faujasiidae represents a stem family of the order Clypeasteroida. Other less-extensive studies, performed with more restricted scopes, suggest alternative taxonomical compositions of this order, in which the Faujasiidae is excluded

(*e.g.*, Durham, 1955; Kier, 1982; Smith, 1984). Currently, it is desirable to contrast these different ideas about the taxonomical composition of the order Clypeasteroida. However, any effort in that direction goes beyond the aim of this work. Therefore, here the family Faujasiidae is considered part of the order Clypeasteroida as it was concluded by Kroh and Smith (2010).

Cretaceous marine sediments of Mexico bear a potentially important fossil record of clypeasteroids, whose taxonomy must be updated following the latest studies (Wang, 1984; Mooi, 1987; Mooi, 1989; Kroh and Smith, 2010; Smith and Kroh, 2011). Nieto and García (2006) published a brief review of the Mexican echinoids, which was only based in a literature search without the direct review of the available specimens; that study enlists the occurrence of 65 echinoids species in different Cretaceous localities throughout Mexico, 20 regular and 45 irregular echinoids, including the following clypeasteroids: *Clypeaster*, *Encope* L. Agassiz, 1840, *Haimea* Michelin, 1851 and *Astrodapsis*.

The aim of this work is to review the Cretaceous fossil record of Clypeasteroida from Mexico based on a careful anatomical review of the specimens deposited in different national or foreign paleontological collections, as well as to sort, recover, and update their taxonomic and geologic data.

2. Materials and Methods

2.1. INSTITUTIONAL ABBREVIATIONS

The fossils of clypeasteroids from the Mexican Cretaceous referred in this study are deposited in different collections, whose abbreviations are the following:

- IGM, Instituto Geológico de México (previous name of the Instituto de Geología, UNAM) that houses the Colección Nacional de Paleontología (CNP) in its Museo María del Carmen Perrillat Montoya, Ciudad Universitaria, Mexico City, Mexico.
- MNHN, Muséum National d'Histoire

Table 1. Order Clypeasteroida according to different authors, showing inconsistencies between approaches.

DURHAM (1955)	KROH & SMITH (2010)	SMITH & KROH (2011)
Suborder Clypeasterina	Stem group Clypeasteroida	Stem group Clypeasteroida
Family Clypeasteridae	† Family Faujasiidae, (+ † Stigmatopyginae)	† Family Plesiolampadidae
Family Arachnoididae	† Family Plesiolampadidae	† Family Conoclypeidae
Suborder Laganina	† Family Conoclypeidae	† Family Oligopygidae
Family Fibulariidae	† Family Oligopygidae	Crown group Clypeasteroida
Family Laganidae	Crown group Clypeasteroida	Suborder Clypeasterina
Family Neolaganidae	Suborder Clypeasterina	Family Clypeasteridae (includes Clypeasterinae; Ammotrophinae; Arachnoidinae)
Suborder Scutellina	Family Clypeasteridae (+ Clypeasterinae; Ammotrophinae; Arachnoidinae)	† Family Fossulasterinae (includes † Scutellinoididae)
Family Scutellidae	† Family Fossulasterinae (+ † Scutellinoididae)	Suborder Scutellina
Family Protoscutellidae	Suborder Scutellina	Stem group Scutellina
Family Eoscutellidae	Stem group Scutellina	† Family Scutellinidae
Family Dendrasteridae	† Family Scutellinidae	Infraorder Laganiformes
Family Echinarachniidae	Infraorder Laganiformes	Family Fibulariidae (includes Echinocyamidae)
Family Monophorasteidae	Family Fibulariidae (+ Echinocyamidae)	Family Laganidae (includes Laganinae; † Neolaganinae)
Family Mellitidae	Family Laganidae (+ Laganinae; † Neolaganinae)	Infraorder Scutelliformes
Family Astriclypeidae	Infraorder Scutelliformes	Family Taiwanasteridae (<i>incertae sedis</i>)
Family Abertillidae	Family Taiwanasteridae (<i>incertae sedis</i>)	Stem group Scutelliformes
Family Scutasteridae	Stem group Scutelliformes	† Family Protoscutellidae
Family <i>incertae cedis</i>	† Family Protoscutellidae	Crown group Scutelliformes
Suborder Rotulina	Crown group Scutelliformes	Family Echinarachniidae
Family Rotulidae	Family Echinarachniidae	† Family Scutellidae
Suborder <i>incertae cedis</i>	Family Dendrasteridae	† Family Eoscutellidae
	Family Rotulidae	† Family Scutasteridae
	† Family Scutellidae	Family Dendrasteridae
	† Family Eoscutellidae	† Family Abertillidae
	† Family Scutasteridae	Family Rotulidae
	† Family Abertillidae	Family Astriclypeidae
	Family Astriclypeidae	† Family Monophorasteridae
	† Family Monophorasteridae	Family Mellitidae
	Family Mellitidae	

