Late Paleocene Architectonicidae (Gastropoda: Heterobranchia) from Baja California, Mexico

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ABSTRACT

Six gastropod species including two new ones, belonging to the family Architectonicidae, of the genera Architectonica, Granosolarium and Pseudomalaxis, are described for the Late Paleocene Sepultura Formation in Baja California, northwestern Mexico. The new species Architectonica bieleri and Architectonica bajaensis are established from well preserved specimens. The genera Granosolarium and Pseudomalaxis are for the first time reported in Baja California.

Key words: architectonicid gastropods, Late Paleocene, Baja California, Mexico.

RESUMEN

Se describen e ilustran seis especies de arquitectonícidos de los géneros Architectonica, Granosolarium y Pseudomalaxis del Paleoceno Tardío, provenientes de la Formación Sepultura en la región norte de Baja California. Dos especies nuevas, Architectonica bieleri y Architectonica bajaensis, se describen con base en especímenes bien conservados. Los géneros Granosolarium y Pseudomalaxis se reportan por primera vez para Baja California.

Palabras clave: arquitectonícidos, Paleoceno Tardío, Baja California, México.

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INTRODUCTION

The purpose of this paper is to report the presence of the gastropod genera *Architectonica*, *Granosolarium*, and *Pseudomalaxis* from a Late Paleocene locality in the Sepultura Formation, Baja California, Mexico.

These genera belong to the family Architectonicidae, Clade Heterobranchia (Bouchet *et al.*, 2005) informal Group "Lower Heterobranchia", commonly known as sundials.

Marine deposits of Paleocene age are present in the coastal ranges from northern California south to Baja California, Mexico. The faunas from these deposits were studied since the 19th Century by Gabb (1864, 1869), and Stanton (1896). In the 20th century studies of molluscan faunas were carried out by Weaver (1905); Dickerson (1914a, 1914b); Waring (1917); Nelson (1925); Stewart (1926); Zinsmeister (1974, 1983).

The first paper that mentioned fossils from Baja California of Paleocene age is by Emmons and Merrill (1894, p. 501) considering "from rolled pebbles of impure limestone obtained along the beach to the south of the Playa, which had evidently fallen from the cliffs above, and from a bed of similar composition in place at what was assumed to be about 1,200 feet higher in horizon, at San Carlos anchorage (collected by Mr. A. D. Foote), eight miles north of Bluff Point, the following forms were identified by Mr. T. W. Stanton.

Cardita planicostata Lam., *Leda gabbi* Conrad, *Urosyca caudate* Gabb, *Nucula* sp., *Pectunculus* sp., *Tellina* sp., *Turritella* sp., *Dentalium* sp., and *Crassatella* sp., and are considered by him to belong undoubtedly to the Tejon –Eocene."

Later Darton (1930, p. 728) copies Emmons and Merrill list of fossils.

Santillán and Barrera (1930, p. 20) mention species that served to determine the age of the Sepultura Formation, this fauna corresponds to the Martinez Formation (Lower Eocene) from California.

The only described and figured Paleocene molluscan faunas from Baja California are those of Zinsmeister and Paredes-Mejía (1988), Squires (1988), Paredes-Mejía (1989), Squires *et al.* (1989), and Squires and Saul (2006).

The molluscan fauna herein studied was collected in Mesa San Carlos, Sepultura Formation (Figure 1), this formation was proposed by Santillán and Barrera (1930). Recent work on this formation began in the early 1960's with Kilmer (1963) mapping of the Cretaceous and Tertiary sequence in the vicinity of El Rosario and near Mesa Purgatorio, where he characterized the Paleocene.

More recently Arzate-Hernández and Tellez-Duarte (1988), Abbott *et al.* (1993), among others have published papers dealing with the geology and paleoenvironmental implications of Mesa Sepultura Formation.

Zinsmeister and Paredes-Mejía (1988, p. 10) comment "The sedimentary section of the Mesa San Carlos region consists of approximately 2,000 m of sandstone with interbedded conglomerates, siltstone and sandy siltstones. The sequence has been divided into the Cretaceous to lower Tertiary Punta Baja, Rosario, and Sepultura formations.

