



## **New records of the hypercalcified sponge *Plectroninia* (Calcarea, Minchinellidae) in the Recent deep ocean**

Jean Vacelet, Benjamin James, Helmut Zibrowius

### **► To cite this version:**

Jean Vacelet, Benjamin James, Helmut Zibrowius. New records of the hypercalcified sponge *Plectroninia* (Calcarea, Minchinellidae) in the Recent deep ocean. *Alcheringa*, 2018, 42 (2), pp.311 - 318. <10.1080/03115518.2017.1395075>. <hal-01922741>

**HAL Id: hal-01922741**

**<https://hal.science/hal-01922741v1>**

Submitted on 18 Jan 2019

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



HAL Authorization



**New records of the hypercalcified sponge *Plectoninia* (Calcarea, Minchinellidae) in the Recent deep ocean**

Journal:	<i>Alcheringa</i>
Manuscript ID	TALC-2017-0006.R1
Manuscript Type:	Standard Research Article
Date Submitted by the Author:	n/a
Complete List of Authors:	Vacelet, Jean; Institut mediterraneen de biodiversite et d'ecologie marine et continentale, James, Benjamin; Station marine d'Endoume Zibrowius, Helmut; Station marine d'Endoume, chemin de la Batterie des Lions
Keywords:	Porifera, Minchinellidae, Bathyal Zone, Lithonida, Calcareous sponges

SCHOLARONE™  
Manuscripts

New records of the hypercalcified sponge *Plectroninia* (Calcarea, Minchinellidae) in the Recent deep ocean

**Abstract**

Numerous small specimens of hypercalcified sponges of the genus *Plectroninia* (Jurassic to Recent) are recorded from deep water in the Atlantic, Indian and Pacific oceans, where they are attached to diverse hard substrata, mostly scleractinian skeletons. Being represented as skeletons of linked calcareous tetractines with an incomplete free spicule complement the specimens could not be identified at the species level. These observations show that *Plectroninia* spp. have a wide distribution in the bathyal zone of the Recent World Ocean, where they may be the most common calcareous sponges.

**Keywords:** Porifera; calcareous sponges; bathyal zone; Minchinellidae; Lithonida.

**Introduction**

Minchinellidae Dendy & Row, 1913 (Calcarea, Lithonida) is a family of calcareous sponges well represented in the fossil record among the “pharetronids”—a polyphyletic group of hypercalcified sponges now classified in diverse taxa of Calcarea and for some of them even in Demospongiae. In the Mesozoic, hypercalcified sponges were significant reef-builders. However, in the Recent, there are a few remnant survivors which have often been considered as relicts. The family Minchinellidae is characterized by a skeleton of tetractine spicules linked together in a rigid structure (Vacelet *et al.* 2002, Vacelet 2012). ). In this family, the genus *Plectroninia* Hinde, 1900 was first described in the fossil record as *P. halli* Hinde, 1900 from Australia, then considered as Eocene but now dated to Early and Middle Miocene (Pickett 1983). After its description as fossil, the genus has been found in the Recent by Kirkpatrick (1900, 1911), who described two species from 90 m depth from the tropical Indo-Pacific. Subsequently, more species have been described from present-day seas, and of the 13 species presently known in the Recent, most occur in dark submarine caves of the tropical Indopacific and the Mediterranean (Vacelet 2012). First bathyal records (down to 1600 m) were from the north Atlantic and the Mediterranean (Könnecker 1989, Vacelet *et al.* 1989, Könnecker & Freiwald 2005). The diagnosis of the genus *Plectroninia* in Systema Porifera is: Minchinellidae with a basal skeleton made up of two types of fused tetractines, a layer composed of large tetractines and a layer of small tetractines. Tetractines fused by their basal actines, with the apical actine remaining free and pointing outwards. Basal actines attached by simple zygois in small tetractines, zygois reinforced by a cement layer in large tetractines. Cortical skeleton of free spicules tangentially arranged (Vacelet *et al.* 2002).

Our additional new records throughout the World Ocean confirm the wide distribution of the genus *Plectroninia* and show that it should no longer be considered as a rare relict or a refugee group in present-day seas.

The new samples presented here were mostly found on coral skeletons collected in various areas of the World Ocean and mostly from bathyal depths (Table 1). The samples are reduced to the rigid skeleton and do not include the free spicules. Accordingly, they cannot be identified at the species level. Nevertheless, this unique

collection is of great interest by widely improving our knowledge of *Plectroninia* spp. in the Recent.

### Material and methods

The collection of *Plectroninia* resulted from sorting samples taken during various oceanographic cruises (Table 1), mostly by dredging, occasionally by picking up from a submersible. In order to identify scleractinians, corals were often treated with hot sodium hypochlorite solution which contributed to making small calcified epifauna more evident. Tiny *Plectroninia* were thus easier to recognize than on the raw material where they are commonly concealed by trapped sediment or, when already dead, overgrown by “soft” sponge crusts.