Naturelle, Collection des échinodermes fossiles, Paris, France.

- USNM-PAL, National Museum of Natural History, Paleontological Collection, Smithsonian Institution, Washington, USA.

2.2. OBSERVED SPECIMENS

This work includes the review of specimens belonging to order Clypeasteroida deposited in different collections: *Astrodapsis bajasurensis* Squires and Demetron IGM 5926-5932, *Clypeaster pileus* Israelsky IGM 2553, *Clypeaster rogersi* (Morton) IGM 2554, *Encope grandis* subsp. *inezana* Durham IGM 2825-2827, *Encope loretoensis* Durham IGM 8150-8151, *Encope michoacanensis* Durham IGM 7057-7061, *Encope perspective* Agassiz IGM 7062, *Encope shepherdii* Durham IGM 2822-2824, *Encope tatetlaensis* Böse IGM 147-148 and IGM 7154, *Haimea bajasurensis* Squires and Demetron IGM 5934-5937, *Hardouinia aequorea* (Morton) USNM-PAL 464465-464466, 464468, 464470-464473, USNM-PAL, *Hardouinia potosiensis* Lambert MNHN FJ01116 and *Petalobrissus burckhardti* Lambert USNM-PAL 108380. One specimen of *Hardouinia aequorea* from the Regional Collection (CNP, IGM, UNAM) was determined, described, and illustrated. The taxonomical identities of the specimens studied were redetermined using the criteria of Kroh and Smith (2010) and Smith and Kroh (2011).

3. Results

3.1. PALEONTOLOGICAL SYSTEMATICS

Class Echinoidea Leske, 1778
Order Clypeasteroida A. Agassiz, 1872
Stem group Clypeasteroida
Family Faujasidae Lambert, 1905
Subfamily Stigmatopyginae Smith and Wright,
2000
Genus *Hardouinia* Haime in d'Archiac and
Haime, 1853

Synonymous. *Hardouinia* Haime in d'Archiac and Haime, 1853, p. 214. Pomel, 1883, p. 65.

Cooke, 1942, p. 6; 1953, p. 19.

Echinanthus Desor, 1858, p. 295.

Gonioclypeus Emmons, 1858, p. 309.

Australanthus Bittner, 1892, p. 20. H.L. Clark, 1946, p. 357. Mortensen, 1948, p. 222.

Cassidulus (*Hardouinia*) Gregory, 1891, p. 436.

Proccassidulus (*Hardouinia*) Lambert and Thiéry, 1921, p. 362.

Type species. *Pygorhynchus mertonis* Michelin, 1851, p. 240 by monotypy (Cooke, 1953).

Stratigraphic range. Upper Cretaceous (Turonian to Maastrichtian, Smith and Kroh, 2011).

Hardouinia aequorea (Morton, 1834)

Figure 2, A–D.

Synonymous. *Cassidulus aequoreus* Morton, 1834, p. 76, fig. 3.14.

