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Yucatania clavus, new genus and species of the family Thrombidae (Porifera: Demospongiae: Astrophorida) from the continental shelf off Yucatan, Mexico

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Abstract.—*Yucatania clavus* a new genus and new species for the family Thrombidae is reported from the continental shelf off the Yucatan Peninsula, Mexico. It is the second genus of the family, which is characterized by the presence of a new skeletal character, based on reduced triaenes, which are here termed ''demotriaenes,'' and constituting the main megasclere spicule. These are arranged in a radial palisade pattern at the periphery with a confused architecture in the choanosome. In addition, *Yucatania* has the typical skeletal megascleres of the family, i.e., the small acanthotriaene, in addition to the amphiaster type. These characteristics are established to include the type species: *Y. clavus*. *Thrombus*, the sole genus of the family up to now, is distinct from *Yucatania* by possessing a single spicule type, i.e., the small acanthotriaenes. These are arranged with the cladomes tangential to the surface, without reaching a radial or a palisade structure, and only two of the five members of it bear the amphiaster type. A redescription of the family Thrombidae is here included.

Up to now, Thrombidae has been known from a single genus, *Thrombus* Sollas, 1886, with five described species *T. abyssi* (Carter, 1873), *T. kittonii* (Carter, 1874), *T. challengeri* Sollas, 1886, *T. ornatus* Sollas, 1888, and *T. jancai* Lehnert, 1998. The relationship with other species of the Astrophorida is more than plausible due to the presence of acanthotriaene megascleres, but this hypothesis has to await further findings before the phylogenetic position of thrombids can be settled with confidence.

The new genus described herein is the second genus of the family. The presence of a different spicule type in the new species described herein, called ''demotriaene,'' in addition to the typical spicule of the family, and the amphiaster type occurring in *Thrombus abyssi* and *T. jancai*, as well as a different skeletal arrangement, justifies the recognition of a new genus and species. An emended description of the family Thrombidae is presented to update the diagnostic characters of the group.

Materials and Methods

Two samples of this new taxon come from several surveys performed from intertidal to 312 m depth, near the collecting point, the north coast off Yucatan, the Campeche Bank, and the coast line off Quintana Roo. The new genus described herein was dredged by the research vessel *Justo Sierra* on the continental shelf off Yucatan, north of the Yucatan Peninsula, Mexico. Light microscopic (LM) images were obtained on a Zeiss compound microscope fitted with a digital Canon camera of 7.1

megapixels. Scanning electron microscopic (SEM) images were obtained with a JEOL JSM-6063LV microscope with an integrated digital camara. The type material is deposited in the Colección Nacional del Phylum Porifera Gerardo Green (CNPGG), at the Instituto de Ciencias del Mar y Limnología, Universidad Nacional Autónoma de México, México, as well as in the National Museum of Natural History, Smithsonian Institution, Washington, D. C. (USNM).

The Yucatan shelf extends seaward for over 260 km of a limestone platform, mainly of biogenic mollusk mat, with a border depth of 200 m. The powerful Yucatan Current (5 knots in average) runs close to the shore, coming through the Yucatan Channel (Merino 1997). A warm humid climate prevails with a maximum mean temperatures of 32.5°C from August to September and a minimum temperature of 13°C in January. Environmental factors at the two collection sites are temperature 20.5–21°C, salinity 36.7–36.8‰, and oxygen 3.7–3.85 ml/l.

Systematics

Family Thrombidae Sollas, 1888

Diagnosis (emended).—Astrophorida with short shafted triaenes usually spined (acanthotriaenes) as the typical spicule type of the family. Cladomes are of normal, dicho and/or trichotriaene shape. One species possesses reduced triaenes, characterized by the absence of clads, a larger rhabdome and a slight or strong spination, here termed "demotriaenes." If present, microscleres are amphiasters. Skeletal arrangement is radial at the periphery, with rhabdomes directed inwards, cladomes are tangential to the surface. The same skeletal components show a confused architecture in the choanosome. Aquiferous system diplodal.

