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First description of scleractinian corals from the Santa Marta and Snow Hill Island (Gamma Member) formations, Upper Cretaceous, James Ross Island, Antarctica

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Abstract Antarctic corals are known from the Upper Cretaceous Santa Marta Formation (Santonian–early Campanian) and Gamma Member (late Campanian) of Snow Hill Island Formation (late Campanian–early Maastrichtian) but they have not so far been taxonomically described. We describe three corals taxa based on 29 specimens collected in 2007 and 2016 on James Ross Island (northeast of the Antarctic Peninsula). They represent the first formal record of scleractinian corals from the Santa Marta Formation, identified as Caryophylliidae indet. and Gamma Member of Snow Hill Island Formation, identified as ?*Astreopora* sp. and *Fungiacyathus deltoidophorus*. The family Caryophylliidae and the genus *Astreopora* were not restricted to the Weddellian Biogeographic Province but the species *Fungiacyathus deltoidophorus* was endemic to Antarctica during the Cretaceous. The genus *Fungiacyathus* and the family Caryophylliidae thrive in Antarctica until the present day. *Fungiacyathus* occurred in shallower environments during the late Campanian than today. No specimens related to *Astreopora* have yet to be found in Antarctica after the late Campanian. This can be explained by the capacity of *Fungiacyathus* and Caryophyllidae to endure cold waters, since they are asymbiotic corals. The symbiotic ?*Astreopora* sp., due to its sensitivity to low temperatures, became extinct in this continent as soon as the Antarctic waters began to cool, around the Campanian/Maastrichtian. The presence of ?*Astreopora* sp. in Gamma Member of Snow Hill Island Formation may represents the first occurrence of this genus in Antarctica and the oldest record of this genus in the Southern Hemisphere.

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Keywords scleractinia, taxonomy, Campanian, James Ross Sub-Basin, Antarctica

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1 Introduction

Scleractinians are solitary or colonial corals bearing a skeleton of aragonite, including all true post-Paleozoic fossil corals. These corals can be divided into two ecological groups: the symbiotic, characterized by the presence of vast numbers of unicellular symbiotic, dinoflagellates or zooxanthellae in their endodermal tissues, and the asymbiotic, which lack of zooxanthellae (Wells, 1956).

Symbiotic corals are restricted to shallow tropical waters, generally with depths less than 20 m and temperatures between 25 ℃ and 29 ℃, due to the photosynthetic needs of the zooxanthellae algae. Some recent taxa can be found in depths up to 90 m, supporting temperatures as cold as 16 ℃ (Fernandes, 2011). Even though asymbiotic corals can occur associated with coral reefs, they are not subjected to the same environmental restrictions as the symbiotic, surviving in depths up to 6000 m and temperatures ranging between 1.1 ℃ and 28 ℃. Their geographic distribution includes all the seas and oceans of normal salinity (Fernandes, 2011).

The Antarctic sedimentary rocks, from Mesozoic and Cenozoic, are quite fossiliferous (e.g., Scasso et al., 1991; Luther, 1999; Olivero, 2012a). At least 16 species of scleractinian corals have been identified in the Late Cretaceous (Lopez de Bertodano Formation) and Paleocene (Sobral Formation) strata from the Seymour and Snow Hill islands (e.g. del Valle et al., 1982; Filkorn, 1994). So far, scleractinian corals in the Santa Marta Formation (Santonian–early Campanian) and Gamma Member (late Campanian) of Snow Hill Island Formation (late Campanian–early Maastrichtian) at James Ross Island have been recorded (e.g. Scasso et al., 1991; Olivero, 2012a) but were not studied in detail. Darrel and Taylor (1993) illustrated some coral specimens from Santa Marta Formation referring them to *Deltocyathus*? *complanatus* but did not provide any further taxonomic description.

Here we provide the first taxonomic description of scleractinian corals from the Santa Marta Formation (Alpha Member) and Gamma Member of Snow Hill Island Formation, including the first record of asymbiotic *Fungiacyathus deltoidophorus* and Caryophylliidae indet., and the symbiotic symbiotic ?*Astreopora* sp.

2 Geological setting

The James Ross Sub-Basin, part of the Larsen Basin, is located in the northeast of the Antarctic Peninsula and contains a significant Meso-Cenozoic sedimentary succession (Figure 1) related to the Gondwanan break-up and subsequent development of a back-arc basin (Hathway, 2000).