Type material. Specimen from the ferruginous sand, Prairie Bluff, Alabama, USA, with no catalog number available, illustrated by Morton (1834, fig. 3.14). Probably deposited in the Philadelphia Academy of Natural Sciences.

Description. Test subpentagonal, elongated. Aboral surface convex, oral surface flat and slightly sunken toward the peristome. Ambulacra narrow and continue toward the peristome. Phylloides surrounding the peristome. Interambulacra wide and covered with small tubercles. Periproct aboral, sunken in a furrow, covering one third of the posterior diameter. Peristome pentagonal, surrounded by a floscele.

Examined material. USNM-PAL 464465, 464466, 464471 and 464472, from the Upper Cretaceous (Maastrichtian) sediments of Prairie Bluff Chalk, Alabama, USA. USNM-PAL 464468, 464470 and 464473, from Upper Cretaceous (Maastrichtian), Prairie Bluff Chalk, Mississippi, USA.

Distribution. Cárdenas Formation, San Luis Potosí, Mexico. Lagunar system, with low energy and storm deposits (Sánchez-Rodríguez, 1997). It has been reported in Navesink Marl, Group Mon-

mouth, New Jersey and Ripley Formation (Upper Cretaceous), Alabama, USA (Sánchez-Rodríguez, 1997).

Hardouinia aequorea (Morton, 1834) IGM 6259

Figure 1, Table 2.

Description. Aboral surface rounded. Apical system monobasal, slightly anterior, concurring with the apex; with four genital pores, G3 towards the front. Petaloid ambulacra with similar length; ambulacra III close to *ambitus*. Petaloids with internal pores elliptical and external pores slit-shaped, connected by a slightly shallow channel. Ambulacra with outer pore elongated transversely; no visible pores beyond ambulacra. Periproct aboral, visible from the top, almost reaching the *ambitus*; triangular, elongated vertically, sunken in a furrow. Oral surface slightly sunken longitudinally. Peristome slightly anterior, pentagonal, surrounded

by a floscele. Bourrelets tooth-like, projecting into and over the peristome. Phyllodes, wide, single pored; the inner series straight, with rounded small pores; the outer series arranged in a broad arc, with elliptical pores.

Observations. *Hardouinia aequorea* differs from *Australanthus* and *Petalobrissus* by having flat test and elongated ambulacra. It also diverges from *Hardouinia potosiensis* in the position of the periproct. In *H. potosiensis* the petaloids do not reach the periproct, contrary to the posterior petaloids in *H. aequorea*. The holotype has a subconical test, but without specimens to compare, this could be either a regular shape or the result of the fossilization process. Locality. IGM-locality 956. Cárdenas, San Luis Potosí (21°38'22"N, 99°38'22"W); Upper Cretaceous, Campanian–Maastrichtian (Ferrusquía-Villafranca *et al.*, 2016). Collected by Ralph L. Myers, 1966.