Yucatania, new genus

Type species.—*Yucatania clavus*, by original designation.

Diagnosis.—Irregular, massive Thrombidae. With "demotriaenes" (reduced triaenes) as main megasclere type, small acanthotriaenes, usually trifurcated but some with simple clads, accompanied by amphiasters. Ectosomal architecture with demotriaenes radially arranged at periphery intermingled with small acanthotriaenes. Choanosomal architecture disorganized.

Etymology.—The name *Yucatania* refers to the sampling locality of the type species, north off the Yucatan Peninsula, Mexico.

Remarks on the genus.—*Yucatania* belongs to the family Thrombidae due to its short shafted and acanthose triaenes. It is different from *Thrombus* Sollas, 1886, the sole genus of the family up to now, basically due to the presence of "demotrieanes," which are the main skeletal component in *Yucatania* and are here reported for the first time. This character, together with the radial skeletal arrangement in the periphery, accounts for the main differences between the two genera, and for which no clear relationship with other poriferan taxa, except with *Thrombus*, is yet known.

The presence of "demotriaenes" in the family Thrombidae as true megascleres (184–407 μm long) strengthens their assignment to the order Astrophorida, even though the demotriaenes are not as large as the long shafted triaenes typical of so many Astrophorids. Small sized triaenes are not exclusive to the Thrombidae. Other taxa in the Astrophorida, such as Pachastrellidae (*Characella aspera* Sollas, 1886 rhabds: 200–400 μm; *Acanthotriaene crypta* Vacelet et al., 1976, 155–500 μm) have small size triaenes. Other small triaenes, different from those of Pachastrellidae, are found in "Lithistids" (Corallistidae, Neopeltidae). Nevertheless, they are of a distinct nature, and the

complementary spiculation proper of each taxon is very different from the complement of Thrombidae.

Demotriaenes are poliaxon spicules clearly seen by the axial filament, which radiates to a very short extent from the base of the cladome to the reduced clads (Fig. 1A–D). This makes demotriaenes appear like tuberose monoaxon spicules. Otherwise, few of them show one of the actines enlarged almost to a normal clad (Figs. 1C, 2A–D), which demonstrates the reduced character of the demotriaene clads. This spicule type, here compared, reveals some affinities with other pseudoastrose spicules like the tuberose tylostyles proper of crambeids such as *Discorhabdella* and *Crambe* and the acanthoplagiotriaenes from raspailiids such as *Cyamon* and *Trikentrion*. Young tylostyles of *Crambe* show the poliaxial nature of this apparent monaxonid spicule precisely on the short actines of the tyle, bearing an orifice at the end of each spine, which demonstrates the existence of an axial filament and thus poliaxones (Uriz et al. 2003). Demotriaenes reveal a poliaxial origin also, but neither short actines or tuberose projections examined in several preparations of *Yucatania* contain an orifice corresponding to an axial filament (Fig. 4F–L). Otherwise, the axial filament, either on a spiny or a smooth demotriaene, radiates toward each reduced clad (Figs. 1A–D, 2A, D). The presence of homologous acanthose pseudoastrose spicules or plagiotriaenes in both Poecilosclerida and Astrophorida can be interpreted as a common morphological character retained from a common ancestor, but this feature represents a sole character state. The differences in their respective skeletal arrangement (axially compressed and plumoreticulate versus simple radial skeletons) are not recognized for each family level. The spines presented in demotriaenes are of the same shape as those presented in the typical small acanthotriaenes of Thrombidae, which is the particular trait of this group. This relationship is contentious, and thus, the family Thrombiidae still remains in a pendent phylogentic analysis until further findings are available.

Yucatania clavus, new species
(Figs. 1–4; Table 1)

Material examined.—Holotype CNPGG-0750, Yucatan 23°32′N, 88°34′W, 20 Nov 1985, 61 m depth, rocky substrate. Schyzotype (USNM 2040014), Yucatan 23°33′N, 88°07′W, 19. X.1985, 75 m. Paratype CNPGG-0751, Yucatan 23°33′N, 88°07′W, 19 Nov 1985, 75 m depth, rocky substrate.