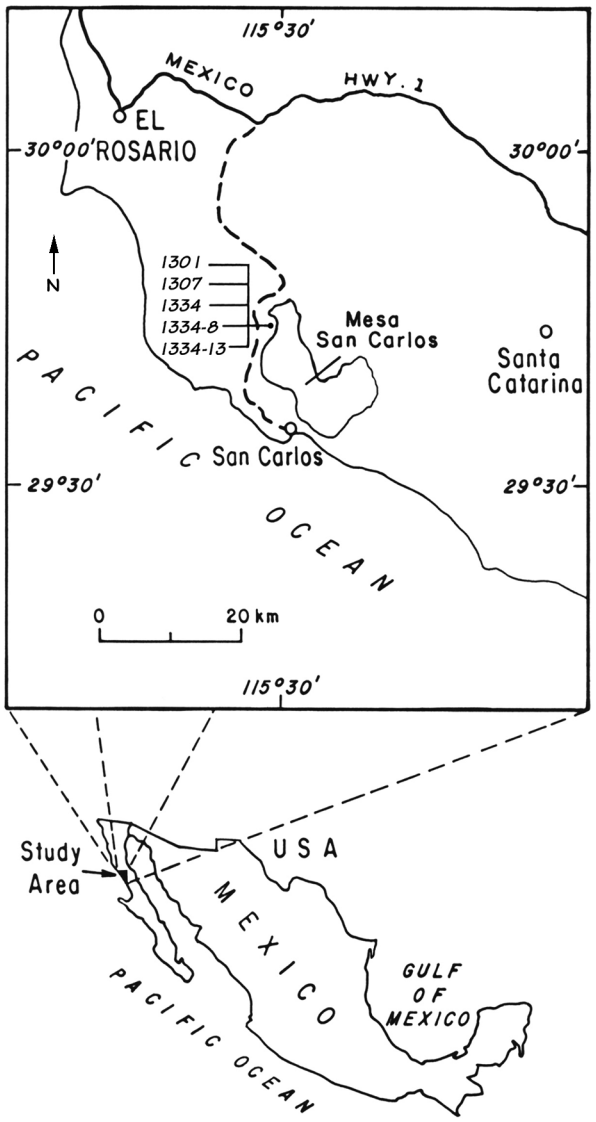

Figure 1. Location map of Mesa San Carlos, Baja California, with Purdue University (PU) collecting localities.

Overlying the Rosario Formation are conglomerates and medium to coarse grained sandstones of the Sepultura Formation. The lithology of the Sepultura Formation varies greatly along strike. Near the coast, at Puerto San Carlos the base of the sequence consists of coarse conglomerates with interbedded sandstones resting unconformably on the Rosario Formation. Along the northwestern and northern side of mesa, approximately 5 km inland, the basal part of the Sepultura Formation consists of fine grained sandstones which are very similar to the underlying Rosario Formation".

The Sepultura Formation was measured in three sections. The third one is located on the northwestern slope of Mesa San Carlos, along Cajiloa Creek, and consists of

interbedded fine grained, thinly bedded, micaceous sandstones and shales, it is in this section where the gastropod fauna was collected.

One species from the Paleocene of California has been described as *Architectonica tuberculata* Weaver (1905, p. 117, pl. 12, figs. 7, 7a) but it is unlike the Baja California specimens. And from the West Coast of North America six species have been described, all from California: *A. cognata* Gabb, 1864, from Contra Costa County, *A. hornii* Gabb, 1864, from Kern County, *A. simiensis* Nelson, 1925 and *A. llajasensis*, Sutherland, 1966 from Ventura County, *A. ullreyana* Dickerson, 1916, and *A. weaveri* Dickerson, 1913, from Sutter County. The Baja California specimens are not similar to these species, all from faunas considered by their authors to be Eocene.

Five species of *Architectonica* have been described from Paleocene deposits in the Gulf Coast States, but they are larger and have dorsal and ventral sculptural features, as numerous spiral ribs and axial threads that override the spiral ribs, than in *A. bieleri* and *A. bajaensis*. Four of them are *A. alabamense* (Dall, 1892), *A. bimixta* (Aldrich, 1895), *A. periscelidum* (Dall, 1892), and *A. planiforme* (Aldrich, 1895) are from Uppermost Porters Creek Formation in Alabama. The fifth one is *A. phoenicea* Gardner, 1933 from Kincaid Formation in Texas.