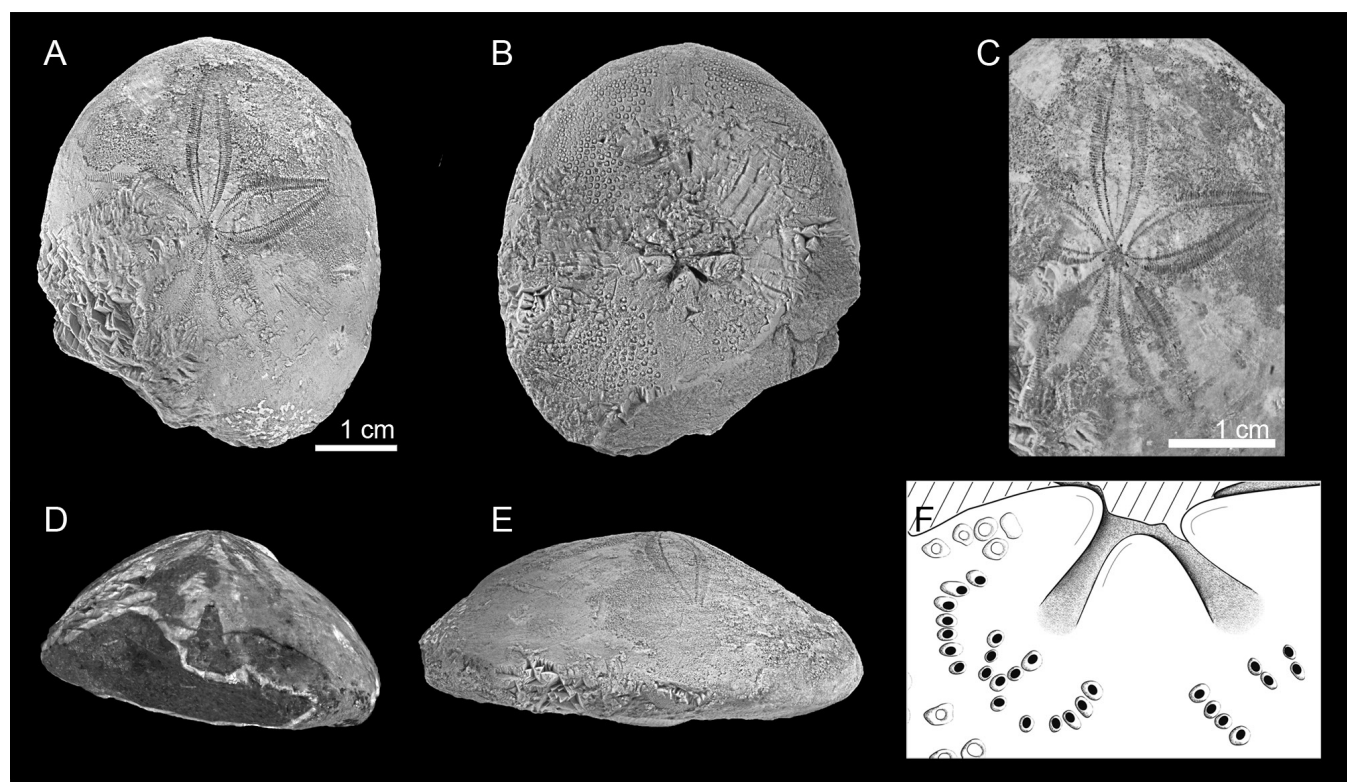


Figure 1 *Hardouinia aequorea* IGM 6259. Length: 52.18 mm; height: 22.06 mm; width: 42.41 mm. Late Cretaceous. Cárdenas, San Luis Potosí (21°38'22" N, 99°38'22" W). Collected by Ralph L. Myers, 1966. A. Aboral view, B. Oral view, C. Petaloid ambulacra, D. Posterior view, E. Lateral view (right), F. Phyllodes.

Table 2. Morphometric data (mm) of *Hardouinia aequorea* IGM 6259.

	Length	Width	Height
Test	52.2	22.1	42.4
Ambulacrum I	18.2	5.6	*
Ambulacrum II	17.2	7.1	*
Ambulacrum III	20.6	5.3	*
Periproct	7.7	3.0	*

Hardouinia potosiensis Lambert, 1936
Figure 2, E–G.

Type species. *Echinobrisus setifensis* Cotteau, 1866, p. 151 by original designation (Kier, 1962). Stratigraphic range. Upper Cretaceous (Turonian to Maastrichtian, Smith and Kroh, 2011).

Type material. Holotype MNHN L.19.773. Coniacian (Upper Cretaceous) sediments of the Cárdenas Formation, San Luis Potosí, Mexico (Lambert, 1936, pp. 5–6, figs. 1.2–1.4).

Description. Test large, oval, rounded at the anterior rear, slightly elongated. Aboral surface subconic. Apical system anterior, with four genital pores. Petaloid ambulacra, narrow, short, lanceolate and distally closed; posterior ambulacra not reaching the periproct. Periproct elongated and pointy. Oral surface slightly concave towards sub-central peristome. Oral area with bourrelets and phylodes.