However, the living tissue and free spicules of the dermal layer were lost during the bleach treatment, and the specimens, in most cases reduced to the basal skeleton of linked spicules, could not be identified or described to the species level. The specimens were observed and photographed under a binocular microscope. Some were sputter-coated with gold-palladium and observed under a Hitachi S570 scanning electron microscope.

The *Plectroninia* collection has been deposited as a whole in the Porifera collection of Muséum National d'Histoire Naturelle, Paris, number MNHN-IP-2015-1480 to 1543.

### Results

All specimens are small encrustations, roughly circular, with a minimum size of 0.5 x 0.5 mm, and up to 5 x 6 mm (Figs. 1–3). The number of specimens found by sampling sites was variable according to the number of corals skeletons that were examined. In most sites, there was a single specimen. However, up to 24 specimens were found in a New Caledonia site (Alis Musorstom 6, DW 400, 14/02/1989). A total number of 109 specimens was found. Most are reduced to a well preserved basal skeleton composed of two layers of tetractines fused or intermingled by their *basal* actines with the apical actine free and pointing outward. The basal layer, generally well visible near the edge of the crust, is made of small tetractines, and is covered by a layer of larger tetractines, conforming to the typical structure of the Recent species in the genus *Plectroninia* (Figs 1–3). In a few cases, some free spicules from the dermal layer and choanosome, diactines, triactines, and tuning fork (diapasons) triactines, remain intermingled with the linked tetractines. Some specimens, already dead when sampled, show an eroded, poorly preserved basal skeleton. Siliceous skeletons of encrusting lithistids, also present on some of the substrates, are easily distinguished from the calcareous *Plectroninia* skeletons.

Size and skeleton characters (in particular spicule ornamentation) show some variation. The free apical actine of the large tetractines is generally smaller than 200 µm, with a maximum length of 234 µm observed in a specimen from New Caledonia. These free actines may be nearly smooth with only a few spines near the base, or bear a variable number of short, conical spines, arranged in rows in a specimen from La Réunion (Fig. 2D). The basal actines have more numerous conical spines, also frequently in rows, and are linked together by enlarged ends (Figs. 1C & D, 2B & F, 3B, E & F). Growth stages of these tetractines are observed in some specimens (see,

for example Fig. 3B). The small tetractines are more heavily spined, with spines sometimes nearly as large as the free apical actine and bearing a secondary spination. In some individuals the underside of the sponge could be seen and shows that it was attached to the substrate by the enlarged ends of the basal actines of the small tetractines (Figs. 2D, 3F).

**Discussion**

The samples here can be identified with the genus *Plectroninia* as it is conventionally understood while the placement of these Recent forms in the same genus with the fossil *Plectroninia halli* (type of the genus) is pending, awaiting a revision of other fossil genera in the Minchinellidae (Finks *et al.* 2011, Vacelet 2012). In some cases, the basal skeleton is eroded and poorly preserved, making the identification as *Plectroninia* less certain. However, the preservation is good enough to prevent confusion with other Recent genera of Minchinellidae. *Petrostroma* Döderlein, 1892 and *Minchinella* Kirkpatrick, 1908 are erect rather than encrusting. *Petrostroma* is known from a single record from the upper bathyal in the tropical Pacific and has a rigid skeleton forming radial lines (Vacelet 2012), a feature absent in all our specimens. *Minchinella* has a rigid skeleton made of a single category of large tetractines partly embedded in a cement, whereas all our specimens have linked tetractines of two size classes and are devoid of embedding cement. In *Monoplectroninia* Pouliquen & Vacelet, 1970, from Mediterranean submarine caves, the rigid skeleton consists of a single type of small tetractines. In *Tulearinia* Vacelet, 1977 the rigid skeleton is feebly linked and would not resist the drastic cleaning by sodium hypochlorite.

Being mostly reduced to the basal rigid skeleton, without the free spicules of the choanosome and dermal layer, our specimens cannot be identified to any of the 13 known Recent species listed in World Porifera Database (Van Soest *et al.* 2015), for which a comparative table of spicules has been given by Könnecker et Freiwald 2005. However, the differences in size and spination of the tetractines of the basal skeleton indicate that several species are present, as implied by the worldwide provenance of the material. Only two species, *P. celtica* Könnecker & Freiwald, 2005 and *P. norvegica* Könnecker, 1989 have been specifically identified in the bathyal zone of a single area (the North–East Atlantic) and it is obvious that the diversity of bathyal *Plectroninia* spp. can be expected to be higher in the World Ocean. We observed a maximum length of 234 µm for the free apical actine, indicating that we did not find *P. norvegica* which is characterized by distinctly larger actines up to 500 µm long.