The composition of this fauna compared with faunas of the same age in north and central California shows that the Mesa San Carlos area is characterized by tropical conditions.

The late Paleocene fauna from Mesa San Carlos has affinities with the coeval tropical faunas from the Gulf coast.

The molluscan material discussed in this work comes from Mesa San Carlos Purdue University localities PU-1301, 1307, 1334, 1334-8, 1334-13. (Figure 1). For more detailed information about the localities see Paredes-Mejía (1989, p. 455).

The studied material is deposited in the Museo Ma. Carmen Perrilliat M., Colección Nacional de Paleontología, Instituto de Geología, Universidad Nacional Autónoma de México. Types are included in the Type Collection and classified under the acronym IGM. The localities are registered in the locality catalogue of the Instituto de Geología, Universidad Nacional Autónoma de México. The classification herein follows that of Bouchet *et al.* (2005).

SYSTEMATIC PALEONTOLOGY

Clade Heterobranchia
Superfamily Architectonicoidea Gray, 1850
Family Architectonicidae Gray, 1850
Genus *Architectonica* Röding, 1798

Type. By subsequent designation (Gray, 1847), *Architectomica* by error. *Architectonica perspectiva* Röding (=*Trochus perspectivus* Linnaeus, 1758). Recent, tropical western Pacific Ocean.

Architectonica bieleri sp. nov.

Figures 2.1 - 2.9

Architectonica cf. *A. periscelida* (Dall, 1892). Paredes-Mejía, 1989, p. 155, pl. 1, figs. 26-31.

Diagnosis. Shell small-sized; depressed. Sculpture of three primary spiral noded ribs. Prosocline axial threads from suture to suture. Periphery with two nodulose carina.

Description. Shell small-sized, depressed, carinate. Protoconch of one and a half whorls. Teleoconch of four whorls. Suture impressed. Sculpture of three primary spiral noded ribs. One primary spiral rib close to the suture and between this and the second primary spiral rib is present a thin spiral rib and between the second and third primary spiral ribs there are three thin secondary spiral ribs. The whole surface is covered by prosocline axial threads from suture to suture. Periphery with two nodulose carina. Ventral surface covered with orthocline axial threads. Umbilicus broad, with a well marked nodose umbilical rib. Aperture oblique.

Etymology. In honor to Rüdiger Bieler for his important contributions to the knowledge of Architectonicids.

Types. Holotype IGM 4405 diameter 13.96 mm, height 6.07 mm; paratypes IGM 4406 diameter 8.0 mm, height 2.76 mm; IGM 4407 diameter 6.03 mm, height 2.24 mm.

Material examined. Three specimens.

Occurrence. Holotype IGM 4405 PU loc. 1334-8; paratypes IGM 4406, IGM 4407 PU loc. 1334-13.

Discussion. The Mesa San Carlos specimens are not like any other species in the Paleocene in North America. They are similar to *Architectonica fungina* (Conrad, 1833, p. 44) from the Middle Eocene, Cork Mountain Formation of Alabama and Mississippi, in having the radiating lines from the umbilicus to the carina, but the Mexican are larger in size.

Architectonica bajaensis sp. nov.

Figures 2.10 - 2.12

Architectonica n. sp. A. Paredes-Mejía, 1989, p. 158, pl. 2, figs. 1-3.

Diagnosis. Shell small-sized, convex. Sculpture of fine beaded spiral ribs. Periphery with two thin spiral ribs. Ventral surface with axial threads between periphery and umbilicus.

Description. Shell small-sized, convex. Protoconch not preserved. Teleoconch of five whorls. Suture canaliculated. Sculpture of three fine, widely spaced, beaded spiral ribs close to the anterior suture, a concave smooth space and smaller two fine beaded spiral ribs on the fourth and fifth whorls of teleoconch. Periphery with two thin spiral ribs. Ventral surface between periphery and umbilicus with axial threads. Umbilicus deep and wide, with about 20 strong, equally spaced axial nodes and very weak spiral threads. Aperture subquadrate.

