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# Studies on Southwest Pacific Hexactinellida 1: *Atlantisella lorraineae*, a new glass sponge genus and species record for New Zealand

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**ABSTRACT**

A second species of *Atlantisella* Tabachnick, 2002 (Class Hexactinellida Schmidt, Order Lyssacinosida Zittel, Family Euplectellidae Gray) is described here from Tangaroa Seamount on the southern Kermadec Ridge, off the Bay of Plenty in northeastern New Zealand. The New Zealand species differs considerably from the North Central Atlantic type species, *A. incognita* Tabachnick, 2002, in lacking hexactine dermalia, by possessing calycocome-like oxyhexaster microscleres, and in the different form of the oxystauractins. *Atlantisella lorraineae* sp. nov. is named in memory of the co-author's mother, Mrs Lorraine Kelly, who passed away on 1 October 2016. ❐ *Hexactinellida, Lyssacinosida, Euplectellidae, Atlantisella, taxonomy, new species, Tangaroa Seamount, southern Kermadec Ridge, Chatham Rise, New Zealand EEZ*

Prior to this work, our knowledge of the glass sponge family Euplectellidae Gray in New Zealand waters was limited to three certain species, *Regadrella okinoseana* Ijima, 1896, *Walteria leuckarti* Ijima, 1896 and *W. flemmingi* Schulze, 1885, and eight undescribed species (Kelly *et al.* 2009). The discovery of only the second species of *Atlantisella* Tabachnick, 2002 in New Zealand waters, when the genus was previously known only from south of the Azores Archipelago in the Central Atlantic, is remarkable for the highly disjunct distribution.

The genus *Atlantisella* is presently classified as one of the five monospecific members of the subfamily Corbitellinae Gray (Order Lyssacinosida Zittel, Family Euplectellidae) since it is attached to hard substrate by a basal disc and lacks a stalk. The relationship of *Atlantisella* to other corbitellins is unclear; it bears pentactine dermalia, unusual for the family and shared with only three of the 26 genera, *Heterotella* Gray, 1867, *Placopegma* Schulze, 1895 and *Pseudoplectella* Tabachnick, 1990 and possesses a combination of microscleres not shared with any of those three genera. Moreover, the present arrangement of euplectellids into three subfamilies, Euplectellinae Gray, Corbitellinae and Bolosominae Tabachnick, the latter erected by Tabachnick (2002), is being increasingly questioned as an appropriate reflection of the phylogeny of the family. The arrangement was a slight modification of the older division of the family based primarily

upon the nature of substrate attachment, either rooted in sediments by anchoring spicules (Euplectellinae) or grappled onto hard substrate by a basal disc (Corbitellinae and now Bolosominae). This basic taxonomic division was previously questioned in a cladistic analysis of morphological characters by Mehl (1992) in her conclusion that *Euplectella* Owen, 1841, a rooted member hence classified in the subfamily Euplectellinae, has as closest sister *Regadrella* Schmidt, 1880, attached by basal disc and classified in the subfamily Corbitellinae. A more recent cladistic analysis of morphological characters (Henkel *et al.* 2015) corroborated that mode of substrate fixation in euplectellids is probably more plastic than generally appreciated and unsuitable for distinction at the subfamily level.

Recent molecular analyses (Dohrmann *et al.* 2012; Wörheide *et al.* 2012) lack strong support for the present taxonomic division of Euplectellidae based upon mode of attachment and it is clear that the classification of the family requires major revision. Unfortunately there are no molecular data available of *Atlantisella* to help clarify its relationship to other euplectellids. Although *Atlantisella* has remained monospecific since it was first proposed, Tabachnick (2002) alluded to another undescribed species off Hawai'i. This is probably one of the two undescribed *Atlantisella* species illustrated in the University of Hawai'i's HURL Animal Identification Guide (Anon 2016). Other undescribed *Atlantisella* species are illustrated from Central California (Burton & Lundsten 2008) and the Galápagos Islands (Van Soest *et al.* 2012).

Here we describe only the second known species of *Atlantisella*, from the southern Kermadec Ridge and the Graveyard Seamount complex on the northeast Chatham Rise, to the northeast and east of New Zealand, respectively. This new species of *Atlantisella* is named in memory of the co-author's mother, Mrs Lorraine Kelly, who passed away on 1 October 2016, after a long and difficult illness.