The presence of calcareous sponges of the Class Calcarea in the deep sea has been underestimated for a long time (Rapp *et al.* 2011). In fact they are more common than formerly expected and our data suggest that the genus *Plectroninia* may be one of the most common Calcarea in the bathyal zone, worldwide. Being minute and having the dermal layer often covered by mud, they are easily overlooked when deep sea material is sorted, whether they incrust hard substrates or live loose on muddy sand (Könnecker 1989). However, their rigid basal skeleton of fused or linked spicules (apt for fossilization) can withstand drastic cleaning and thus becomes more easily visible. The cleaning technique that we used here reveals that these sponges may be very common in the deep sea, with a very large distribution in bathyal depths. Presently, the maximum depth record of *Plectroninia* is 1644 m on the Vavilov Seamount in the

Western Mediterranean (Table 1), with other remarkably deep records to 1600 m from the western Mediterranean (Vacelet *et al.* 1989) and other remarkably deep records to 1269 m and 1391 m from the eastern Mediterranean basin (Ilan *et al.* 2003), i.e., in a sea that is commonly considered as having a poor deep-sea fauna.

The absence of locations in wide areas of the World Ocean in our distribution map (Fig. 4) should not be interpreted as presenting the reality of *Plectroninia* distribution. We did not have access to potential substrates from all areas. We also admit that our records may be biased by more attention having been given to tiny epifauna in one coral collection than in another, according to circumstances (need to having a collection treated fast or not, diversity of the components, quantity, etc.).

Due to sampling bias, our records are more frequent in certain areas, for instance around New Caledonia, a region covered by many cruises which provided an exceptionally large quantity and diversity of bathyal scleractinian corals. Of particular interest are the records from Barbados and Brazil, Tropical Western Atlantic. No representative of Minchinellidae was previously recorded from this area where submarine caves are famous for the fauna of hypercalcified demosponges ("Sclerosponges") as in Jamaica (Hartman & Goreau 1970).

Our observations suggest that minute *Plectroninia* spp. are the most common calcareous sponges in the Recent bathyal environment. It is not clear if this was the case also in the geological past. Minchinellidae have been considered as rather shallow in Eocene strata (Finks *et al.* 2011), but this was mostly based on the obsolete idea that in the Present Calcarea are confined to depths shallower than 60 m. This assumption has already been questioned (Borojevic & Graat-Kleeton 1965, Vacelet 1988, Janusssen *et al.* 2003, Rapp *et al.* 2011). We now have reasons to consider the fossil Minchinellidae as a relatively deep-water group, thriving at sub-photic depths as suggested for *Porosphaera*, a genus common in the fossil record, and other Minchinellidae from the Cretaceous (Nestler 1961 & 1965, Reitner 1992, Wilmsen *et al.* 2012). In more recent times, in the Upper Miocene (Messinian), *Plectroninia* is clearly a member of a diversified upper bathyal assemblage (Barrier *et al.* 1991).

Table 1: Collection data of the specimens.

Fig. 1: A–D: Specimen from Brazil, 217 m depth. Note the presence of a tuning fork triactine in D (arrow). E–F: specimen from Azores, 914 m depth.

Fig. 2: A–D: Specimen from La Réunion, 470–540 m depth. B and C show some preserved free spicules, including a tuning fork triactine in C (arrow). D is a view of the underside, showing the attachment of the small tetractines by an enlarged ends on the substratum. E–F: specimen from New Caledonia, 270 m depth.

Fig. 3: A–C: Specimen from New Caledonia, 360 m depth. In B, presence of a tuning fork triactine and of a growing stage of large triactine (arrows). D–F: other specimen from New Caledonia, 360 m depth. In A & D, an area of the underside detached from the substratum.

Fig. 4: Localization of the new records of *Plectroninia*.

## References

BARRIER, P., ZIBROWIUS, H., LOZOUET, P., MONTENAT, C., OTT D'ESTEVOU, P., SERRANO, F. & SOUDET, H.J., 1991. Une faune de fond dur du bathyal supérieur dans le Miocène terminal des Cordillères bétiques (Carboneras, SE Espagne). *Mésogée* 51, 3–13.