The James Ross Archipelago (James Ross, Snow Hill, Humps, Seymour, Vega, Cockburn, Persson and Lockyer islands) presents the best exposure of volcano-sedimentary rocks of its homonymous sub-basin. Two thick sedimentary successions are recognized on James Ross Island: Gustav Group (Aptian–Coniacian) and Marambio Group (Santonian–Danian) (Olivero, 2012a). The Gustav Group consists of the Pedersen, Lagrelius Point, Kotick Point, Whisky Bay and Hidden Lake formations (Riding and Crame, 2002), which represent a deep marine depositional environment with submarine fan and slope deposits. This group is not very fossiliferous, being composed mainly of conglomerates and sandstones (Ineson, 1989; Medina et al., 1992; Whitham et al., 2006).

The Marambio Group is rich in fossils, consisting of siltstones, argillites and fine-grained sandstones, interpreted as being deposited in a shallow inner to outer continental shelf environment with the presence of a prograding delta (Crame et al., 1991; Pirrie et al., 1997; Olivero, 2012a). Although there are several proposed subdivisions for the Marambio Group (e.g., Pirrie et al., 1997; Olivero and Medina, 2000; Olivero, 2012a), in this contribution we follow the stratigraphy of Olivero (2012a), which divides this group into: Santa Marta Formation, Rabot Formation, Snow Hill Island Formation, Hamilton Point Member, Karlsen Cliffs Member, Sanctuary Cliff Member, Haslum Crags Sandstone, Lopéz de Bertodano Formation and Sobral Formation (Figure 2).

2.1 Santa Marta and Snow Hill Island (Gamma Member) formations

The Santa Marta Formation (Santonian–early Campanian) is composed of an intercalation of sandstones, siltstones, and argillites with volcanic tuffs and rare coquinas (Olivero, 2012a). It was originally defined to the northwest of James Ross Island and subdivided into Alpha, Beta and Gamma

