



New species of Scissurellidae, Anatomidae, and Larocheidae (Mollusca: Gastropoda: Vetigastropoda) from New Zealand and beyond

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Abstract

Thirteen new species of Scissurellidae (*Scissurella regalis* n. sp., *Sinezona mechanica* n. sp., *Sinezona platyspira* n. sp., *Sinezona enigmatica* n. sp., *Sinezona wanganellica* n. sp., *Satondella azonata* n. sp., *Satondella bicristata* n. sp.), Anatomidae (*Anatoma amydra* n. sp., *Anatoma kopua* n. sp., *Anatoma megascutula* n. sp., *Anatoma tangaroa* n. sp.), and Larocheidae (*Larochea spirata* n. sp., *Larocheopsis macrostoma* n. sp.) are described, all of which occur in New Zealand waters. The greatest geographic source of new taxa is the islands and underwater features off northern New Zealand. The new shell-morphological term “sutsel” is introduced for the area between the SUTURE and the SELenizone.

Keywords: new species, shell, radula, New Zealand, Indo-Malayan Archipelago

Introduction

The molluscan fauna of New Zealand is relatively well-known, based on the monographs by Powell (1979), and the inventories by Spencer & Willan (1995) and Spencer et al. (2009, 2011). The scissurellids have received some recent attention by Marshall (1993, 2002). Extensive collecting in the New Zealand region and large scale sediment sorting (by B.A.M.) over the last 35 years have yielded over 20,000 specimens of scissurellids and anatomids, including a number of undescribed species, which are here described. The global revision of this group scheduled to be published in late 2012 (Geiger unpubl. data) serves as a basis for global comparisons.

Scissurellids are basal snails (Vetigastropoda) that are found in all fully marine environments from the intertidal to the deep sea and from pole to pole. They have small shells (0.54–11 mm) without nacre and most have a slit or hole in the shell. Several families of uncertain relationships are contained in this group (Geiger et al. 2008). This contribution concerns Scissurellidae s.s., Anatomidae, and Larocheidae, but does not include the hydrothermal vent taxa Sutilizonidae and Temnocinclidae, or Depressizonidae.

Materials and Methods

Standard methods for scanning electron microscopy (SEM) were employed (Geiger et al. 2007). The terminology as defined by Geiger & Sasaki (2009) is applied. A new term is introduced, the sutsel, which refers to the space between the *suture* and the *selenizone* above. It is a particularly important character to distinguish *Anatoma* species. Its width is measured in multiples of the width of the selenizone (0× = no sutsel, suture immediately below selenizone, 0.5× = half as wide as selenizone, 1× = as wide as selenizone, 2× = twice as wide as selenizone), usually at a particular whorl count. The term trochiform is used to indicate a shell that is approximately as tall as wide with multiple whorls; no further shape connotations are implied. Dimensions for the holotypes are given as width × height. Maximum dimension is the largest dimension, usually as width. Four standardized views are given: apertural, umbilical, apical, and enlargement of the protoconch. Specimens are cited in the following format

(Institutional-repository-abbreviation Registration-Number, number of specimens); example: (NMNZ M. 012345, 12). No number of specimens is indicated for holotypes as they are always single specimens. Verbal size indications are given in relation to the known size range within each genus.

Abbreviations

AMS Australian Museum Sydney, New South Wales, Australia.
FV Fisheries Vessel.
GNS Institute of Geological and Nuclear Sciences, Lower Hutt, New Zealand.
MNHN Muséum National d'Histoire Naturelle, Paris, France.
NMNZ Museum of New Zealand Te Papa Tongarewa, Wellington, New Zealand.
NO Navire Océanographique.
RV Research Vessel.
USNM National Museum of Natural History, Smithsonian Institution, Washington, District of Columbia, USA.
OD Original designation.
M Monotypy.
SD Subsequent designation.

Systematics

Scissurellidae Gray, 1847

Scissurella d'Orbigny, 1824

Type species. *Scissurella laevigata* (SD: Gray 1847) [possibly a synonym of *Scissurella costata* d'Orbigny, 1824: cf. Marshall 2002]. Temperate and tropical waters of all oceans, Jurassic through Recent.

Scissurella regalis new species

(Figure 1)

Type material. Holotype (NMNZ M.173745: Fig. 1A). Paratypes from type locality (NMNZ M.303322, 12: Fig. 1B). 1.16 × 0.76 mm.

Type locality. Three Kings Rise, New Zealand, 31.866°S, 172.433°E, 780–790 m, RV *Rapuhia*, 5 Feb. 1988, comminuted bryozoans and shell.