- BOROJEVIC, R. & GRAAT-KLEETON, G., 1965. Sur une nouvelle espèce de *Sycon* et quelques Démosponges récoltées par le "Cirrus" dans l'Atlantique Nord. *Beaufortia* 13, 81–85.
- DÖDERLEIN, L., 1892. Über *Petrostroma schulzei*, n. g., n. sp. der Kalkschwämme. *Verhandlungen der Deutschen Zoologischen Gesellschaft in Heidelberg* 2, 143–145.
- FINKS, R.M., HOLLOCHER, K. & THIES, K.J., 2011. A major Eocene sponge fauna (Castle Hayne Formation, North Carolina). *Journal of the North Carolina Academy of Science* 127, 39–175.
- HINDE, G.J., 1900. On some remarkable Calcisponges from the Eocene strata of Victoria (Australia). *Quarterly Journal of the Geological Society of London* 56, 50–66.
- ILAN, M., GUGEL, J., GALIL B.S. & JANUSSEN, D., 2003. Small bathyal sponge species from East Mediterranean revealed by a non-regular soft bottom sampling technique. *Ophelia* 57, 145–160.
- JANUSSEN, D., RAPP, H.T. & TENDAL, O.S., 2003. A myth vanished, calcareous sponges are alive and well at abyssal depths. *Deep-Sea Newsletter* 32, 17–19.
- KIRKPATRICK R., 1900. Description of sponges from Funafuti. *The Annals and Magazine of Natural History* 34, 345–363.
- KIRKPATRICK, R., 1908. On two new genera of recent Pharetronid sponges. *The Annals and Magazine of Natural History* 2, 503–514.
- KIRKPATRICK, R., 1911. On a new Lithonine sponge from Christmas Island. *The Annals and Magazine of Natural History* 8, 177–179.
- KÖNNECKER G., 1989. *Plectroninia norvegica* sp. nov. (Calcarea, Minchinellidae), a new pharetronid sponge from the North Atlantic. *Sarsia* 74, 131–135.
- KÖNNECKER, G. & FREIWALD, A., 2005. *Plectroninia celtica* sp. nov. (Calcarea, Minchinellidae), a new species of "Pharetronid" sponge from bathyal depths in the northern Porcupine Seabight, NE Atlantic. *Facies* 51, 53–59.
- NESTLER, H., 1961. Spongien aus der weissen Schreiekreide (Unteres Maastricht) der Insel Rügen (Ostsee) [Sponges from the White Chalk (Lower Maastrichtian) of the island of Rügen (Baltic Sea)]. *Paläontologische Abhandlungen* 1, 1–70.
- NESTLER, H., 1965. Die Rekonstruktion des Lebensraumes der Rügener Schreiekreide-Fauna (Unter-Maastricht) mit Hilfe der Paläoökologie und Paläobiologie. *Beiheft zur Zeitschrift Geologie* 49, 1–147.
- PICKETT, J., 1983. An annotated bibliography and review of Australian fossil sponges. *Memoirs of the Association of Australasian Palaeontologists* 1, 93–120.
- POULIQUEN, L. & VACELET, J., 1970. Nouvelles observations sur des Eponges Pharétronides Minchinellidae de Méditerranée. *Téthys* 2 (2), 437–442.

RAPP, H.T., JANUSSEN, D. & TENDAL, O.S., 2011. Calcareous sponges from abyssal and bathyal depths in the Weddell Sea, Antarctica. *Deep-Sea Research II* 58, 58–67.

REITNER, J., 1992. "Coralline Spongien". Der Versuch einer phylogenetisch–taxonomischen Analyse. *Berliner Geowissenschaftliche Abhandlungen I*, 1–352.

VACELET, J., 1977. Eponges Pharétronides actuelles et Sclérosponges de Polynésie Française, Madagascar et de La Réunion. *Bulletin du Muséum National d'Histoire Naturelle, Paris* 444, 345–366.

VACELET, J., 1988. Indications de profondeur données par les Spongiaires dans les milieux benthiques actuels. *Géologie Méditerranéenne* 15, 13–26.

VACELET, J., BOROJEVIC, R., BOURY-ESNAULT, N. & MANUEL, M., 2002. Order Lithonida. In *Systema Porifera, A Guide to the Classification of Sponges*. HOOPER J.N.A. & SOEST R.W.M.van (eds), Kluwer Academic/Plenum Publishers, New York, 1185–1192.

VACELET, J., 2012. Hypercalcified Extant Calcarea. In *Treatise on Invertebrate Paleontology On line, Part E (Revised)*. SELDEN P.A. ed., Volume 4, Hypercalcified Porifera. The University of Kansas, Paleontological Institute, Lawrence (Kansas, USA), Chapter 4C, 1–15.

VACELET, J., BOURY-ESNAULT, N. & ZIBROWIUS, H., 1989. Unexpected deep–water records of calcareous sponges (Calcarea). *Deep-Sea Newsletter* 15, 24–25.

Van Soest, R.W.M, Boury-Esnault, N., Hooper, J.N.A., Rützler, K., de Voogd, N.J., Alvarez de Glasby, B., Hajdu, E., Pisera, A.B., Manconi, R., Schoenberg, C., Janussen, D., Tabachnick, K.R., Klautau, M., Picton, B., Kelly, M., Vacelet, J., Dohrmann, M., Díaz, M.C., Cárdenas, P. 2015, World Porifera database. Accessed at <http://www.marinespecies.org/porifera> on 2015–11–12

WILMSEN, M., FURSICH, F.T. & MAJIDIFARD, M.R., 2012. *Porosphaera globularis* (Phillips, 1829) (Porifera, Calcarea) from the Maastrichtian of the Farokhi Formation of Central Iran. *Cretaceous Research* 33, 91–96.