## MATERIAL AND METHODS

Specimens were collected from Tangaroa Seamount on the southern Kermadec Arc (Fig. 1) by seamount sled onboard the National Institute of Water & Atmospheric Research (NIWA) research vessel RV *Tangaroa*; the collection station is cited as NIWA Stn TAN0XXX/XX. Purported images of living sponges identified as *Atlantisella lorraineae* sp. nov. were captured by DTIS (Deep Towed Imaging System) onboard RV *Tangaroa* from the southern Kermadec Arc and Chatham Rise (Fig. 2), courtesy of NIWA's Deepsea Mining of the Kermadec Arc and OS20/20 Chatham Rise biodiversity hotspots programmes. Specimens were either frozen at -10°C or preserved in 95% ethanol, and later transferred to 70% ethanol.

In the laboratory the holotype was first digitally photographed and 10 mm² samples were rinsed in water and digested in hot nitric acid (95°C) to obtain clean spicule suspensions. After cooling and diluting with water a 0.5 ml aliquot from one sample was filtered onto a 10 mm diameter polycarbonate micropore filter (0.2 µm ion-etched pores), dried and mounted on a scanning electron microscopy (SEM) stub with double-sided tape. The remaining suspensions were transferred to petri dishes and visually recognisable spicule types were picked by forceps or pipette under a dissecting microscope and transferred to individual dishes of water. These clean spicules were transferred individually by pipette or needle to clean 9 mm² cover glasses to which they quickly adhered by drying. The cover glasses were then attached to SEM stubs by epoxy.

Clean spicules remaining in the diluted nitric acid suspensions were processed for light microscopy (LM) by sequential filtration on three or four 25 mm diameter, 0.22 µm pore size nitrocellulose filters followed by air drying; spicule tufts were picked off of the last filters of each set by forceps when still wet and spread in water on a microscope slide and air-dried. After drying all of the filters and spicule spreads were mounted in Canada Balsam under cover glasses for LM. Because the holotype was too thin to reliably sample spicules from each