Etymology. *Regalis*, Latin for royal in reference to the type locality.

Description. Shell small (to 1.16 mm: holotype, Fig. 1A), trochiform, depressed. Protoconch of 1 whorl, fine axials with strong median thickenings, no apertural varix, apertural margin straight. Teleoconch I of 1.125 whorls, 23–27 axial lamellae, no spiral sculpture. Teleoconch II of 0.66 whorl, suture strongly impressed. Shoulder with axial lamellae of increasing density (holotype), interstices with fine growth lines, no spiral sculpture. Base with slight constriction below selenizone, same strength and density of axial lamellae as on shoulder, indistinct spiral threads on last quarter whorl from below selenizone, growing fainter towards umbilicus. Umbilicus wide, rounded whorls, underside of protoconch visible. Selenizone above periphery, keels moderately strong, moderately elevated; slit open, margins parallel. Animal unknown.

Distribution. Three King Rise, 780–790 m.

Remarks. This species is only known from the type lots. *Scissurella regalis* is strikingly similar to *Sinezona platyspira* n. sp., but the slit has parallel rather than convergent margins and the axial lamellae extend almost to the selenizone rim on the last half whorl. The crowding of the axial lamellae towards the apertural margin in the holotype indicates that it is a fully-grown specimen and not a juvenile of a *Sinezona* species, in which the foramen has yet to close. A comparable *Scissurella-Sinezona* pair is *Scissurella azorensis* Nolt, 2008 and *Sinezona semicostata* Burnay & Rolán, 1990, from the Macaronesian Islands. Small specimens of *Sci. regalis* and *Sin. platyspira* may be indistinguishable based on shell morphology.