Examined material. Holotype MNHN FJ01116. Cárdenas Formation, San Luis Potosí, Mexico. Upper Cretaceous, Campanian–Maastrichtian (Ferrusquía-Villafranca *et al.*, 2016). Distribution. Cárdenas Formation, San Luis Potosí, Mexico. (Lambert, 1936; Myers, 1968).

Genus *Petalobrissus* Lambert and Thiéry, 1921

Petalobrissus burckhardtii Lambert, 1936
Figure 2, H–K.

Synonymous. *Phyllobrissus cubensis* Cooke, 1953, p. 17, figs. 17.11–17.14.

Type material. Holotype MNHN L.19.775. Cretaceous, Ocozocuaula, Chiapas, Mexico.

Description. Test oval, slightly wider at the posterior rear. Aboral surface slightly inflated. Oral surface flat, slightly concave at the peristome. Petaloid ambulacra short, reaching half the distance between the apical system and the ambitus. Apical system anterior, with four genital pores and a central large madreporite (Cooke, 1953).

Examined material. *Phyllobrissus cubensis* USNM-PAL 108380. Ocozocuaula, Chiapas, Mexico. Cretaceous, Senonian.

Distribution. Ocozocuaula, Chiapas (Cooke, 1953). Cretaceous, Upper Senonian (Kier and Lawson, 1978).

4. Discussion

Families Faujasidae, Echinarachniidae, Clypeasteridae, and Mellitidae are wrongly included in the most recent revision on Cretaceous Echinoids in Mexico (Nieto and García, 2006). The specimens exist in the referred collection, but do not correspond to Cretaceous localities (Table 3).

Genus *Astrodapsis* is included in family Echinarachniidae, and genera *Clypeaster* and *Encope* in family Mellitidae. Both families are classified in the crown group of infraorder Scutelliformes Haeckel, 1896. Family Echinarachniidae has been reported from the middle Eocene to present, with recent species reported in North Pacific (from Japan to California, USA) (Kroh and Smith, 2010; Smith and Kroh, 2011). Family Mellitidae originated during early Miocene (Kroh and Smith, 2010) and includes recent species reported in Central and South America and the Caribbean Sea (Smith and Kroh, 2011).