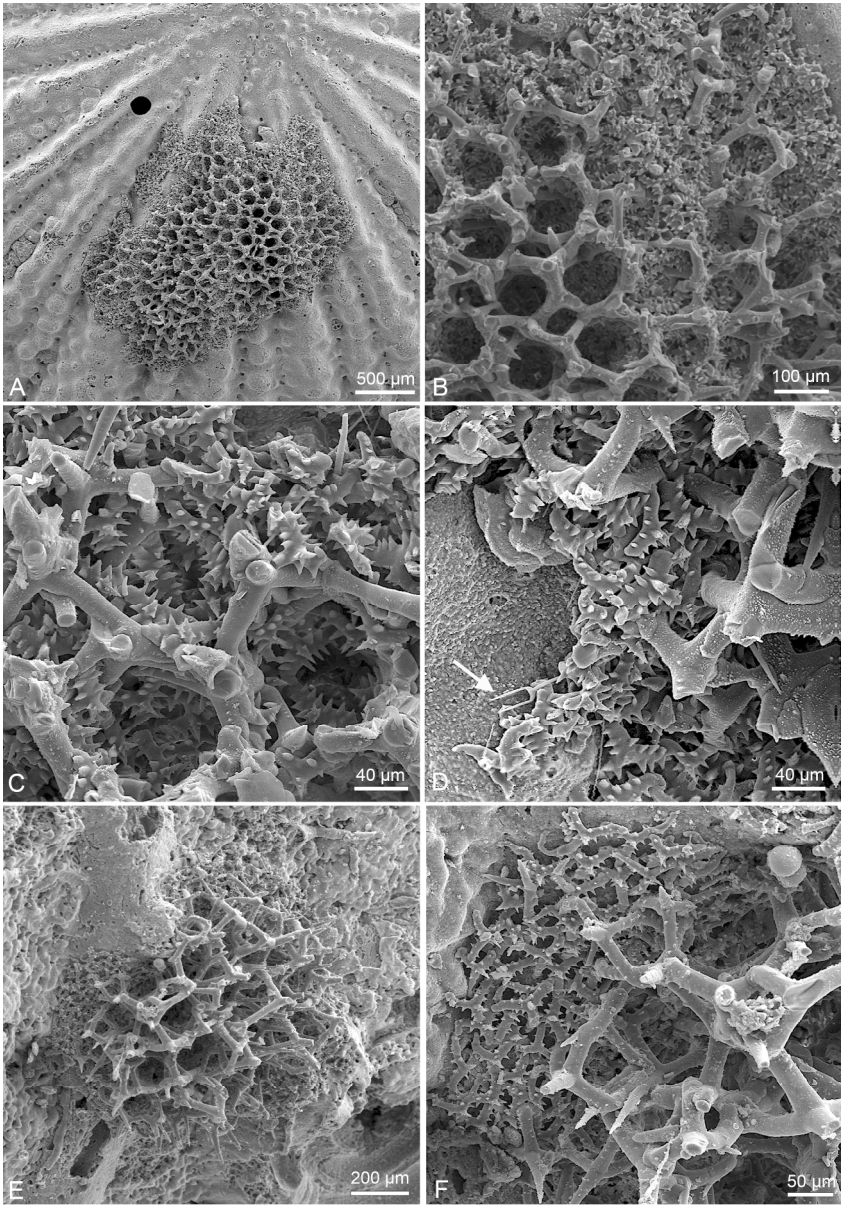


Fig. 1: A-D: Specimen from Brazil, 217 m depth. Note the presence of a tuning fork triactine in D (arrow).  
E-F: specimen from Azores, 914 m depth.

241x346mm (300 x 300 DPI)