Type locality.—Yucatan, Mexico.

Description.—Massive sponge 19 cm long, 15 cm wide, 9 cm thick, growing in conjunction with a vermetid gastropod (Fig. 3A–C). Surface microhispid, rough at touch, oscules numerous and scattered, rounded, some oval 1–4.5 mm in diame-

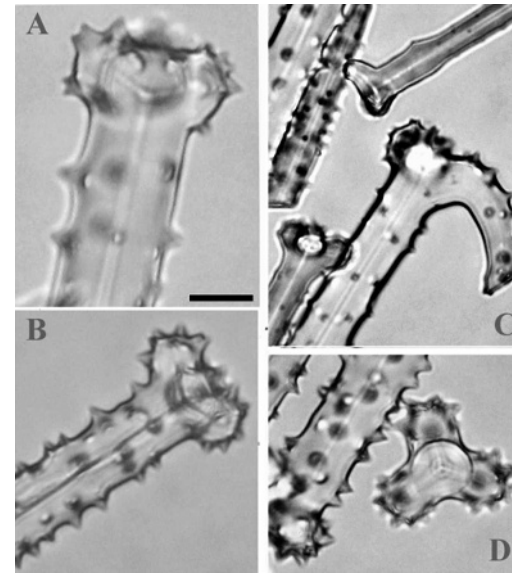

Fig. 1. LM photographs of demotriaene spicules from *Yucatania clavus*. A–D, Focusing axial canals (axial filament) which radiate for short extent toward reduced actines. A, B, Acanthodemotriaene; C, Demotriaene (upper side); D, Transverse section of acanthodemotriaene showing axial filament trifurcated. Scale bar = 15 μm for A–D.

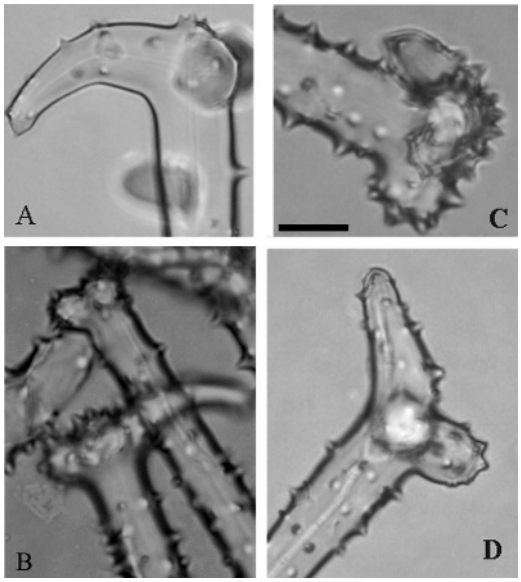

Fig. 2. A–D, LM photographs of enlarged actines in acantho- and smooth demotriaenes of *Yucatania clavus*. Axial filament focused in enlarged actine in A and at base of cladome in D. Scale bar = 15 μm for A–D.

ter, slightly projected from surface 1–3 mm, consistency firm, slightly compressible. Brownish yellow color in spirit. No discernible cortex, but spicular density higher in ectosome than in choanosome (Fig. 3D).

Spicules.—(Table 1). Acantho-demotriaenes as the main megascleres (Figs. 3E, F, 4A–C, F, G), resemble tuberose acanthostyles due to vestigial or reduction of clads as constant character. Occasionally, one tuberose clad enlarged as normal clad (Figs. 1C, 2A–D), ends blunt or spined, 184–407 × 10.5–26 μm; demotriaenes similar to first one but smoother, slightly spined, straight or sinuous (Figs. 1C, 4D, E, H–L), and slender, 190–405 × 5–11 μm, some spiny intermediates present. Small acanthotriaenes I, usually trichotriaenes (Figs. 3E, F, 4N–Q), rarely plagiotriaenes (Fig. 4M): rhabds 32.5–78 × 5.7–11 μm, clads 20.8–28.6 μm; small acanthotriaenes II, usually trichotriaenes (Figs. 1F, 4P, R, S), smoother or slightly spined, very rare in

Table 1.—Spicule dimensions of *Yucatania clavus*. Measurements in μm are ranges of 30 spicules, with means in parentheses.