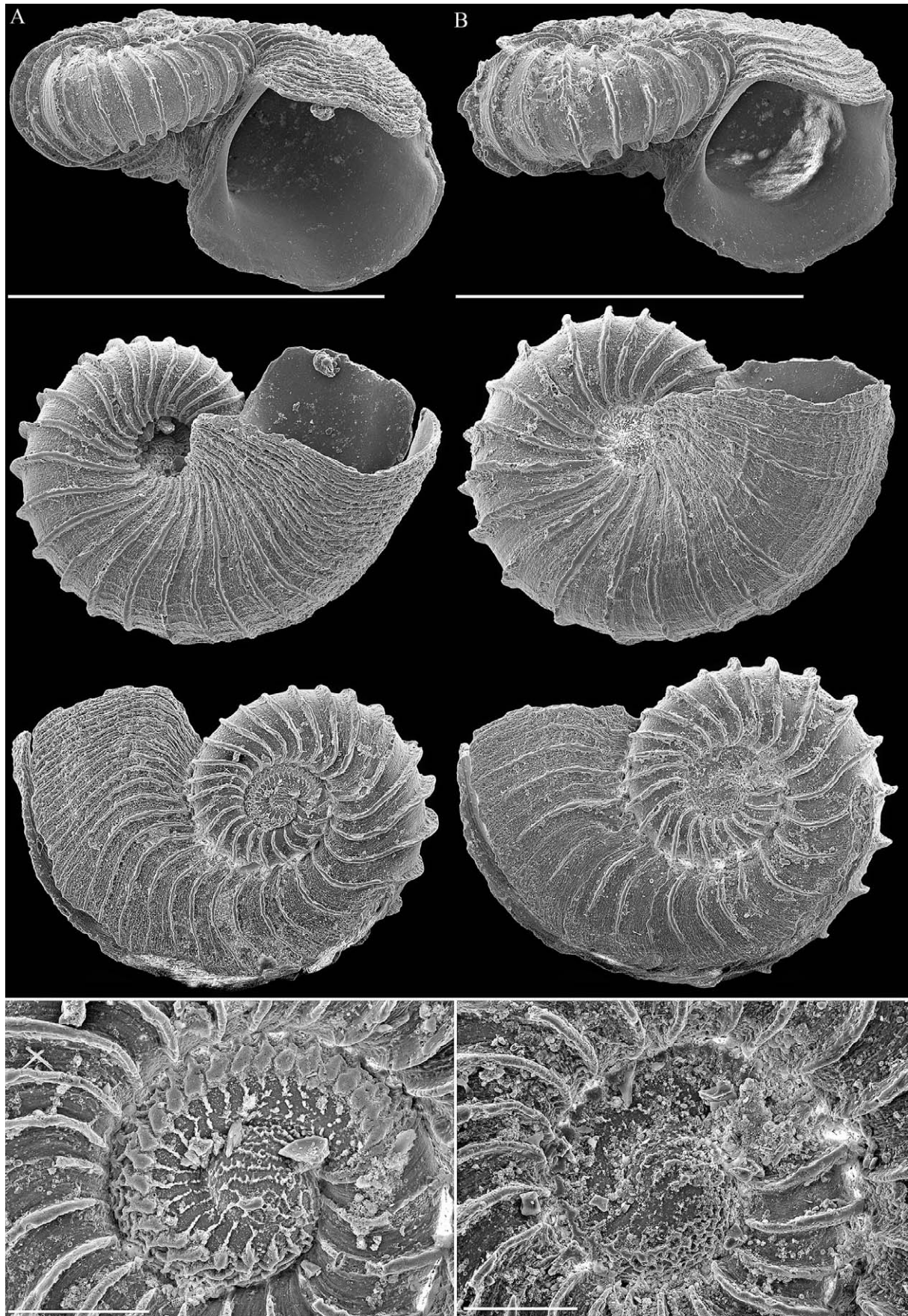


FIGURE 1. *Scissurella regalis* new species. Three King Rise, New Zealand, 780–790 m. A. Holotype (NMNZ M.173745). B. Paratype (NMNZ M.303322). Scale bars shell = 1 mm. Scale bars protoconch = 100 μ m.

Scissurella prendrevillei Powell, 1933 (DLG [pers. obs.] suspects that *Sci. marshalli* Bandel, 1998 is a synonym) from New Zealand has a protoconch with fine axials but has less distinct median thickenings, has fewer axial lamellae on teleoconch I (17–20 vs. 23–27), and usually has broad but low spiral cords surrounding the umbilicus. *Scissurella azorensis* from the Azores and the Western Mediterranean and *Sci. maraisorum* Geiger, 2006 from eastern South Africa have broader and lower axial cords, which do not reach the suture, and have no spiral sculpture on shoulder or base. The Panamic *Scissurella kaiserae* Geiger, 2006 has a shorter teleoconch I (<1 vs. > 1 whorl), lacks spiral sculpture on the shoulder, and the axial cords are at most as tall as wide. *Scissurella lobini* (Burnay & Rolán, 1990) from the northeastern Atlantic has a protoconch with more widely spaced axial cords devoid of a median thickening, lacks spiral sculpture on the teleoconch, and has at least 50% fewer axial cords.

Sinezona Finlay, 1926

Type species. *Schismope brevis* Hedley, 1904 (OD).

From temperate northern hemisphere to Antarctica, Eocene through Recent.

Sinezona enigmatica new species

(Figures 2–3)

Type material. Holotype (NMNZ M.303302: Fig. 2). Paratypes from type locality (AMS C.461493, 13: Fig. 3). 1.24 × 0.86 mm.



FIGURE 2. *Sinezona enigmatica* new species. Holotype. Mcgregors Bay, Whangarei Harbour, New Zealand (NMNZ M.303302). Scale bar shell = 1 mm. Scale bar protoconch = 100 μ m.

Type locality. McGregors Bay, Whangarei Harbour, northern New Zealand, 36.750°S, 175.467°E, low tide.

Etymology. Enigma, Latin for something inexplicable, referring to the surprising finding of a new species in a well-collected area, adjective; see also Remarks.