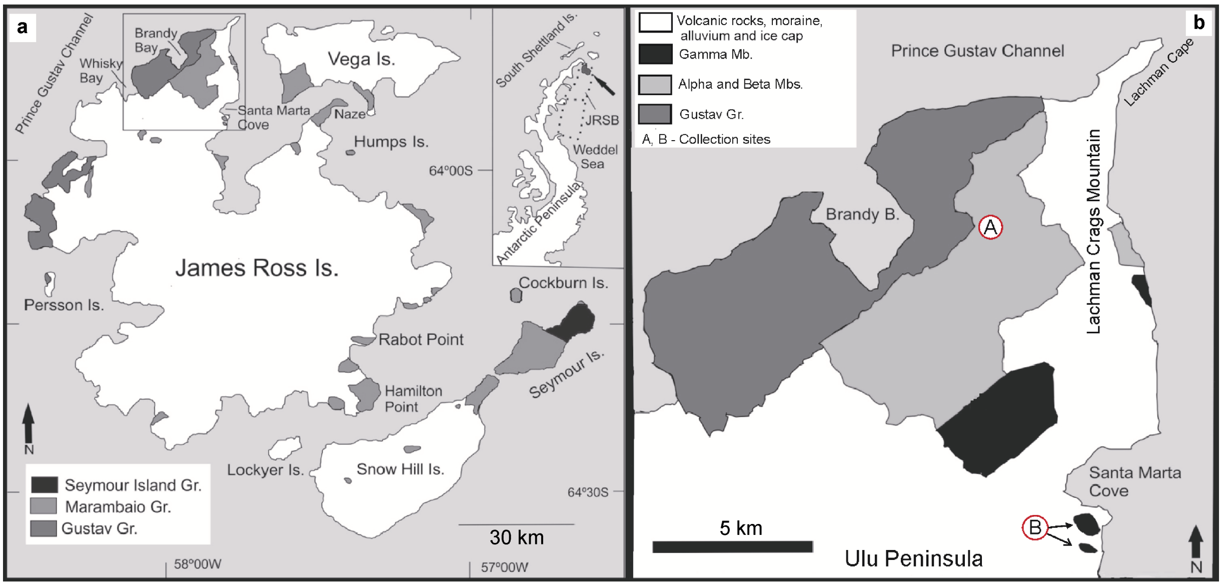

Figure 1 **a**, Sedimentary deposits of the Cretaceous/Paleogene outcrops of the James Ross Sub-Basin. In detail, the region where the PALEOANTAR I and II expeditions were concentrated. **b**, Simplified geological map of the Ulu Peninsula, showing outcrops of the Santa Marta (Alpha and Beta members) and Snow Hill Island (Gamma Member) formations, as well as the collection areas of the studied fossils. A—represents point AK 042 (Caryophylliidae indet.); B—represents points 22, 24, 26, AK 281 and AK 292 (*Fungiacyathus deltoidophorus* and ?*Astreopora* sp.) (adapted from Castro and Carvalho, 2015; Reguero et al., 2016).

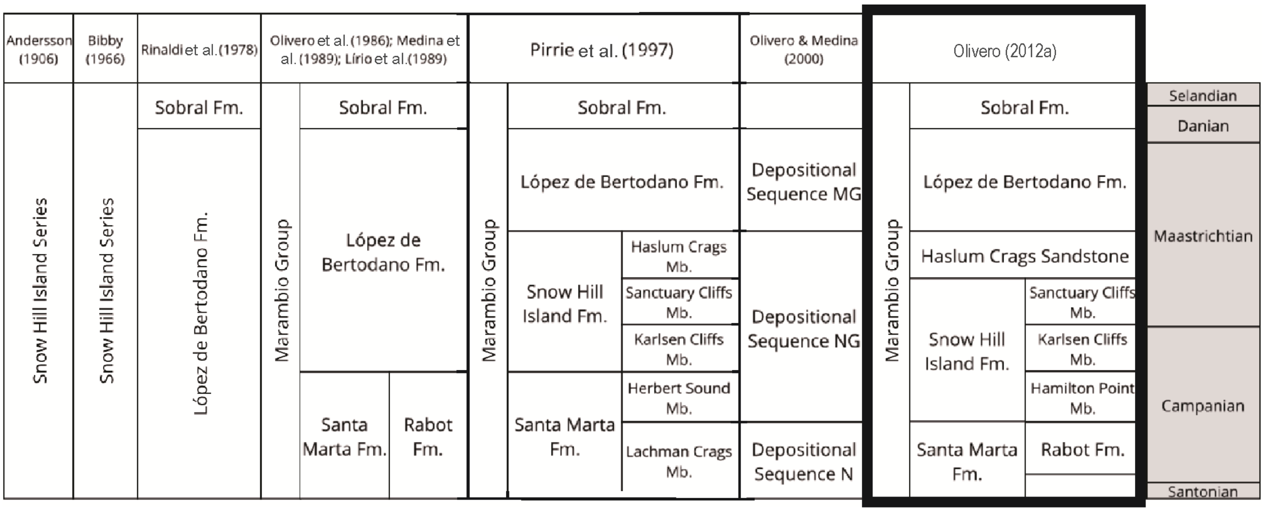

Figure 2 Several proposals of subdivisions of the Marambio Group, highlighting the proposal of Olivero (2012a). Adapted from Milanese et al. (2017).

members by Olivero et al. (1986), however due to great lithostratigraphic similarity between the Alpha and Beta members, Crame et al. (1991) considered them to be a single unit and named it Lachman Crags Member (Santonian–middle Campanian), while the Gamma Member (late Campanian) was renamed Herbert Sound Member, this member represents a basin wide shallowing event (Crame et al., 1991).

Olivero (2012a) pointed out that the Gamma Member is included into the Snow Hill Island Formation instead of the Santa Marta Formation, as originally defined. The Gamma Member crops out at Santa Marta Cove and Dreadnought Point and is dominated by sandstones beds with scarce *Neograhamites primus* ammonites, common gastropods, bivalves and coquinas (Guerra et al., 2015).

In the southeast of James Ross Island (Rabot Point and Hamilton Point), there are two another stratigraphic unit: Rabot Formation (Lirio et al., 1989) and Hamilton Point Member (Pirrie et al., 1997). The Rabot Formation is laterally correlated to the Alpha and Beta members and the lower portion of the Gamma Member. The Hamilton Point Member is the lateral equivalent of the intermediate to upper portion of the Gamma Member (Pirrie et al., 1997).