	Length	Thickness
Holotype CNPGG-0735		
Acantho-demotriaene	184–407 (321)	11–26 (16)
Smooth-demotriaene	190–405 (306)	5–11 (7.5)
Acantho-trichotriaene:		
Rhabd	33.8–78 (57.5)	6.5–11 (8.9)
Clads	20.8–28 (24.3)	
Smooth trichotriaene:		
Rhabdome	40–62.4 (52)	3.6–5.5 (4.6)
Clads	15.6–25.7 (21)	
Amphiaster	5–7 (6)	
Paratype CNPGG-073		
Acantho-demotriaene	200–405 (312.8)	10.5–20.5 (15.5)
Smooth-demotriaene	200–380 (294)	5–7.8 (6)
Acantho-trichotriaene:		
Rhabds	32.5–74.6 (55.4)	5.7–10.4 (7.8)
Clads	23–28.6 (25.4)	
Smooth trichotriaene:		
Rhabdome	39–70 (51.5)	4–6.7 (5)
Clads	15.5–26 (20)	
Amphiaster	5–7 (6)	

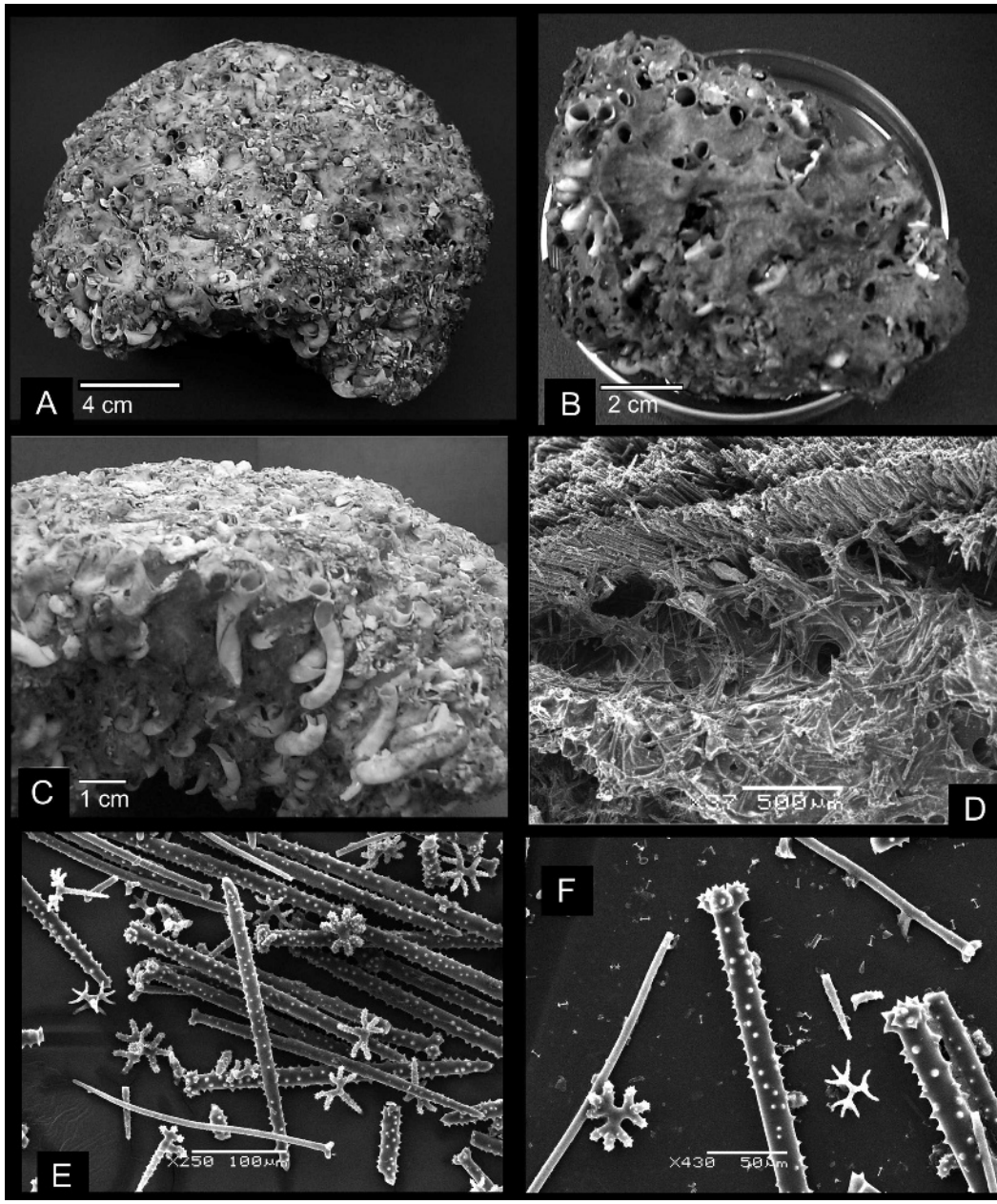

Fig. 3. *Yucatania clavus*. A, Holotype specimen in dried state; B, Paratype specimen in spirit; C, Side view of holotype showing proportion of vermetids within sponge; D, SEM micrograph of perpendicular section, note demotriaenes in palisade toward surface (top) and choanosomal confused arrangement; E, F, General view of spiculation, in F see tiny amphiasters.

plagiotriaene shape: rhabds 39–70 × 3.6–6.7 μm, clads 15.5–26 μm. These could be developmental stages. Amphiasters (Figs. 3F, 4T–Z): 5–7 μm long with some developmental stages observed.

Skeleton.—Ectosome radially arranged by acantho-demotriaenes in dense felt palisade, spicules projecting out of surface 110–280 μm, rhabds directed toward choanosome (Fig. 3D). Small acantho-