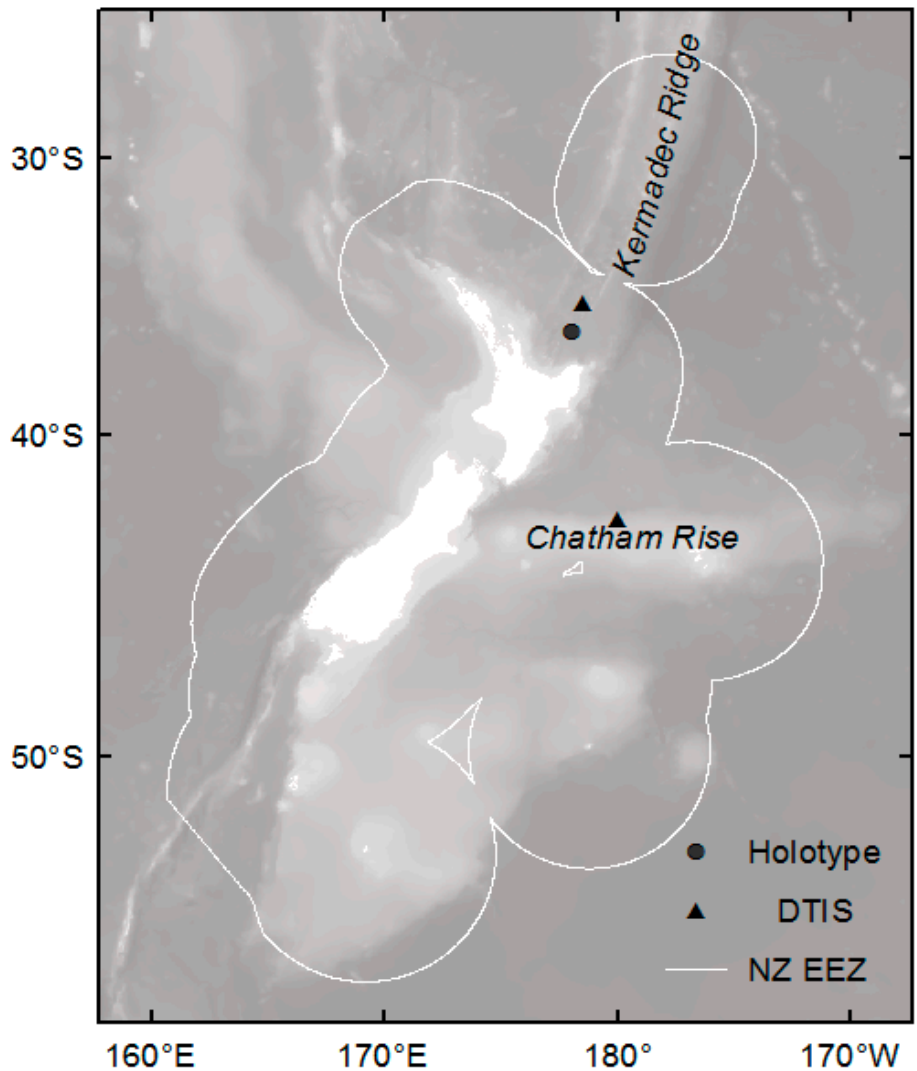


FIG. 1. Study area showing the collection locality of the holotype of *Atlantisella lorraineae* sp. nov. and the location of specimen images captured by DTIS on the southern Kermadec Ridge region (Rumble II West and Tangaroa Seamount) and Graveyard and Diabolical Seamounts on the Chatham Rise.

surface, a 10 mm$^2$ sample was whole-mounted in Canada Balsam to enable determination of the location of the various spicule types.

SEM preparations were sputter-coated with gold-palladium and imaged with a Hitachi S-3500 SEM at the Biology Department, University of Victoria. Spicules in the LM preparations were measured with a digitiser optically connected to either compound or dissecting LM by drawing tube (camera lucida) and Sigma-Scan® software. Dimensions are cited as mean (mean) and standard deviation (s.d.), range, and the number of measurements made (no.).

Primary type materials are accessioned within the NIWA Invertebrate Collection (NIC) at the National Institute of Water & Atmospheric

Research (NIWA), Greta Point, Wellington (prefix NIWA).

Abbreviations used in the text: DTIS, NIWA's Deep Towed Imaging System; HURL, Hawai'i Undersea Research Laboratory, University of Hawai'i; LM, light microscopy; NIC, NIWA Invertebrate Collection, Evans Bay, Wellington; NIWA, National Institute of Water & Atmospheric Research, Evans Bay, Wellington; No., number of measurements made; SEM, scanning electron microscopy; s.d., standard deviation.

## SYSTEMATICS

### Class HEXACTINELLIDA Schmidt, 1870

### Order LYSSACINOSIDA Zittel, 1877

### Family EUPLECTELLIDAE Gray, 1867

#### *Atlantisella* Tabachnick, 2002

*Atlantisella* Tabachnick, 2002: 1416–1418, fig. 18.

**Type Species.** *Atlantisella incognita* Tabachnick, 2002 (by original designation).

**Diagnosis.** Body is tubular, basiphytous. Choanosomal spicules are diactins, rarely triactins, stauractins and pentactins which are often fused by synapticula in the lower part of the sponge. Dermalia and atrialia are macrospined pentactins sometimes supplemented with hexactins. Microscleres are graphiocomes and staurasters, with or without calycocome-like oxyhexasters (emended from Tabachnick, 2002).

#### *Atlantisella lorraineae* sp. nov.
(Figs 1–4; Table 1)

**Material Examined.** HOLOTYPE: NIWA 82163: NIWA Stn TAN1206/23, southwest flank of Tangaroa Seamount, southern Kermadec Ridge, 36.336º S; 178.018º E, 1490–1422 m, 17 April 2012. Other Locations (images only): TAN1007/33, Rumble II West, southern Kermadec Arc, 35.347° S; 178.544° E, 1181–1439m, 30 May 2010 (Fig. 2A); TAN0905/54, Diabolical Knoll, Graveyard Hills, northeast Chatham Rise, 42.790° S; 179.987° W, 950 m, 18 June 2009 (from Clark *et al.* 2009) (Fig. 2B); TAN0905/23, north-northeast Graveyard Seamount, Graveyard Hills, northeast Chatham Rise, 42.760° S; 179.961° W, 770–919 m, 15 June 2009 (Fig. 2C–E).

**Description.** *Shape*. Morphology of the holotype is a large thin-walled funnel with extended foliose edges (Fig. 2, 3A) but since it has no base and the edges of the funnel are broken, the exact form of the entire specimen remains uncertain. Images of living sponges reveal that while some sponges have a funnel-shaped morphology, many form a flattened sheet with foliose margins (Fig. 2A–B). Similarly, some have quite a long hollow peduncle (Fig. 2C) and others a short, hollow peduncle (Fig. 2D).