The Campanian fauna from Santa Marta Formation and Gamma Member are not yet completely known (Crame, 2019), but it is often referred as part of the Weddellian Biogeographic Province. This province included the seas of New Zealand, South America (Patagonia) and Antarctica from the Late Cretaceous to late Eocene (e.g., Zinsmeister, 1979, 1982; Olivero and Medina, 2000; Novas et al., 2015). More recently, Brazilian researchers have made significant progress in the understanding of the vertebrate paleontology (e.g., Kellner et al., 2011, 2018; Sayão et al., 2017), nannofossils (Guerra et al., 2015) and dinoflagellate cyst assemblage (e.g., Castro and Carvalho, 2015) of this stratigraphic unit.

2.2 Outcrop descriptions

The collection localities for this paper come from two different units. At Point AK 042, the lithology consists of fine to very fine sandstones, associated with turbiditic levels and rare conglomeratic levels deposited in a shelf environment below the level of storm waves belonging to the upper portion of the Alpha Member of Santa Marta Formation, N sequence *sensu* Olivero (2012a).

The lithology of Point AK 042 is the same as the Lithofacies B *sensu* Scasso et al. (1991). This lithofacies was deposited in the distal part of a submarine fan developed on the mid-outer shelf (Pirrie, 1989; Scasso et al., 1991; Olivero, 2012a). According to Scasso et al. (1991) the Lithofacies B is composed of the "*Cerithium*"–*Rotularia* and *Eryphyla*–"*Aporrhais*" biofacies that indicate autochthonous to parautochthonous associations in a soft substrate and possibly in the photic zone. Due to the stratigraphic position of the Point AK 042 and its lithological description, it is positioned in the "*Cerithium*"–*Rotularia* biofacies, facies Group II *sensu* Scasso et al. (1991). The ammonites' assemblages that occur in this lithofacies indicate an early Campanian age (Olivero, 1992, 2012a).

Points 22, 24, 26 (Santa Marta Cove), AK 281 and AK 292 are located close together, and are represented by fine to medium bioturbed sandstones, with cross-stratification, occurrence of fossiliferous concretions and conglomeratic levels, deposited in a shelf environment above the level of storm waves, belonging to the lower portion of Gamma Member of Snow Hill Island Formation, NG sequence *sensu* Olivero (2012a).

The lithology of points 22, 24, 26, AK 281 and AK 292 is similar to Lithofacies E *sensu* Scasso et al. (1991) which presents autochthonous to parautochthonous assemblages (*Taioma* and *Cucullaea*–"*Neilo*" biofacies *sensu* Scasso et al., 1991). Due to the relative stratigraphic position of these points, they are probably positioned in *Cucullaea*–*Neilo* biofacies, facies Group VI *sensu* Scasso et al. (1991). The association of ammonites in these lithofacies suggests a late Campanian age (Olivero, 2012a).

The occurrence of rock *in situ* was sparse, at all the outcrops cited in this paper. Because of it we did not have security for the elaboration of a sedimentologic profile, but we were able to position them in the Santa Marta (Alpha Member) and Snow Hill Island (Gamma Member) formations. For a better visualization of the geological context, the specimens were tentatively plotted, based on stratigraphic position and lithology, in a general sedimentologic profile of the Santa Marta and Snow Hill Island (Gamma Member) formations (Olivero, 2012b) (Figure 3).