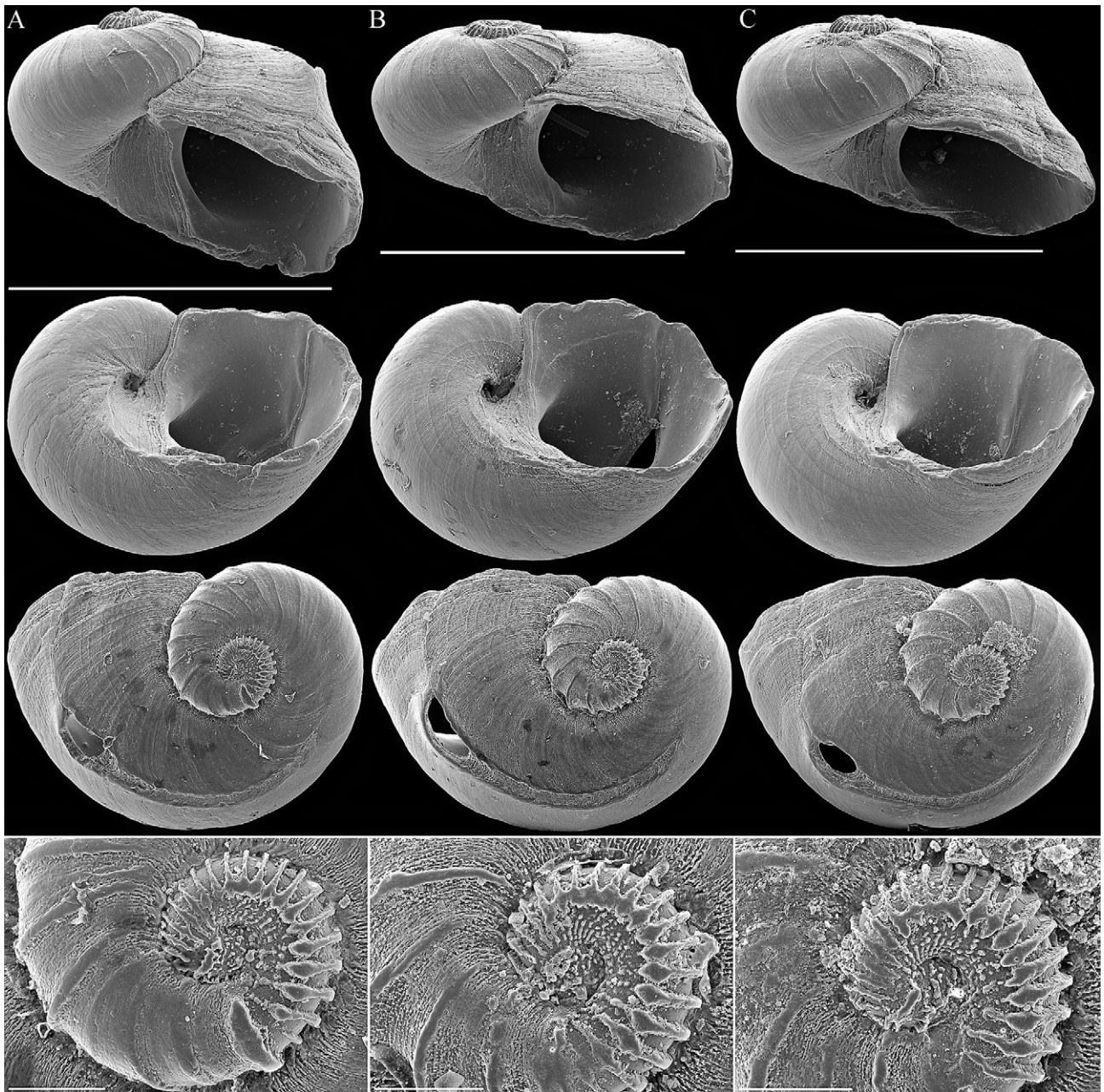


FIGURE 3. *Sinezona enigmatica* new species. Paratypes. A–C. McGregors Bay, Whangarei Harbour, New Zealand (AMS C.461493). Scale bars shell = 1 mm. Scale bars protoconch = 100 μ m.

Description. Shell medium size (to 1.24 mm. Figs 2–3), trochiform depressed. Protoconch of 1 whorl, strong axial sculpture with median thickenings, apertural varix not connected to embryonic cap, apertural margin straight. Teleoconch I of 0.9–1.1 whorls, 12–13 strong axial cords, diminishing in strength with growth, hardly perceptible at onset of selenizone, weaker towards suture; interstices with fine irregular growth marks. Teleoconch with moderately impressed suture, 0.25–0.4 whorl. Shoulder slightly convex, weak irregular growth marks, faint spiral threads or low indistinct cords, irregularly spaced, approximately 8 at apertural margin. Base with weak constriction below selenizone, macroscopically smooth, fine indistinct spiral threads, most distinct at apertural margin; threads finest and densest below selenizone, fewer, more prominent cordlets near umbilicus. Umbilicus at angle to base, surrounded by weak cords; walls with finest growth increments, straight. Aperture ovoid, roof

overhanging. Selenizone above periphery; keels low, moderately strong; lunules indistinct; foramen with raphe extending anteriorly.

Animal unknown.

Distribution. Northern New Zealand, intertidal.