Etymology. The new species is named for Baja California, Mexico.

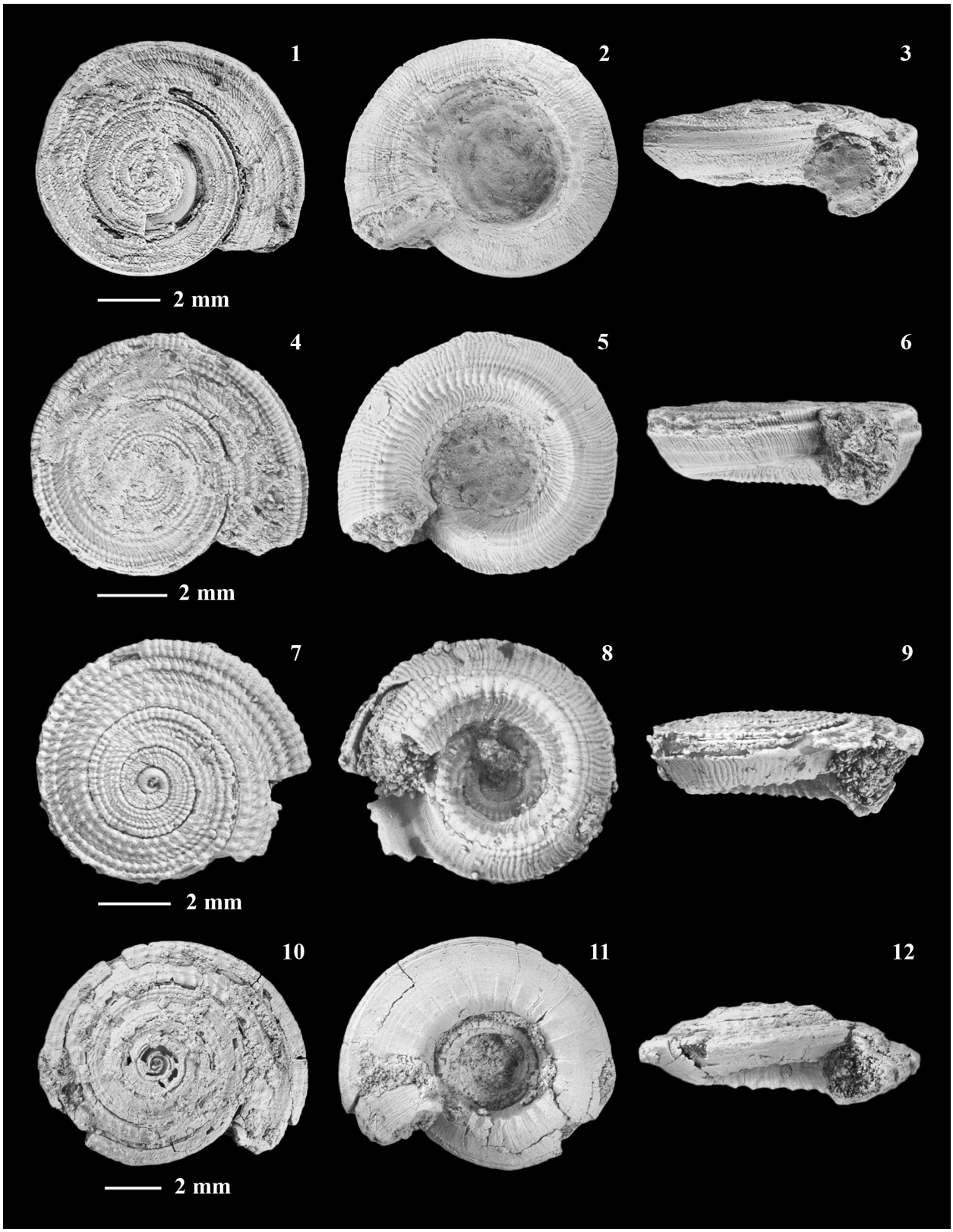

Figure 2. 1-9, *Architectonica bieleri* sp. nov. 1: dorsal view, holotype IGM 4405, locality PU 1334-8; 2: ventral view, holotype IGM 4405, locality PU 1334-8; 3: lateral view, holotype IGM 4405, locality PU 1334-8; 4: dorsal view, paratype IGM 4406, locality PU 1334-13; 5: ventral view, paratype IGM 4406, locality PU 1334-13; 6: lateral view, paratype IGM 4406, locality PU 1334-13; 7: dorsal view, paratype IGM 4407, locality PU 1334-13; 8: ventral view, paratype IGM 4407, locality PU 1334-13; 9: lateral view, paratype IGM 4407, locality PU 1334-13. 10-12: *Architectonica bajaensis* sp. nov. 10: dorsal view, holotype IGM 4408, locality PU 1301; 11: ventral view, holotype IGM 4408, locality PU 1301; 12: lateral view, holotype IGM 4408, locality PU 1301.

Type. Holotype IGM 4408, diameter 11.63 mm, height 4.68 mm.
Material examined. One specimen.
Occurrence. PU loc. 1301.
Discussion. The Mexican specimen has no similarities to any species that have been described from the Paleocene of California. It presents some similarities to *Architectonica leana* (Dall, 1892) p. 325, pl. 22, fig. 12 from the Lower Eocene, Hatchetigbee Formation, Alabama in the dorsal surface with almost the same sculpture, but differs in the ventral surface by not have the spiral rib close to the periphery. Also differs from *A. greggi* (Harris, 1897) p. 480, pl. 23, figs. 5, 5a from the Eocene of Gregg's Landing, Alabama in not having a raised spiral coarsely crenulated carina medially located.

It differs from *A. bieleri* in not having prosocline axial threads from suture to suture in the teleoconch whorls and also the periphery differs in not having a nodulose carina .

***Architectonica* sp. 1**
Figures 3.1 - 3.3

Architectonica n. sp. B. Paredes-Mejía, 1989, p. 159, pl. 2, figs. 4, 5.