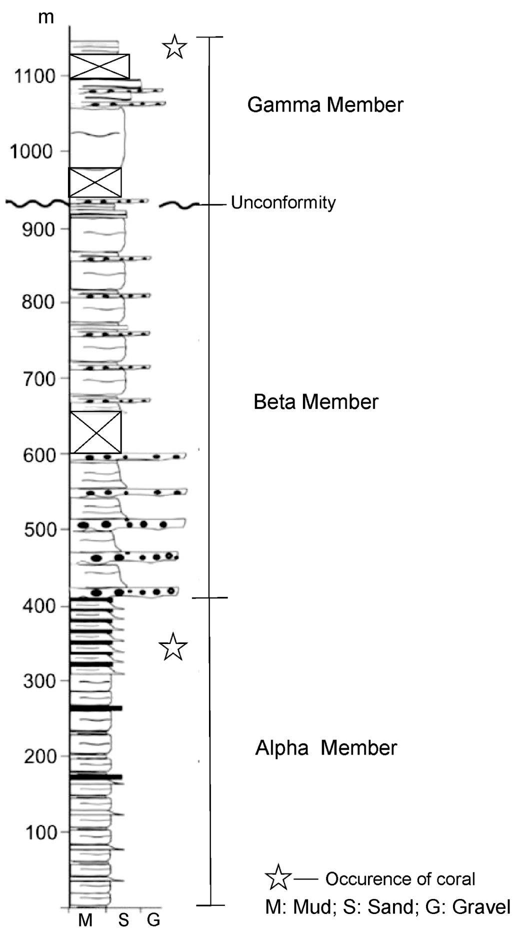

Figure 3 General sedimentologic profile of the Santa Marta (Alpha and Beta members) and Snow Hill Island (Gamma Member) formations. Adapted from Olivero (2012b).

3 Materials and methods

The analyzed fossils are deposited in the Paleoinvertebrates collection, housed at Departamento de Geologia e Paleontologia, Museu Nacional, Universidade Federal do Rio de Janeiro (MN-I) and at the scientific collection of Phanerozoic fossils (CFF) of the Universidade Federal do Estado do Rio de Janeiro (UNIRIO). The specimens housed at the Paleoinvertebrates collection that were inside the building of Museu Nacional suffered a tragical fire on September 2, 2018 (e.g., Kellner, 2019; Scheffler, 2019). All specimens of ?*Astreopora* sp. and Caryophylliidae indet. were recovered, but unfortunately no specimen of *Fugiacyathus deltoidophorus* was rescued so far.

The 29 studied specimens were collected in the austral summers of 2007 and 2016, during the expeditions of the PALEONTAR Project (PROANTAR—Programa Antártico Brasileiro), organized by the Museu Nacional/UFRJ and a team of interinstitutional Brazilian researchers to the James Ross Island. The taxonomic identification was based on the "Treatise on Invertebrate Paleontology" (Wells, 1956), the "Fossil Scleractinian Coral from James Ross Basin, Antarctica" (Filkorn, 1994) and the "An illustrated key to the genera and subgenera of the recent azooxanthellate Scleractinia (Cnidaria, Anthozoa), with an attached glossary" (Cairns and Kitahara, 2012). We used for measurements a digital caliper (0.02 mm accuracy).

4 Systematic paleontology

Order Scleractinia (Bourne, 1900)
Suborder Caryophylliina (Vaughan and Wells, 1943)
Superfamily Caryophylliicae (Gray, 1847)
Family Caryophylliidae (Gray, 1847)
Caryophylliidae indet. (Figures 4a, 4b)

Material: Two specimens (MN 8656-Ia and MN 8656-Ib).

Provenance: Upper portion of Alpha Member (Santa Marta Formation), early Campanian, unnamed locality, field number AK 042 (63º49′40.4″S, 57º53′20.5″W).

Description: Solitary corals with length varying from 13 to 15 mm, medium *corallum* (between 7.0 and 9.0 mm) encircled by thick layers of tectura, about 35 septa preserved, laminar *septum* without dentation. The shape of the calice is from turbid to subcylindrical and the wall is septothecal.

Remarks: The columella, is poorly preserved which makes it difficult to accurately differentiate the MN 8656-Ia and MN 8656-Ib specimens from the other genera of solitary corals that belongs to the family Caryophylliidae, such as *Paracyathus*, *Cyathoceras*, *Oxysmilia* and *Lophosmilia*, reason why we decided to identify the specimens analyzed here just to family level. The general morphology, mainly the external shape, of the specimens of Caryophylliidae here described, is very similar to *Caryophyllia* sp. from Seymour Island, Eocene from La Meseta Formation (Stolarski, 1996).

Occurrence for the family Caryophylliidae: It appeared in the Permian and has had a cosmopolitan distribution ever since (e.g. Howse, 1848; Forbes, 1845; Wells, 1933; Stephenson, 1941; Sohl and Koch, 1984; Eliasova, 1991; Stolarski, 1996; Leloux, 1999; Lösser and Liao, 2001; Helm et al., 2003; Turnsek et al., 2003; Jell et al., 2011).

Observation: The family has a cosmopolitan distribution during the Cenozoic. It is a living family (e.g., Wells, 1956; Cairns et al., 2005).