*Dimensions*. Entire holotype specimen is 22 mm tall and 31 mm in diameter at the top; the wall is 0.50 (0.26–0.74) mm thick, n=7.

*Texture*. Flexible but extremely fragile and easily broken. Surfaces are smooth or slightly undulatory, without channelisation.

*Colour*. In life, pale translucent tan to white, light beige when preserved, wet or dry.

*Choanosomal skeleton*. A loose spicule network bounded externally and internally by ectosomal membranes (Fig. 3B–C) supported by tangential rays of large spined surficial pentactins. The proximal rays of pentactins of the two surfaces overlap in a network of moderate-size diactins (Fig. 4B). Microscleres are distributed throughout the skeleton.

*Ectosomal skeleton*. A raised reticulation formed by crossed rays of surficial spined pentactins. Mesh sides of the fairly regularly rectangular dermal lattice are 150 (75–236) µm, n=65, of the less regular atrial lattice are 163 (75–299) µm, n=65. No spicule fusion by synapticula was encountered in the holotype.

*Megascleres*. (Fig. 4; Table 1): Superficial pentactins, choanosomal diactins and a few tauactins. The superficial pentactins (Fig. 4A) are indistinguishable dermalia and atrialia. Tangential rays are coarsely spined on the external surface and ray tips are simply rounded and finely rough. Overall size of these spicules varies greatly but the proximal ray is always much longer than the tangential rays. The proximal ray is coarsely spined on the half adjacent to the centrum while the distal half is smooth and ends in a finely-rough rounded tip. Diactins (Fig. 4B) are moderate in size and