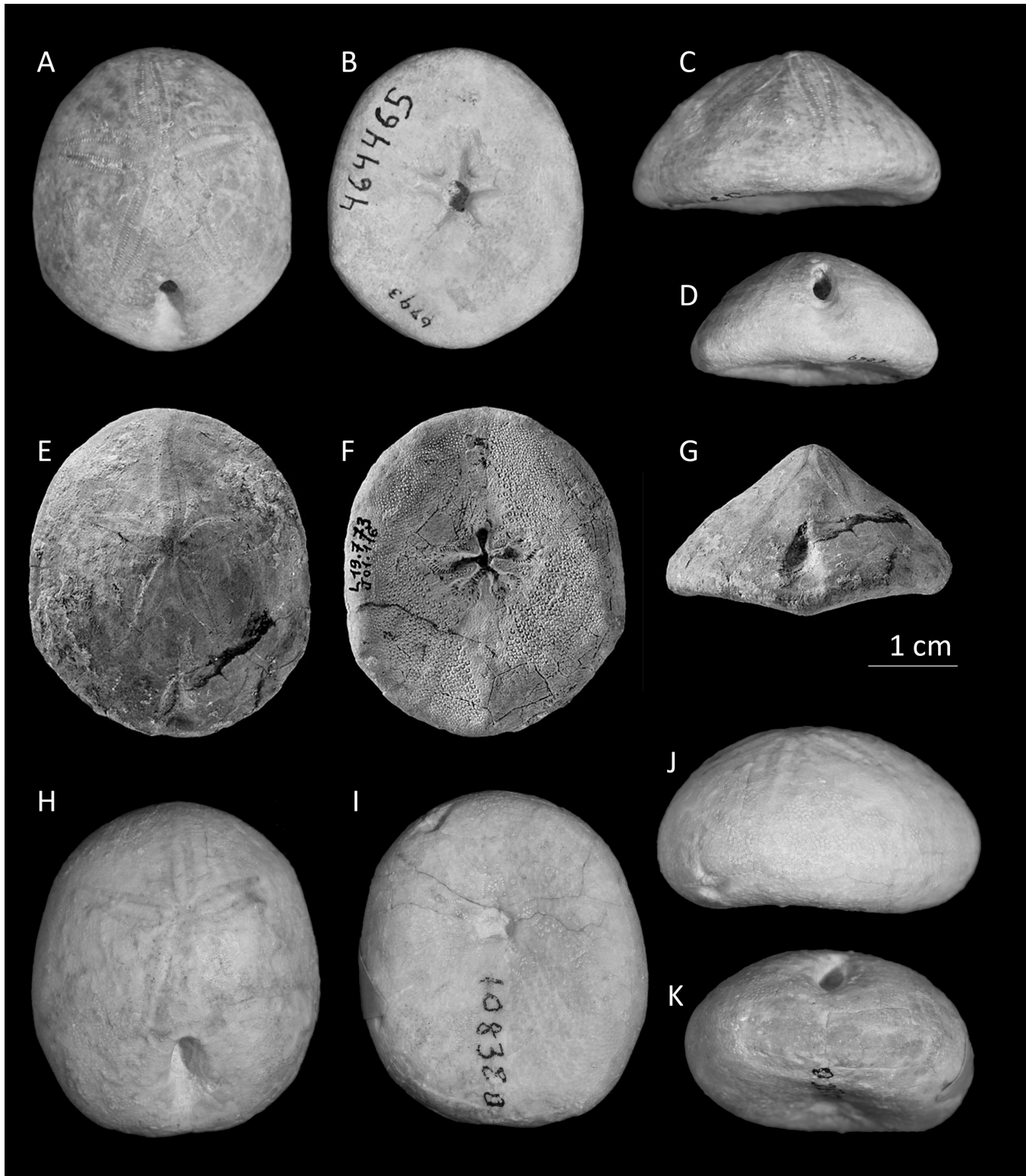


Figure 2 Upper Cretaceous Faujasiiidae from Mexico. *Hardouinia aequorea* (Morton, 1834); USNM-PAL 464465. A. Aboral view, B. Oral view, C. Lateral view (left), D. Posterior view. *Hardouinia potosiensis* Lambert, 1936 (Holotype MNHN F.J01116, Credits MNHN, 2017). E. Aboral view, F. Oral view, G. Posterior view. *Petalobrissus burckhardti* Lambert, 1936 (USNM-PAL108380). H. Aboral view, I. Oral view, J. Lateral view (left), K. Posterior view.

Table 3. Species of clypeasteroids reported in the most recent revision of Cretaceous echinoids in Mexico (Nieto and García, 2006).

*Species present in the National Collection of Paleontology (IGM).

Family	Species
Clypeasteridae	
	<i>Clypeaster pileus</i> Israelsky, 1924*
	<i>Clypeaster rogersi</i> Morton, 1834*
Echinarachniidae	
	<i>Astrodapsis bjasurensis</i> Squires and Demetrion, 1993*
	<i>Haimea bjasurensis</i> Squires and Demetrion, 1994*
Faujasiiidae	
	<i>Hardouinia potosiensis</i> Lambert, 1936
Mellitidae	
	<i>Encope grandis</i> subsp. <i>inezana</i> Durham, 1950*
	<i>Encope loretoensis</i> Durham, 1950*
	<i>Encope michoacanensis</i> Durham, 1994*
	<i>Encope perspectiva</i> L. Agassiz, 1841*
	<i>Encope shepherdii</i> Durham, 1950*
	<i>Encope tatetlaensis</i> Böse, 1906*

Durham (1994) described *Encope michoacanensis* using invalid catalog numbers from the National Paleontological Collection (IGM). We include the catalog numbers used in the original references and the corrected catalog numbers used in the National Paleontological Collection (Table 4).