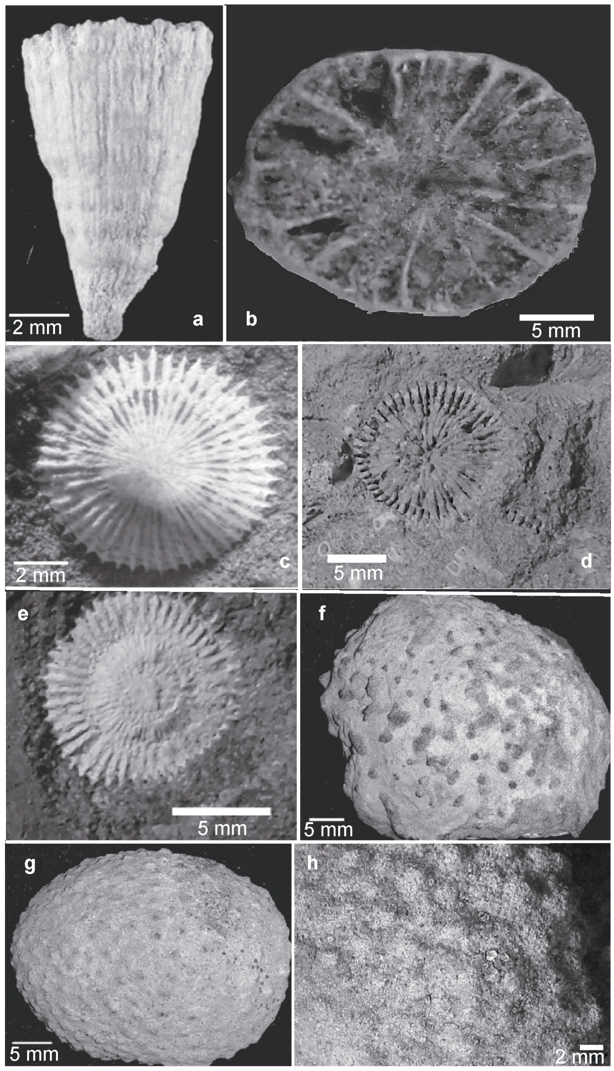

Figure 4 Scleractinian corals from Santa Marta (Alpha Member) and Snow Hill Island (Gamma Member) formations. Caryophylliidae indet. (**a–b**): **a**, lateral view (MN 8656-Ia); **b**, calicular view (MN 8656-Ia). *Fungiacyathus deltoidophorus* (**c–e**): **c**, base view (MN 9978-Ia); **d**, calicular view (CFF 0308b); **e**, base view (CFF 308a). ?*Astreopora* sp. (**f–h**): **f**, general view (MN 9984-I); **g**, general view (MN 9985-I); **h**, general view (corallite) (MN 9985-I).

Suborder Fungiina (Verrill, 1865)
Superfamily Fungiicae (Dana, 1846)
Family Fungiidae (Dana, 1846)
Genus *Fungiacyathus* (Sars, 1872)
Subgenus *Fungiacyathus* (Moseley, 1881)
Type species: *Fungiacyathus fragilis* (Sars, 1872)
Fungiacyathus deltoidophorus (Felix, 1909)
(Figure 4c, 4d, 4e)

Material: 19 specimens (MN 9978-Ia, MN 9978-Ib, MN 10022-I, MN 10202-I, MN 10203-I, MN 10207-I, MN 10229-I, MN 10233-I, MN 10236-I, MN 10250-I, MN 10251-I, MN 10269-I, MN 10270-I, MN 10292-I, MN

10443-I, CFF 308 a, b, c, CFF 210). All the Museu Nacional specimens not recovered so far and we have only their photos.

Provenance: Lower portion of Gamma Member (Snow Hill Island Formation), late Campanian, unnamed locality, field number point 24 (63º56′46.6″S, 57º51′13.5″W).

Description: Solitary corals, copulate, free, with *corallum* ranging from 7 to 14 mm in diameter, discoidal; base of corallum flat to slightly convex, costate; presence of *synapticulae*; laminar septa thin; costae correspond to septa equal in size and gradually increase in height and width toward calicular margin; small, elliptical, trabecular and feebly developed columella. Corallum with four cycles of septa (48 septa), all unperforated.