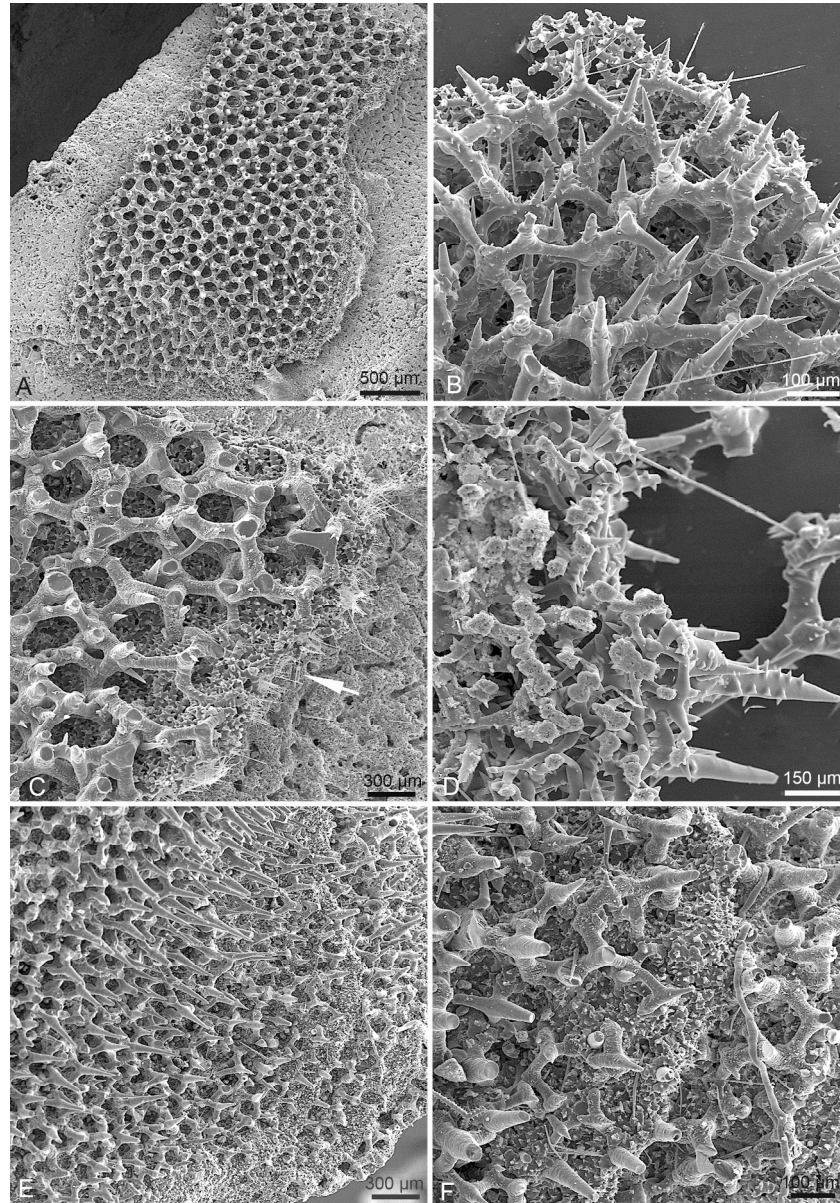


Fig. 2: A–D: Specimen from La Réunion, 470–540 m depth. B and C show some preserved free spicules, including a tuning fork triactine in C (arrow). D is a view of the underside, showing the attachment of the small tetractines by an enlarged ends on the substratum. E–F: specimen from New Caledonia, 270 m depth.

168x241mm (300 x 300 DPI)