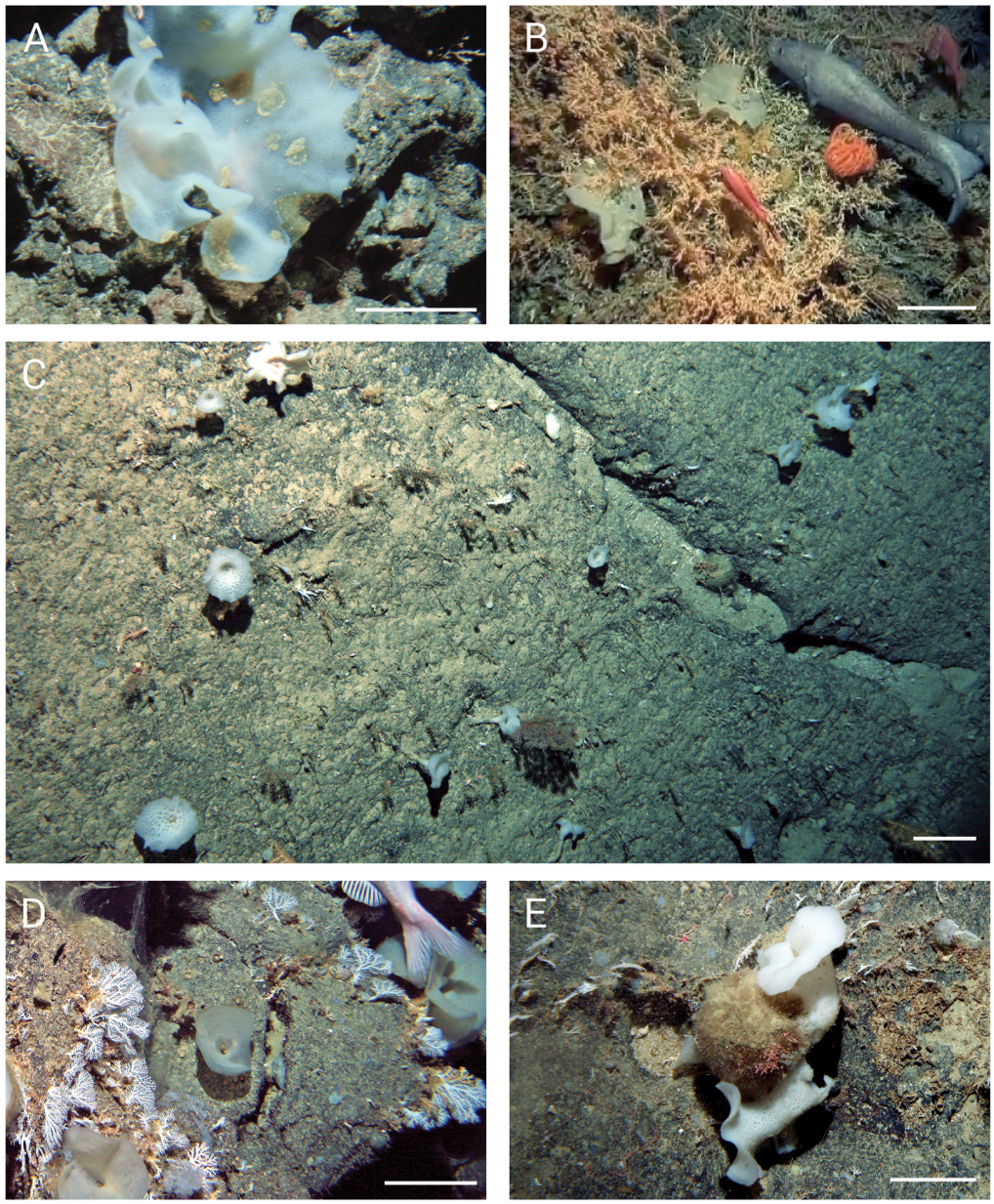


FIG. 2. Images of living *Atlantisella lorraineae* sp. nov. **A**, NIWA Stn TAN1007/33, Rumble II West, southern Kermadec Arc, 1181–1439 m (from Clark *et al.* 2010), scale = 4 cm; **B**, attached to stony coral *Madrepora oculata*, NIWA Stn TAN0905/54, Diabolical Knoll, Chatham Rise, 950 m (From Clark *et al.* 2009), scale = 5 cm; **C**, array of specimens at different stages of maturity, scale = 8 cm; **D**, specimens showing the opening to the hollow peduncle and thin, fine 'weave' of the body, scale = 7 cm; **E**, body wall of these specimens slightly coarser and thicker, possibly a different species, scale = 10 cm. Images captured by DTIS onboard RV *Tangaroa* from NIWA Stn TAN0905/23, Graveyard Seamount, Chatham Rise, 770–919 m (from Clark *et al.* 2009), unless stated otherwise.

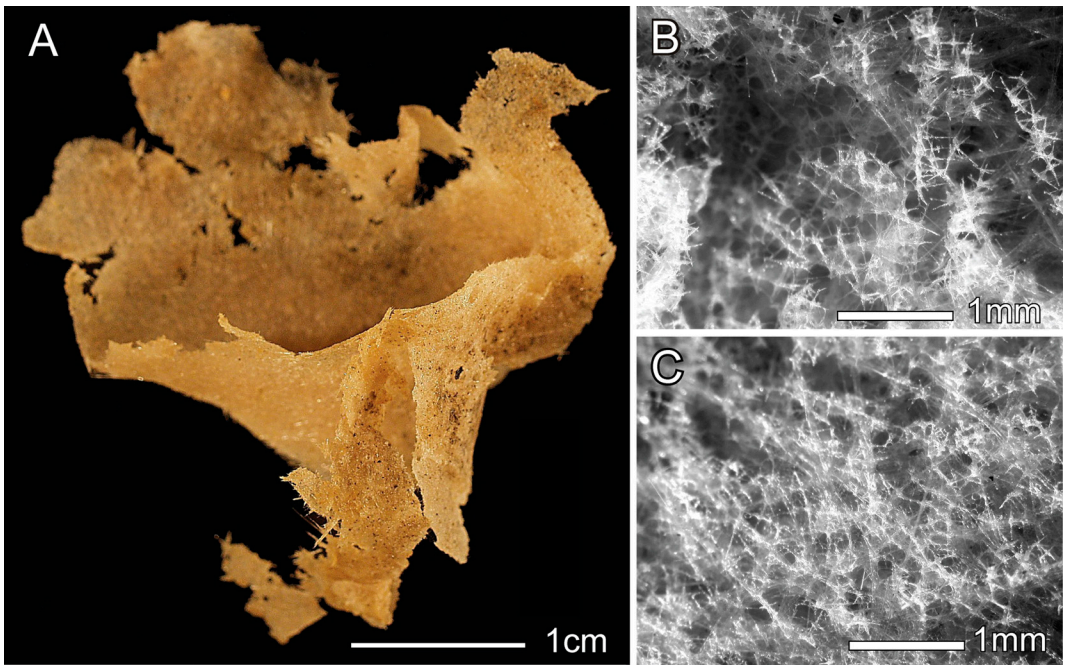


FIG. 3. *Atlantisella lorraineae* sp. nov., holotype NIWA 82163, morphology and skeleton. **A**, body of holotype; **B**, close up of dermal surface; **C**, close up of atrial surface.