Remarks: Differs from *Deltocyathus*, a Caryophyllina coral superficially close to *Fungiacyathus*, because the columella is papillose in *Deltocyathus* but trabecular in *Fungiacyathus*. Felix (1909), originally, based on the corallites' diameters (d) and septa number (n) distinguished three different species: *Fungiacyathus antarcticus* (Felix, 1909) (d = up to 26 mm and n = 48 to 96), *Fungiacyathus deltoidophorus* (Felix, 1909) (d = 4 to 14 mm and n = 48) and *Fungiacyathus larseni* (Felix, 1909) (d = up to 14 mm and n = 48). Filkorn (1994) noticed the great overlap in the dimensions of the corallites of *F. deltoidophorus* and *F. larseni*. In addition to the dimensions of the skeletal elements, Felix (1909) also included features as the development of the central region of the columella (flat or convex), the length of the costae and the size difference of the fine granulations on the aboral region. However, Baron-Szabo (2008) interpreted all these characteristics as environmentally induced, and, therefore, intraspecific variations. In addition, *F. antarcticus* seems to correspond to the later ontogenetic stage of *F. larseni* and *F. deltoidophorus*. For this reason, in a similar hypothesis as the one proposed by Baron-Szabo (2008), these three species are here considered synonymous.

Occurrence of *Fungiacyathus deltoidophorus*: Late Campanian–Maastrichtian, Antarctica (Filkorn, 1994); ?Paleocene, Egypt (Baron-Szabo, 2008) and ?Eocene, Barbados (Baron-Szabo, 2008).

Suborder Astrocoeniina (Vaughan and Wells, 1943)

Family Acroporidae (Verrill, 1902)

Genus *Astreopora* (Blainville, 1830)

Type species: *Astrea myriophtalma* (Lamarck, 1801); subsequent designation (Milner-Edwards and Haime, 1850)

?*Astreopora* sp. (Figure 4f, 4g, 4h)

Material: Eight specimens (MN 9984-I, MN 9985-I, MN 10005-I, MN 10006-I, CFF 189, CFF 188, CFF 187, CFF 186).

Provenance: Lower portion of Gamma Member (Snow Hill Island Formation), late Campanian, field number point 22 (63º56′15.4″S; 57º50′48.1″W); Santa Marta Cove, field number point 26 (63º56′44.6″S; 57º51′12.2″W); unnamed locality A, field number AK 292 (63º56′15.4″S; 57º50′48.1″W) and unnamed locality B, field number AK 281 (63º56′49.4″S; 57º49′42.5″W).

Description: Colonial corals with a spinose surface, corallites embedded in a reticular coenosteum, massive, plocoid, extratentacular budding, globular corallite with small diameter (maximum 1.0 mm), wall of solid corallites, poorly developed thin septa, dissepiments tabulate, no (?) columella nor axial corallites.

Remarks: The specimens analyzed here has a morphology very similar to the genus *Astreopora*, however due to the poor preservation of them, we decide to leave them in open nomenclature. ?*Astreopora* sp. differs of *Acropora* by not having axial of leading corallite. ?*Astreopora* sp. differs of *Dendracis* by having massive shape. ?*Astreopora* sp. differs of *Cyphastrea* by having poorly developed septa and not developing septocostae. The doubtful Chilean record of the *Astreopora* not have extratentacular budding, which is typical of family Acroporidae (Prinz, 1991). Therefore, the Chilean specimens are possibly not really *Astreopora*. ?*Astreopora* sp. differs from the Paleocene–Oligocene *Astreopora auvertiaca* (Michelin, 1844), because the corallites are sparser among themselves (Baron-Szabo, 2006). ?*Astreopora* sp. differs from the Senonian–Eocene *Astreopora hexaphylla* (Felix, 1906) because the former has a massive shape, while the second has ramose or encrusting shape (Baron-Szabo, 2006). ?*Astreopora* sp. is very similar to Maastrichtian-Eocene *Astreopora esperanzae* (Frost and Langenheim, 1974) but differs in having less developed septa and smaller corallite (maximum 1 mm in ?*Astreopora* sp., maximum 1.8 mm in *A. esperanzae*) (Baron-Szabo, 2006).

Occurrence for the genus *Astreopora*: ?Hauterivian, Chile (Prinz, 1991); ?Albian, United States of America (Wells, 1932); Senonian, Ukraine (Felix, 1906) and Maastrichtian, Jamaica (Baron-Szabo, 2006).

Observation: The genus has a cosmopolitan distribution in both Pacific and Indian oceans during the Cenozoic. It is a living genus (e.g. Lamberts, 1982).