5. Conclusions

We report three species of clypeasteroids for the Cretaceous in Mexico: *Hardouinia aequorea*, *Hardouinia potosiensis*, and *Phyllobrissus burckhardti*. These species are classified in the family Faujasiiidae, part of the stem group of clypeasteroids, with origin in the Campanian (Cretaceous). The records of families Echinarachniidae and Mellitidae (Nieto

and García, 2006) are incorrect. These results support the phylogenetic hypothesis on the origin of the order Clypeasteroida proposed by Kroh and Smith (2010).

The correct revision and tracing of the taxonomic information in the paleontological collections allows us to correct catalog numbers of the National Paleontological Collection (IGM) assigned wrongly and published by Durham (1994).

Continuous reviews of the data deposited in biological and paleontological collections are needed in order to study and propose a robust phylogenetic hypothesis for the family Faujasiiidae and to update and amend taxonomic information to eliminate mistakes.

Table 4. Data of the clypeasteroids reported in Nieto and García, 2006 with amendments in catalog numbers. NA: Information not Available.

Catalog	Family	Species	Formation	Locality	Age	Type	Invalid num.
IGM 2553	Clypeasteridae	<i>Clypeaster pileus</i> Israelsky, 1924	NA	La Catalina Mine, Simojovel, Chiapas, Mexico.	Oligocene		
IGM 2554	Clypeasteridae	<i>Clypeaster rogersi</i> (Morton, 1834)	NA	Teapa River, Ixtapangajoyac, Chiapas, Mexico.	Oligocene		
IGM 5926	Echinarachniidae	<i>Astrodapsis bajasurensis</i> Squires and Demetron, 1993	Isidro	Near San Juanico, Baja California Sur, Mexico.	Middle Miocene	Holotype	
IGM 5927	Echinarachniidae	<i>Astrodapsis bajasurensis</i> Squires and Demetron, 1993	Isidro	Near San Juanico, Baja California Sur, Mexico.	Middle Miocene	Paratype	
IGM 5928	Echinarachniidae	<i>Astrodapsis bajasurensis</i> Squires and Demetron, 1993	Isidro	Near San Juanico, Baja California Sur, Mexico.	Middle Miocene	Paratype	
IGM 5929	Echinarachniidae	<i>Astrodapsis bajasurensis</i> Squires and Demetron, 1993	Isidro	Near San Juanico, Baja California Sur, Mexico.	Middle Miocene	Paratype	
IGM 5930	Echinarachniidae	<i>Astrodapsis bajasurensis</i> Squires and Demetron, 1993	Isidro	Near San Juanico, Baja California Sur, Mexico.	Middle Miocene	Paratype	
IGM 5931	Echinarachniidae	<i>Astrodapsis bajasurensis</i> Squires and Demetron, 1993	Isidro	Near San Juanico, Baja California Sur, Mexico.	Middle Miocene	Paratype	
IGM 5932	Echinarachniidae	<i>Astrodapsis bajasurensis</i> Squires and Demetron, 1993	Isidro	Near San Juanico, Baja California Sur, Mexico.	Middle Miocene	Paratype	
IGM 5933	Echinarachniidae	<i>Astrodapsis bajasurensis</i> Squires and Demetron, 1993	Isidro	Near San Juanico, Baja California Sur, Mexico.	Middle Miocene	Paratype	
IGM 5934	Echinarachniidae	<i>Haimea bajasurensis</i> Squires and Demetron, 1994	Tepetate	La Paz, Baja California Sur, Mexico.	Lower Eocene	Holotype	