Description. Shell small-sized, depressed. Protoconch of one whorl. Teleoconch of five whorls. Suture canaliculated. Sculpture of last whorl with a subsutural nodose spiral rib, a second nodose spiral rib finer than the one close to the suture and then two fine spiral ribs, the rest of the whorl without spiral ornamentation. Axial sculpture of prosocline fine threads. Periphery angulated with weak nodes. Ventral surface sculptured with fine spiral ribs overridden by fine axial threads. Umbilicus wide and deep, umbilical cord with closely spaced nodes. Umbilical wall with a raised noded keel. Aperture subquadrate.
Measurements. Specimen IGM 4409, diameter 10.16 mm, height 2.83 mm.
Material examined. One specimen.
Occurrence. PU loc. 1334.
Discussion. This specimen is similar to *Architectonica bieleri* sp. nov. in having in last whorl of teleoconch the same sculpture, but it differs in having a simple nodose spiral cord while in the new one it has two spiral nodose ribs.

Paredes-Mejía, 1989, p. 161 suggests that this specimen is similar to *A. ornata* (Lea, 1833, p. 120, pl. 4, fig. 108) from the Middle Eocene of Claiborne Group from Alabama, but this species is conic, not depressed as the Baja California specimen and has a more nodulose keel.

***Architectonica* sp. 2**
Figures 3.4 --3.6

Architectonica cf. *A. sylvaerupis* (Harris, 1899). Paredes-Mejía, 1989, p. 157, pl. 1, fig. 32, 33.
Description. Only last whorl of the teleoconch is preserved, surface smooth except for crenulated margin of two rows of fine nodes, middle of whorl concave and smooth. Ventral surface smooth except for fine axial threads.
Measurements. Specimen IGM 4410 diameter 10.42 mm, height 5.09 mm.
Material examined. One specimen.
Occurrence. PU loc 1334-13.
Discussion. *Architectonica* sp. 2 differs from *A*. sp. 1 in being larger, and not having fine spiral ribs in last whorl and periphery is not angulated.

Genus Granosolarium Sacco, 1892

Type species. By original designation, *Solarium millegranum* Lamarck, 1822. Miocene, Pliocene. Europe.