5 Final considerations

The presence of scleractinian corals in the Santa Marta and Snow Hill Island (Gamma Member) formations indicate, at least for coral occurrence levels, that the salinity of the waters was normal and the sedimentation rates were low in the region during few moments of the Campanian, since this group would hardly survive in conditions other than those mentioned (Wells, 1956; Fernandes, 2011).

This becomes clear when we observe that corals occur in the Facies Group II and VI *sensu* Scasso et al. (1991). Facies Group II represents a volcaniclastic submarine fan environment with some direct pyroclastic input. Presents extensive evidence of sedimentation by gravity flow processes. The relatively fine-grained turbidites of Facies Group II represent the distal parts of a submarine fan, alternating periods of relatively low sedimentation (Scasso et al., 1991). Scasso et al. (1991) argued that these submarine fans were settled in shallower sea, developed on the shelf, and probably in photic zone; a similar environment is proposed by Pirrie (1989) (Facies Association 1) and Olivero (2012a) (lower portion of Ammonite Assemblage 3). For this reason, the fossils found in this association, despite being in submarine fans, and being shallower waters inhabitants, have no significant transport, as demonstrated by Scasso et al. (1991). The delicate corallites without abrasion or fragmentation of Caryophylliidae indet. described here also corroborates this stament.

The association of Facies Group VI *sensu* Scasso et al. (1991), was deposited in an inner shelf environment, under normal salinity and oxygenation conditions. The similar environment is proposed by Pirrie (1989, Facies Association 2) and Olivero (2012a, Assemblage 8-1). The Ichnofossils Assemblage IV *sensu* Scasso et al. (1991) is characterized by a deposition between the base level of the fair-weather waves until the base level of the storm waves. The fossils of Facies Group VI are basically parautochthonous, with little transport, which is evidenced by the low fragmentation, which can also be seen in corals. Therefore, *Fungiacyathus deltoidophorus* and ?*Astreopora* sp. lived in this inner shelf environment.

The data above demonstrate that, as previously discussed, the coral specimens here analyzed corresponds to an autochthonous to parautochthonous assemblages. The specimens of Caryophylliidae indet. were collected in a mid-outer shelf environment, below the level of storm waves, while the specimens of *Fungiacyathus deltoidophorus* and ?*Astreopora* sp. were collected in an inner shelf environment, above the level of storm waves.

The genus *Fungiacyathus* and the family Caryophylliidae indet. thrive in Antarctica until the present day, but in deep waters (Cairns, 1990). Therefore, the genus *Fungiacyathus* occurred in shallower environments during the late Campanian period than today, as seen previously. Currently, this genus occurs in deeper zones in different parts of the world, between 99 and 6.328 m deep, the deepest for any known scleractinian coral (Cairns, 1990).

The genus *Astreopora* was not restricted to the Weddellian Biogeographic Province, occurring in other parts of the world during the Late Cretaceous. *Fungiacyathus deltoidophorus* was endemic to Antarctica during the Late Cretaceous, ranging between Campanian to Maastrichtian ages. The oldest occurrences of *Fungiacyathus* are known from Antarctica (Snow Hill Island and Lopez de Bertodano formations), so it is possible that this genus appeared for the first time in this continent and later spread to lower latitudes (Yabe and Eguchi, 1942; Keller, 1976; Filkorn, 1994; Jell et al., 2011).

No specimens related to *Astreopora* have yet to be found in Antarctica after the late Campanian. This can be explained by the ability of *Fungiacyathus* and Caryophylliidae to endure colder temperatures, since they are asymbiotic corals. The symbiotic ?*Astreopora* sp., due to its sensitivity to low temperatures, became extinct in this continent as soon as the Antarctic waters began to cool, between the late Campanian and the early Maastrichtian (Pirrie and Marshall, 1990; Crame and Luther, 1997; Dingle and Lavelle, 1998; Francis and Poole, 2002; Olivero, 2012a). Currently, all living corals in Antarctica are asymbiotic. The low temperatures and low light levels, characteristic of deep waters, are very unfavorable to sustain photosynthetic algae (Cairns, 1990; Waller and Feehan, 2013).

Finally, the presence of ?*Astreopora* sp. in the base of Snow Hill Island Formation (Gamma Member) may represents the first occurrence of this genus in Antarctica and the oldest record of this genus in the Southern Hemisphere.

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