TABLE 1. Spicule dimensions (µm) of *Atlantisella lorraineae* sp. nov., holotype NIWA 82163.

| Parameter | mean | s.d. | range | no. |
|---|---|---|---|---|
| Surface macrospined pentactin | | | | |
| tangential ray length | 174 | 28 | 99–221 | 50 |
| tangential ray width | 11.8 | 2.4 | 6.8–17.1 | 50 |
| proximal ray length | 326 | 128 | 163–764 | 50 |
| proximal ray width | 12.7 | 2.3 | 8.7–21.0 | 50 |
| Choanosomal diactin | | | | |
| length | 2228 | 969 | 1000–4720 | 50 |
| ray width of typical diactins | 11.3 | 3.8 | 5.4–21.0 | 50 |
| ray width of thicker diactins | 26.0 | 4.6 | 17.7–41.5 | 52 |
| Oxystauraster | | | | |
| diameter | 125 | 12 | 100–150 | 50 |
| primary ray length | 17.1 | 2.5 | 11.7–22.1 | 50 |
| secondary ray length | 45.8 | 5.2 | 33.7–58.1 | 50 |
| Calycocome-like oxyhexaster | | | | |
| diameter | 150 | 13 | 122–179 | 50 |
| primary ray length | 16.2 | 1.9 | 12.2–20.1 | 50 |
| secondary ray length | 59.4 | 6.2 | 48.5–73.5 | 50 |
| Graphiocome | | | | |
| centrum diameter | 27.6 | 2.4 | 19.6–35.7 | 50 |
| secondary ray (raphide) length | 212 | 18 | 161–250 | 50 |

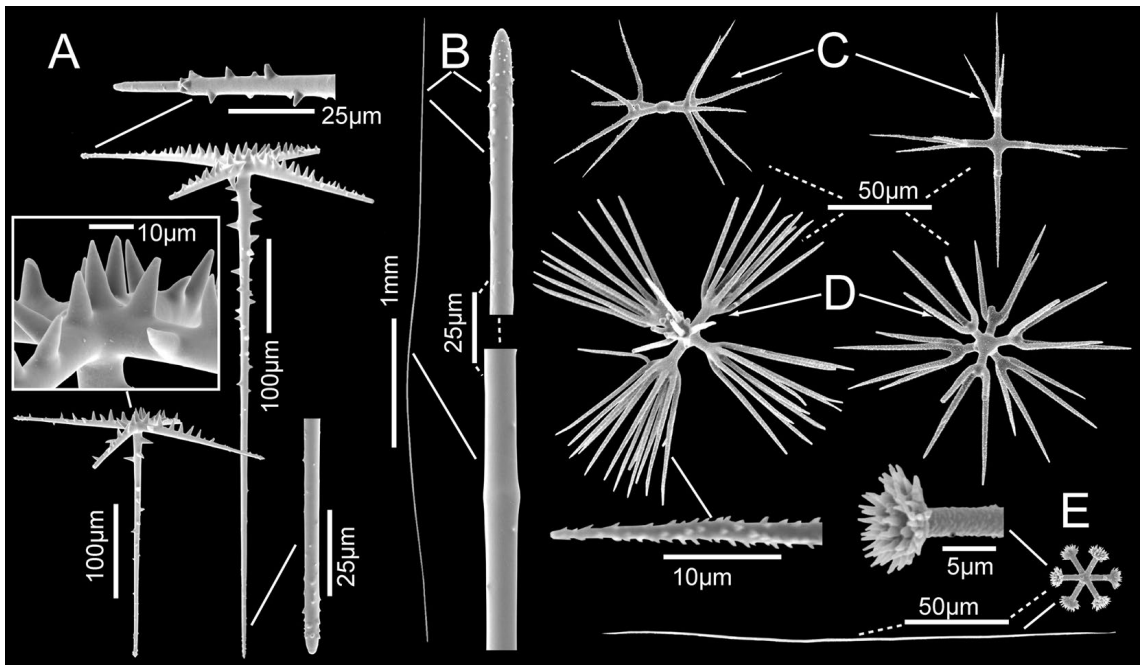


FIG. 4. *Atlantisella lorraineae* sp. nov., holotype NIWA 82163, spicules. **A**, two surficial pentactins, whole and enlarged ray ends and center; **B**, diactin, whole and enlarged end and middle segments; **C**, oxystauraster in side and facial views; **D**, calycocome-like oxyhexasters with differing terminal ray numbers and an enlarged terminal ray end; **E**, graphiocome centrum and loose terminal ray.