***Granosolarium* sp.**
Figures 3.7 - 3.9

Architectonica n. sp. C. Paredes-Mejía, 1989, p. 161, pl. 2, figs. 6-8.
Description. Shell small-sized, slightly convex. Protoconch not preserved. Teleoconch of four whorls. Suture canaliculated. Sculpture of six fine spiral ribs intersected by fine axial threads, two coarse noded ribs near the margin. Periphery delimited by strong spiral cord. Ventral surface of shell convex on its anterior area, changing to steeply concave as it extends upward, forming an elevated, rather thick welt near the umbilicus area and sculptured with four fine spiral threads. Umbilicus wide sculptured with fine spiral ribs, the area posterior to the raised welt flat and sculptured with two thick, well defined strong cords, crossed by fine radial cords, rounded small nodes at the intersection of the spiral and radial cords. Aperture not preserved.
Measurements. Specimen IGM 4411, diameter 3.91 mm, height 1.45 mm.
Material examined. One specimen.
Occurrence. PU loc. 1301.
Discussion. No species of *Granosolarium* have been described from the Paleocene of the Pacific Coast of North America. From Eocene deposits in the Atlantic Gulf States only five species have been described: *Architectonica* (*Granosolarium*) *ornata jacksonia* Palmer, *in* Harris and Palmer, 1946-1947, p. 270, pl. 33, figs. 2-4, 13; *Architectonica* (*Granosolarium*) *meekana subsplendida* Palmer, *in* Harris and Palmer, 1946-1947, p. 271, pl. 33, figs. 1, 5-8 both from Moodys Branch Formation in Louisiana; *Architectonica aldrichi* (Dall, 1892) p. 325, pl. 22, figs. 13, 13a from Lower Claiborne, Mississippi; *Architectonica elaborata* (Conrad, 1833) p. 344 from Claiborne, are larger and have finer dorsal and ventral sculpture features than the Mexican specimen. *Granosolarium huppertzi* var. (Harris, 1897) p. 477, pl. 21, fig. 5 from the Eocene of the United States is a juvenile specimen, is similar to it in sculpture but larger.