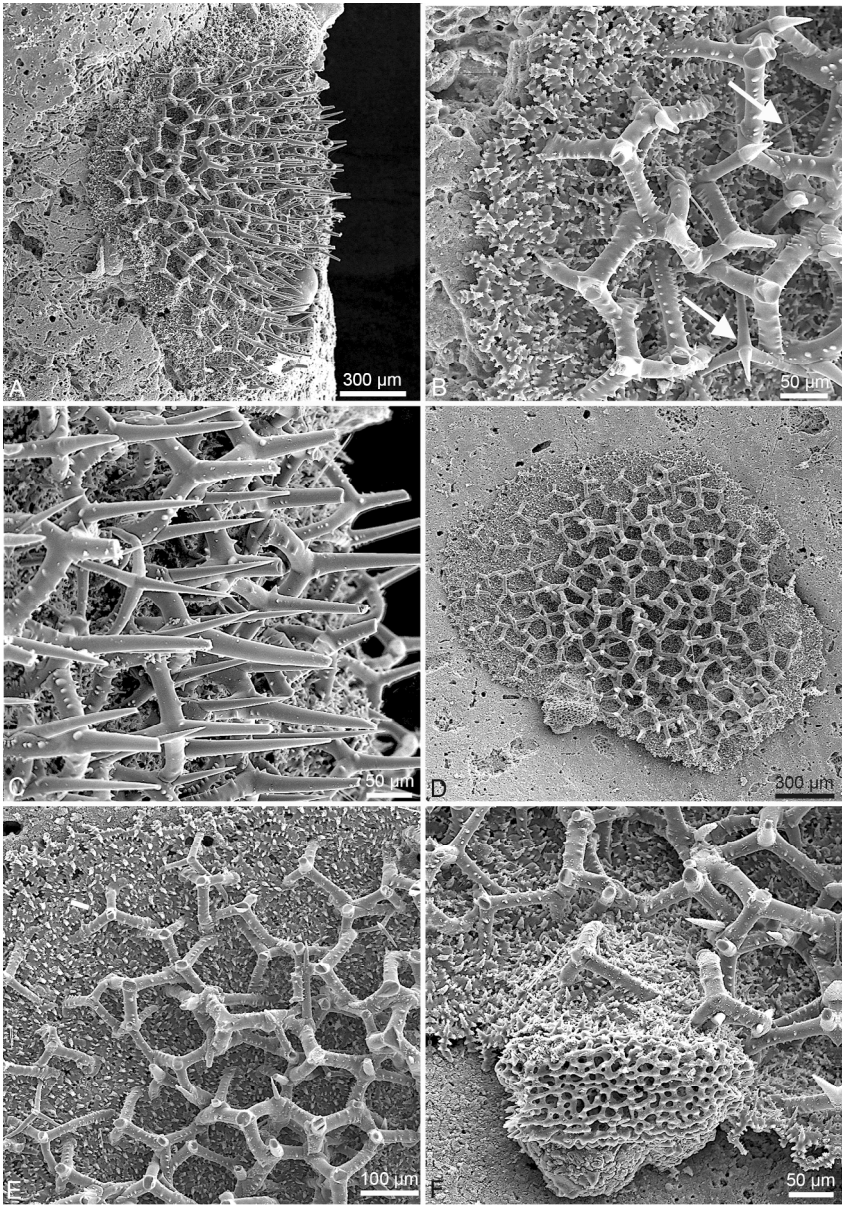


Fig. 3: A–C: Specimen from New Caledonia, 360 m depth. In B, presence of a tuning fork triactine and of a growing stage of large triactine (arrows). D–F: other specimen from New Caledonia, 360 m depth. In A & D, an area of the underside detached from the substratum.

168x241mm (300 x 300 DPI)



Fig. 4: Localization of the new records of *Plectroninia*.

376x281mm (72 x 72 DPI)

Ship-Cruise	Station	Date	Depth (m)	Lat-Long	Area
(on land)	(Messinian fossil)			Carboneras	SE Spain
Cryos Balgim	DW152	17/06/1984	534-560	35°56.7'N-5°34.7'W	Gibraltar
Cryos Balgim	DW128	14/6/1984	480	35°35.3'N-3°45.1'W	Alboran Sea
Capricorne Biomedel	BS15	28/8/1976	1600	42°53'N-6°10'E	NW Mediterranean
Antedon	dredge	9/1/1971	180	43°08'N-5°32'E	NW Mediterranean
Antedon	dive	25/9/1992	21	La Ciotat, cave	NW Mediterranean
Le Suroit Marco	DR46	28/7/1995	1150	43°43.20'N-9°18.09'E	NW Corsica
Sonne SO-41	DC123	16/3/1986	1644	39°56.24'N-12°37.80'E	Vavilov Seamount, NW Med.
Urania CS-96	157	31/12/1996	257	36°29'04"N-12°56'00"E	Sicily Strait
Calypso	1902	4/1965	150	32°42'N-14°14'E	Libya
Bioce	2692	31/8/1994	1162	64°26.60'N-28°15.50'W	SW Iceland
Heliotrope	trawl	4/1989	1100	52°50'N-15°W	W Ireland
Victor Hensen VH97	79	21/4/1997	359	36°34.7'N-11°00'W	Gorringe Seamount
Le Suroit Seamount-1	DE95	11/10/1987	270	35°04.6'N-12°55.3'W	Ampere Seamount
Cryos Balgim	DW43	2/6/1984	150	35°54.1'N-6°14.5'W	Lusitanian Bight
Jean Charcot Biaçores	?	1971	500-900	?	Azores
Jean Charcot Gibraco	DR21	8/1972	914	38°35.07'N-30°40.05'W	Azores
P.W.Hummelinck	1443	19.2.1964	200	13°11'N-59°39'W	Barbados
Akaroa	5C	10/9/1965	370	9°01'S-34°51.2'W	Brazil
Marion Dufresne MD-55	CB103	1/6/1987	200-217	23°36.4'S-42°01.7'W	Brazil
Valdivial	P7	21/5/1982	234-243	26°11'S-6°19'E	Walvis Ridge
Meiring Naudé	SM232	25/6/1979	560-620	32°14.9'S-29°10.4'E	E South Africa
Meiring Naudé	ZA14	7/7/1987	500	26°55.5'S-32°56.8'E	E South Africa
Meiring Naudé	ZA21	8/6/1987	50	26°54.8'S-32°55.0'E	E South Africa
Anton Bruun IIOE-7	371E	18/7/1964	132	24°46'S-35°20'E	Mozambique
Vityaz	2733	18/12/1988	750-755	33°23'S-44°06'E	Madagascar
Marion Dufresne MD-30	DC129	16/2/1982	525	46°06'S-49°17'E	Crozet
Marion Dufresne MD-50	DC114	19/7/1986	160	39°00.5'S-77°46.37'E	St. Paul
Marion Dufresne MD-50	CP145	22/7/1986	825-1020	38°40.66'S-77°35.47'E	St. Paul
Marion Dufresne MD-32	DC27	16/8/1982	290-310	21°22.2'S-55°46.5'E	Reunion
Marion Dufresne MD-32	DR62	22/8/1982	630-710	21°08.7'S-55°11.8'E	Reunion
Marion Dufresne MD-32	FA96	28/8/1989	350-750	19°41.5'S-54°08.3'E	Reunion
Marion Dufresne MD-32	FA117	31/8/1982	450-540	20°51.5'S-55°08.5'E	Reunion
Marion Dufresne MD-32	FA119	1/9/1989	708-720	20°52.2'S-55°05.9'E	Reunion
Marion Dufresne MD-32	FA137	3/9/1982	940-980	20°45.8'S-55°35.6'E	Reunion
Albatross	5312	4.11.1908	256	21°30'N-116°32'E	E China Sea
Vauban Musorstom-1	32	23/3/1976	184-194	14°02.2'N-120°17.7'E	Philippines
Coriolis Musorstom-3	126	4/6/1985	266	11°49.2'N-121°22.1'E	Philippines