divisible into two classes by thickness. Tips are rough and parabolic; the central swelling varies from four distinct knobs to undetectable. Tauactins are rare and physically like the diactins.

*Microscleres.* (Fig. 4; Table 1): Oxystauraster, rare hemioxystauraster, calycocome-like oxyhexasters and graphiocomes. Oxystauraster (Fig. 4C) and hemioxystauraster have an ovoid swollen centrum and four primary rays, each of which bears 3 (1–4) pointed terminal rays. The entire spicule is evenly finely-spined and the terminal rays tend to occur in the plane vertical to that of primary rays, giving the spicule an overall high roughness aspect in lateral view but a lower roughness aspect in facial view. The calycocome-like oxyhexasters (Fig. 4D) have a short solid calyx at the distal end of the primary rays, each supporting 4 (3–11) straight terminal rays; this entire spicule is also evenly ornamented with small reclined spines. Unpatterned branching occurs fairly commonly on individual terminal rays. The graphiocome (Fig. 4E) has centrum and primary rays evenly covered with small bumps; each primary calyx supports ~40 smooth straight terminal rays or raphides, 1.2 (1.0–1.4) µm in diameter but devoid of other characters at the resolution limit of the SEM used.

**Type Location.** Southwest flank of Tangaroa Seamount, southern Kermadec Ridge (Fig. 1).

**Distribution.** Southern Kermadec Ridge and Chatham Rise, New Zealand.

**Substrate, Depth Range, Ecology.** The single specimen examined and assigned as holotype was presumably attached to hard substratum but no attachment disc was collected. The depth range for the holotype is 1490–1422 m. Purported images of living specimens indicate that the sponge may attach to hard substrate such as pillow lava outcrops (Fig. 2A) on the southern Kermadec Arc seamounts. These may be sulphur-stained, indicating hydrothermal and venting activity. They also grow on bedrock outcrops (Fig. 2C) with boulder and cobble fields, interspersed with gravel-sand (Clark *et al.*

FIG. 5. Margaret Lorraine Kelly (16 June 1933–1 October 2016). Image by R. Bialostocki, 25 December 2014

2010, 2013). The Graveyard Hills specimens from NIWA Stn TAN0905 grow on sand-overlaid bedrock with gorgonians and corals (Clark *et al.* 2009). Presumed depth range for non-examined specimens is 770–1439 m.

**Etymology.** The species name *lorraineae* is given in memory of Mrs Lorraine Kelly, the co-author's mother, who died on 1 October 2016, of a long and difficult illness (Fig. 5). Lorraine encouraged, fully supported, and celebrated Michelle's interest in things of the sea, as a young girl in Papua New Guinea, and later, in her academic and field studies.

**Remarks.** This specimen clearly belongs to genus *Atlantisella* by the diagnosis of Tabachnick (2002). It differs from the only species of the genus, *A. incognita* Tabachnick, 2002 by having no hexactine dermalia, having calycocome-like oxyhexasters among the microscleres (absent in *A. incognita*), and in the form of the oxystauractins (relatively longer primary rays but smaller total diameter in *A. incognita*). These differences are sufficient to conclude that the New Zealand form is the holotype of a new species, here designated *Atlantisella lorraineae* sp. nov. The key diagnostic characters of this species are that the body forms a thin-walled (about 0.5 mm) trumpet with foliose margins, the presence of dermalia and atrialia which are large pentactins coarsely spined on the outer surfaces, and microscleres which include oxystaurasters, calycocome-like oxyhexasters and graphiocomes. Morphological characteristics of *A. lorraineae* sp. nov. and eventually those of the four other widespread and as yet undescribed species will help clarify the position of the genus within the Euplectellidae and the relationships between the other genera in the eventual taxonomic revision of the family.

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