IGM 5935	Echinarachniidae	<i>Haimea bajasurensis</i> Squires and Demetron, 1994	Tepetate	La Paz, Baja California Sur, Mexico.	Lower Eocene	Paratype	
IGM 5936	Echinarachniidae	<i>Haimea bajasurensis</i> Squires and Demetron, 1994	Tepetate	La Paz, Baja California Sur, Mexico.	Lower Eocene	Paratype	
IGM 5937	Echinarachniidae	<i>Haimea bajasurensis</i> Squires and Demetron, 1994	Tepetate	La Paz, Baja California Sur, Mexico.	Lower Eocene	Paratype	
IGM 2822	Mellitidae	<i>Encope grandis inezana</i> Durham, 1950	NA	Santa Ines Bay, Mulegé, Baja California Sur, Mexico.	Pleistocene	Paratype	
IGM 2823	Mellitidae	<i>Encope grandis inezana</i> Durham, 1950	NA	Santa Ines Bay, Mulegé, Baja California Sur, Mexico.	Pleistocene	Paratype	
IGM 2824	Mellitidae	<i>Encope grandis inezana</i> Durham, 1950	NA	Santa Ines Bay, Mulegé, Baja California Sur, Mexico.	Pleistocene	Paratype	
IGM 8150	Mellitidae	<i>Encope loretoensis</i> Durham, 1950	Salada	Los Cabos, Baja California Sur, Mexico.	Upper Pliocene	Paratype	
IGM 8151	Mellitidae	<i>Encope loretoensis</i> Durham, 1950	Salada	Los Cabos, Baja California Sur, Mexico.	Upper Pliocene	Paratype	
IGM 7057	Mellitidae	<i>Encope michoacanensis</i> Durham, 1994	Ferrotepec	Near La Mira, Michoacán, Mexico	Lower Miocene	Holotype	IGM 2939
IGM 7058	Mellitidae	<i>Encope michoacanensis</i> Durham, 1994	Ferrotepec	Near La Mira, Michoacán, Mexico	Lower Miocene	Paratype	IGM 2940
IGM 7059	Mellitidae	<i>Encope michoacanensis</i> Durham, 1994	Ferrotepec	Near La Mira, Michoacán, Mexico	Lower Miocene	Paratype	IGM 2941
IGM 7060	Mellitidae	<i>Encope michoacanensis</i> Durham, 1994	Ferrotepec	Near La Mira, Michoacán, Mexico	Lower Miocene	Paratype	IGM 2942
IGM 7062	Mellitidae	<i>Encope michoacanensis</i> Durham, 1994	Ferrotepec	Near La Mira, Michoacán, Mexico	Lower Miocene	Paratype	IGM 2943
IGM 7061	Mellitidae	<i>Encope perspectiva</i> Agassiz, 1841	NA	Santa Cruz, Santa María Huatulco, Oaxaca, Mexico.	Pliocene-Pleistocene		IGM 2944
IGM 2822	Mellitidae	<i>Encope shepherd</i> Durham, 1950	Marquer	Marquer Bay, Carmen Island, Baja California Sur, Mexico.	Upper Pliocene	Paratype	
IGM 2823	Mellitidae	<i>Encope shepherd</i> Durham, 1950	Marquer	Marquer Bay, Carmen Island, Baja California Sur, Mexico.	Upper Pliocene	Paratype	
IGM 2824	Mellitidae	<i>Encope shepherd</i> Durham, 1950	Marquer	Marquer Bay, Carmen Island, Baja California Sur, Mexico.	Upper Pliocene	Paratype	
IGM 147	Mellitidae	<i>Encope tatetlaensis</i> Böse, 1906	NA	Santa María Tatetla, Veracruz, Mexico	Pliocene	Sintype	
IGM 148	Mellitidae	<i>Encope tatetlaensis</i> Böse, 1906	NA	Santa María Tatetla, Veracruz, Mexico	Pliocene	Sintype	
IGM 5174	Mellitidae	<i>Encope tatetlaensis</i> Böse, 1906	NA	Santa María Tatetla, Veracruz, Mexico	Pliocene	Sintype	

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