Danish Exp Kei Isl	25	16.4.1922	85	5°34'20"S-132°55'E	Indonesia
Vauban	475	2/3/1985	415-460	18°35.7'S-163°11.2'E	New Caledonia
Jean Charcot Biocal	DW64	3/9/1985	250	24°47.93'S-168°09.12'E	New Caledonia
Jean Charcot Biogeocal	DW253	16/4/1987	310-315	21°31.75'S-166°28.7'E	New Caledonia
Jean Charcot Biogeocal	DW307	1/5/1987	470-480	20°35.38'S-166°55.25'E	New Caledonia
Coriolis Chalcal-2	DW78	30/10/1986	233	23°41.30'S-167°59.60'E	New Caledonia
Le Suroit Calsub	14/1029	5/3/1989	500	20°38'S-165°56.6'E	New Caledonia
Le Suroit Calsub	16/1031	7/3/1989	400-500	20°37.8'S-167°02'E	New Caledonia
Vauban Musorstom-4	DW162	16/9/1985	525	18°35.0'S-163°10.3'E	New Caledonia
Coriolis Musorstom-5	DW299	11/10/1986	360-390	22°47.70'S-159°23.70'E	New Caledonia
Coriolis Musorstom-5	DW304	12/10/1986	385-420	22°10.34'S-159°25.51'E	New Caledonia
Alis Musorstom-6	DW394	13/2/1989	570	20°49.64'S-167°09.11'E	New Caledonia
Alis Musorstom-6	DW397	13/2/1989	380	20°47.35'S-167°05.17'E	New Caledonia
Alis Musorstom-6	DW399	14/2/1989	282	20°41.80'S-167°00.20'E	New Caledonia
Alis Musorstom-6	DW400	14/2/1989	270	20°42.18'S-167°00.40'E	New Caledonia
Alis Musorstom-6	DW402	14/2/1989	520	20°30.27'S-166°49.28'E	New Caledonia
Alis Musorstom-6	DW407	15/2/1989	60	20°40.70'S-167°06.60'E	New Caledonia
Alis Musorstom-6	DW410	15/2/1989	490	20°38.05'S-167°06'E	New Caledonia
Alis Musorstom-6	DW416	16/2/1989	343	20°42.15'S-166°59.60'E	New Caledonia
Alis Musorstom-6	CP455	20/2/1989	260	21°00.65'S-167°26.08'E	New Caledonia
Alis Musorstom-6	DW459	20/2/1989	425	21°01.39'S-167°31.47'E	New Caledonia
Alis Musorstom-6	CP464	21/2/1989	430	21°02.30'S-167°31.60'E	New Caledonia
Alis Musorstom-6	CP468	21/2/1989	600	21°05.86'S-167°32.98'E	New Caledonia
Alis Musorstom-6	DW473	22/2/1989	236	21°08.80'S-167°55.50'E	New Caledonia
Alis Musorstom-6	DW474	22/2/1989	260	21°08.80'S-167°55.50'E	New Caledonia
Alis-Musorstom-6	DW483	23/2/1989	600	21°19.80'S-167°47.80'E	New Caledonia
Vauban SMIB-3	DW18	23/5/1987	338	23°41.5'S-167°59.4'E	New Caledonia
Alis SMIB-4	DW37	7/3/1989	515-540	24°54.50'S-168°22.30'E	New Caledonia
Alis SMIB-4	DW39	7/3/1989	525-560	24°56.20'S-168°21.50'E	New Caledonia
Alis-SMIB-4	DW53	9/3/1989	270	23°40.1'S-167°59.09'E	New Caledonia
Alis SMIB-5	DW71	7/3/1989	265	23°41.30'S-168°00.70'E	New Caledonia
Alis-SMIB-5	DW101	14/2/1989	270	23°21.1'S-168°04.9'E	New Caledonia
Alis SMIB-8	DW169	29/1/1993	447-450	23°37'S-167°42'E	New Caledonia
NZOI	C527	10.9.1960	508	32°30'S-179°12'W	Kermadec
S.P. Lee L3-84-SP	21-8	4/1984	700	24°56'S-176°38'W	Tonga