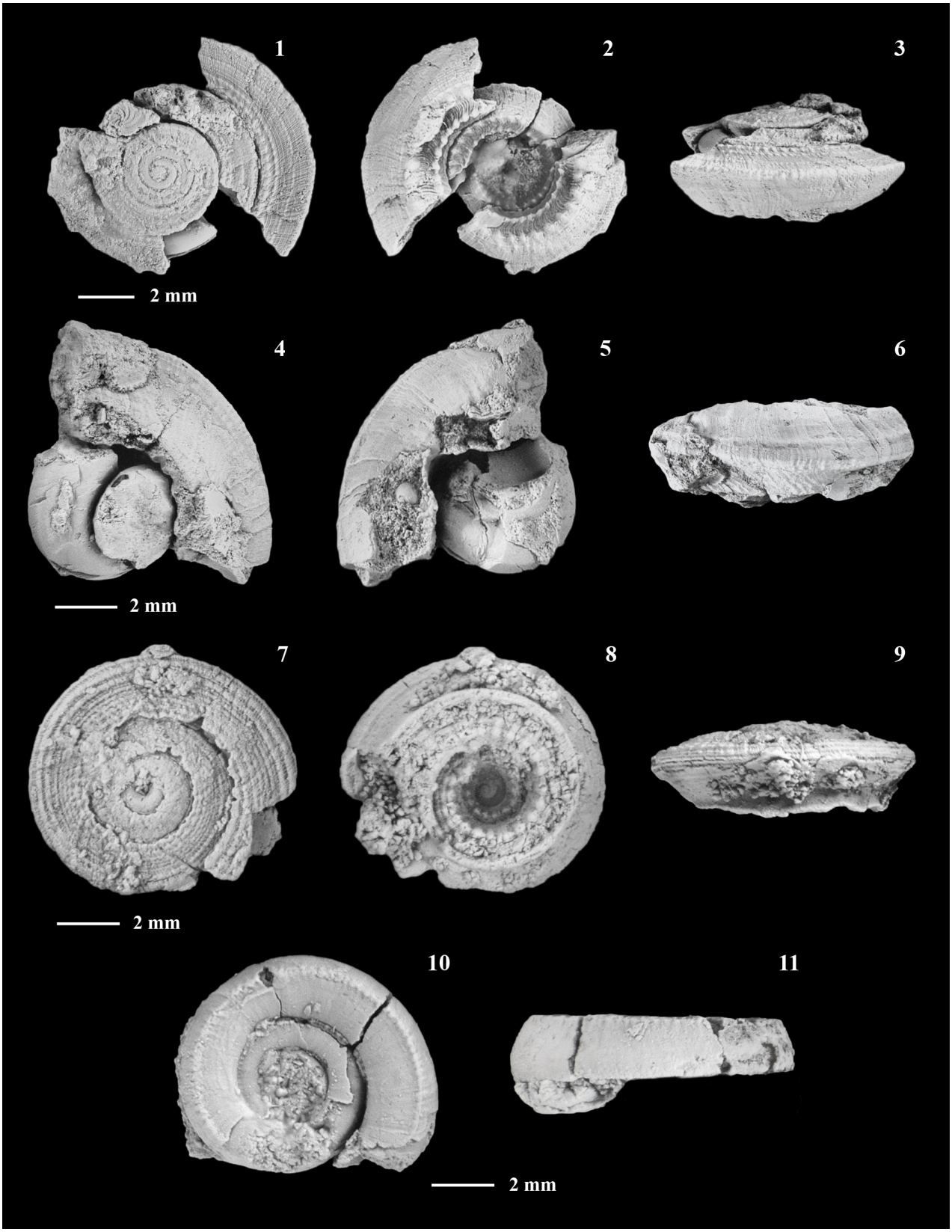

Figure 3. 1-3, *Architectonica* sp. 1. 1: dorsal view, specimen IGM 4409, locality PU 1301; 2: ventral view, specimen IGM 4409, locality PU 1301; 3: lateral view, specimen IGM 4409, locality PU 1301; 4-6: *Architectonica* sp. 2, 4: dorsal view, specimen IGM 4410, locality PU 134-8; 5: ventral view, specimen IGM 4410, locality PU 1334-8; 6: lateral view, specimen IGM 4410, locality PU 1334-8; 7-9: *Granosolarium* sp. 7: dorsal view, specimen IGM 4411, locality PU 1334-13; 8: ventral view, specimen IGM 4411, locality PU 1334-13; 9: lateral view, specimen IGM 4411, locality PU 1334-13; 10 and 11: *Pseudomalaxis* sp. 10: dorsal view, specimen IGM 4412, locality PU 1307; 11: lateral view, specimen IGM 4412, locality PU 1307.

Genus Pseudomalaxis Fischer, 1885

Type. by monotypy. *Pseudomalaxis zanclaea* Philippi (=*Bifrontia*? *zanclaea* Philippi, 1844). Piocene-Recent. Mediterranean Sea.

***Pseudomalaxis* sp.**
Figures 3.10 - 3.11

Cyclostremiscus n. sp. B. Paredes-Mejía, 1989, p. 152, pl. 1, figs. 21, 22.

Description. Shell-small sized, depressed. Protoconch not preserved, only one and a half whorls of teleoconch. Suture canaliculated bordered by a raised beaded rib. Last whorl of teleoconch carinated at the anterior margin with small nodes, surface smooth. Periphery straight. Base not preserved. Aperture subquadrate.

Measurements. Specimen IGM 4412, diameter 3.18 mm, height 0.67 mm.

Material examined. One specimen.

Occurrence. PU loc. 1307.

Discussion. This specimen is similar to *Pseudomalaxis verrilli* (Aldrich *in* Harris, 1899) p. 82, pl. 11, figs. 9, 9a from Hatchetigbee Formation, Lower Eocene Choctaw Corner, Clark County, Alabama in the anterior margin with small nodes and larger than the Mexican specimen.

DISCUSSION

The fauna is represented by three genera of the gastropod family Architectonicidae.

The composition of the fauna compared with faunas of the same age in North and Central California shows that the Mesa San Carlos area is characterized by tropical conditions, where as the other ones were under subtropical conditions.

The Mesa San Carlos gastropod fauna has some affinities with tropical faunas from the Gulf Coast of North America.

In the Paleocene of the Eastern Pacific are reported for the first time Members of *Granosolarium* and *Pseudomalaxis*.

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