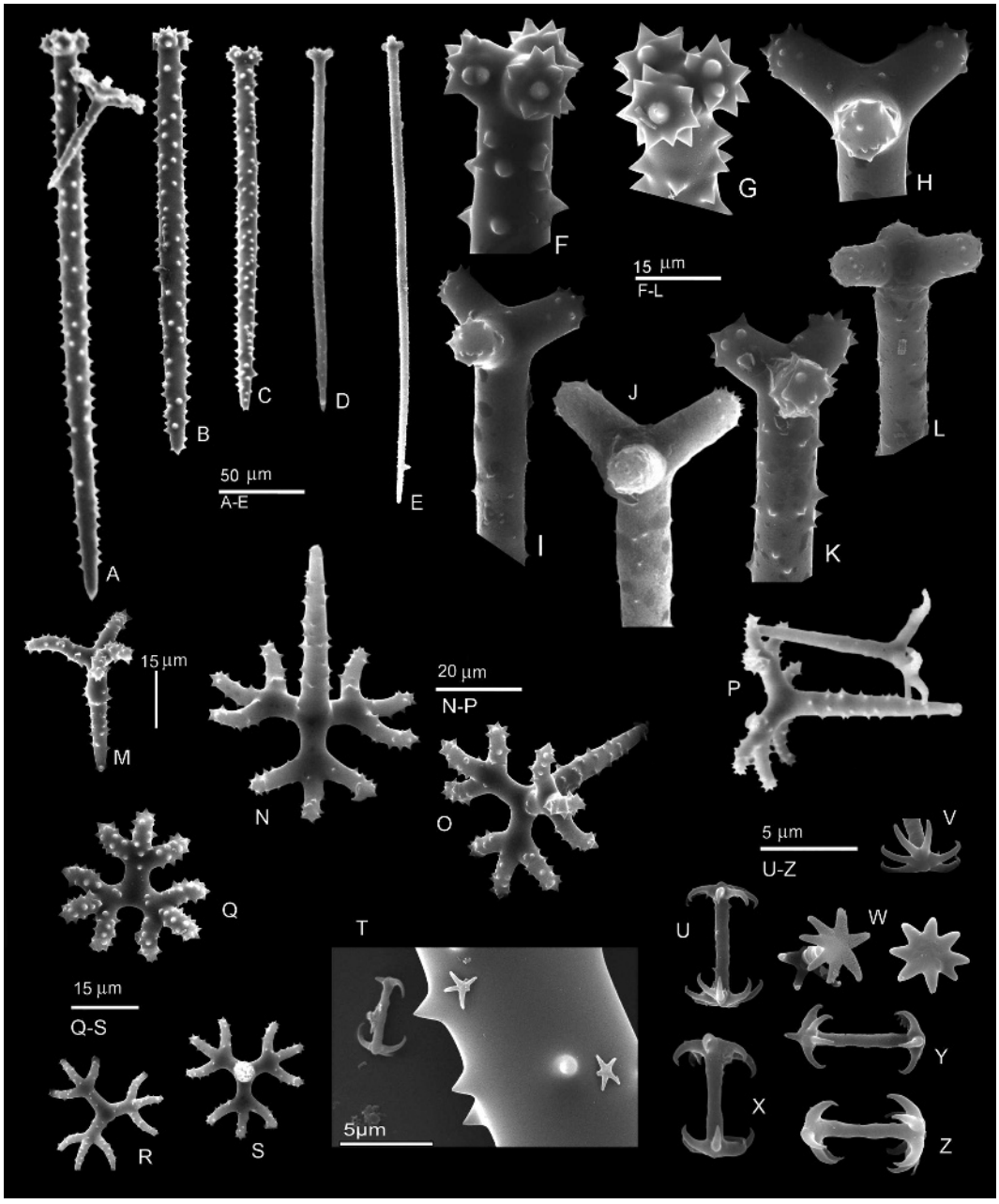

Fig. 4. *Yucatania clavus*. SEM micrographs. A–C, Main spicules acantho-demotriaenes; D, E, Smooth or slightly spined demotriaenes; F–L, Details of demotriaene heads; M, Plagiotriaene; N–Q, Different views of acantho-trichotriaenes; R, S, Slightly spined trichotriaenes (developmental stages); T–Z, Several angles of amphiasters.

triaenes with clads tangentially placed at surface, intermingled with acantho-demotriaenes. Choanosomal architecture not defined, with lower density of spicules than in ectosome, with scattered spicules. Amphiasters abundant and dispersed all over choanosome and ectosome as well.

Etymology.—From the Latin word *clavus* = metal nail, in reference to the nail-like appearance of the "demotriaenes."

Distribution.—Only the type locality, north coast of the Yucatan Peninsula, Mexico.

Remarks.—*Yucatania clavus* shares characters typical for the five species reported in *Thrombus*: *T. abyssi* (Carter, 1873), *T. kittonii* (Carter, 1874), *T. challengeri* Sollas, 1886, *T. ornatus* Sollas, 1888, and *T. jancai* Lehnert, 1998, which include the small acantho-trichotriaene megasclere, some with amphiaster microsclere, some associated with vermetids, and some are shallow like *Y. clavus*. However, none of them has the demotriaene spicule type abundantly present in *Y. clavus*. Another remarkable difference between the *Thrombus* spp. and *Y. clavus* is the radial skeletal arrangement in the periphery. Although the small acanthotriaenes are oriented with clads tangentially and rhabds inward in *Thrombus* spp., the skeletal architecture is not as clear as in *Y. clavus*. In general terms, the clads of the small acanthotriaenes of *Y. clavus* are smaller than other records of *Thrombus* spp. (35–198 μm); the amphiaster microsclere is smaller in *Thrombus* spp. (4–6 μm) than in *Y. clavus*. For size comparison of spicule measurements with *Thrombus* spp. see Lehnert (1998).

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