Remarks. *Sinezona brevis* (Hedley, 1904) from New Zealand has a proportionally taller shell, its protoconch lacks the strong medial thickenings and has a strong apertural varix, has axial cords also on teleoconch II, and has distinct spiral threads on shoulder and base. *Sinezona levigata* (Iredale, 1908) from New Zealand has weak or distinct sculpture of spiral and axial cords forming a reticulate pattern, an umbilical callus, and a very short or even no selenizone, at most as long as the foramen. *Sinezona finlayi* (Laws, 1948) from the Tertiary of New Zealand has stronger spiral sculpture particularly on the base and has axial cords on teleoconch II as well. *Sinezona mechanica* n. sp. from New Zealand has axial cords on teleoconch I reaching the suture and distinct axial cords on teleoconch II.

The smooth surface of the last whorl and the relatively rapidly expanding whorls are shared with *Incisura* species, we also compare the new species to similar members of that genus. *Incisura lyttletonensis* (E.A. Smith, 1894) and *I. rosea* (Hedley, 1904) from the Recent fauna of New Zealand have an open slit. *Incisura auriformis* Geiger & Jansen, 2004, from Australia shares the closed foramen, but has more rapidly expanding whorls, and a very strong bulging cord surrounding the umbilicus.

The finding of the single lot in shallow water from McGregors Bay, Whangarei Harbour raises some questions. This bay has been very thoroughly collected (notably by W.F. Ponder: material NMNZ), yet not a single additional specimen of this species has been obtained from there or anywhere else in the New Zealand region. Whangarei Harbour is an important port for international shipping to and from New Zealand. Various options to account for the specimens were explored. Specimens could have been mislabeled, which is more likely as no further information on collector or date of collection are available, but the adjacent catalog numbers contain typical New Zealand scissurellid taxa, suggesting a single collection event. The specimens could have been brought to New Zealand in commercial ship ballast. If the specimens are indeed adventive, the morphospecies still is new to science and unknown from elsewhere (>10,000 lots and >72,000 specimens examined in the context of a global monograph Geiger, unpubl. data). There are other examples of single lot, shallow water species from other well-collected areas, such as the western Mediterranean (Geiger, unpubl. data). Reluctantly, we take the collection data at face value, and describe this new species with its associated type locality. Confirmation at the stated type locality, or discovery of its true native location will be desirable.

***Sinezona mechanica* new species**

(Figures 4–6)

Type material. Holotype (NMNZ M.174828: Fig. 4). 1.28 × 0.88 mm. Paratypes from type locality (NMNZ M.045402, 2: Fig. 5A–B). Additional paratypes: Saunders Canyon, off Otago Peninsula, South Island, New Zealand, 45.767°S, 170.900°E, 360 m (NMNZ M.160300, 2: Fig. 5C); Aerial Cove, Macquarie Island, 54.483°S, 158.950°E (AMS C.404496, 20).

Type locality. Ocean Bay, Chatham Island, New Zealand, 43.833°S, 176.783°W, 12–15 m, 7 Dec. 2000, F.J. Brook, bryozoans, shell and sand from rock crevice.

Etymology. Latin adjective referring to the sculpture of shell and protoconch suggestive of mechanical gears.

Description. Shell small (to 0.89 mm. Figs 4–5), depressed trochiform globular. Protoconch of 1 whorl, many dense axial cords on centrifugal portion of whorls, thickened at top forming (near) continuous connecting spiral cord. Apertural varix terminal (Fig. 8B), not connected to embryonic cap, apertural margin straight. Teleoconch I of 0.9–1 whorl, approximately 17–20 strong (occasionally barely perceptible) axial cords, no spirals. Teleoconch II of 0.6 whorl, suture little impressed. Shoulder slightly concave, same density and strength of axial cords as on teleoconch I, finest growth marks in interstices, no spirals. Base with weak constriction below selenizone, rounded, same density and strength of axial cords as on shoulder; approximately 4 weak, granular spiral cordlets in adumbilical 1/5 of base. Umbilicus of moderate width, at sharp angle to base, bordered by weak to moderate strength spiral cord, wall straight, smooth. Aperture rounded, roof overhanging. Selenizone above periphery; keels low, moderate strength; lunules distinct; slit open, margins somewhat converging.

Radula (Fig. 6). Rachidian trapezoid, central cusp largest, three cusps on each side. Lateral teeth 1–3 similar, apical cusps largest, 4–6 on outer cutting edge. Lateral tooth 4 reduced, hook shaped, with 1 minute point on each side of tip. Lateral tooth 5 enlarged by broadening, apical cusp largest, 5–7 cusps along inner edge. Inner marginal teeth triangular, apical cusp largest, 1–2 along inner edge, 4–6 along outer edge of tip. Outer marginal teeth with spoon shaped tip bearing many fine bristles. Radular interlock of central field moderate.

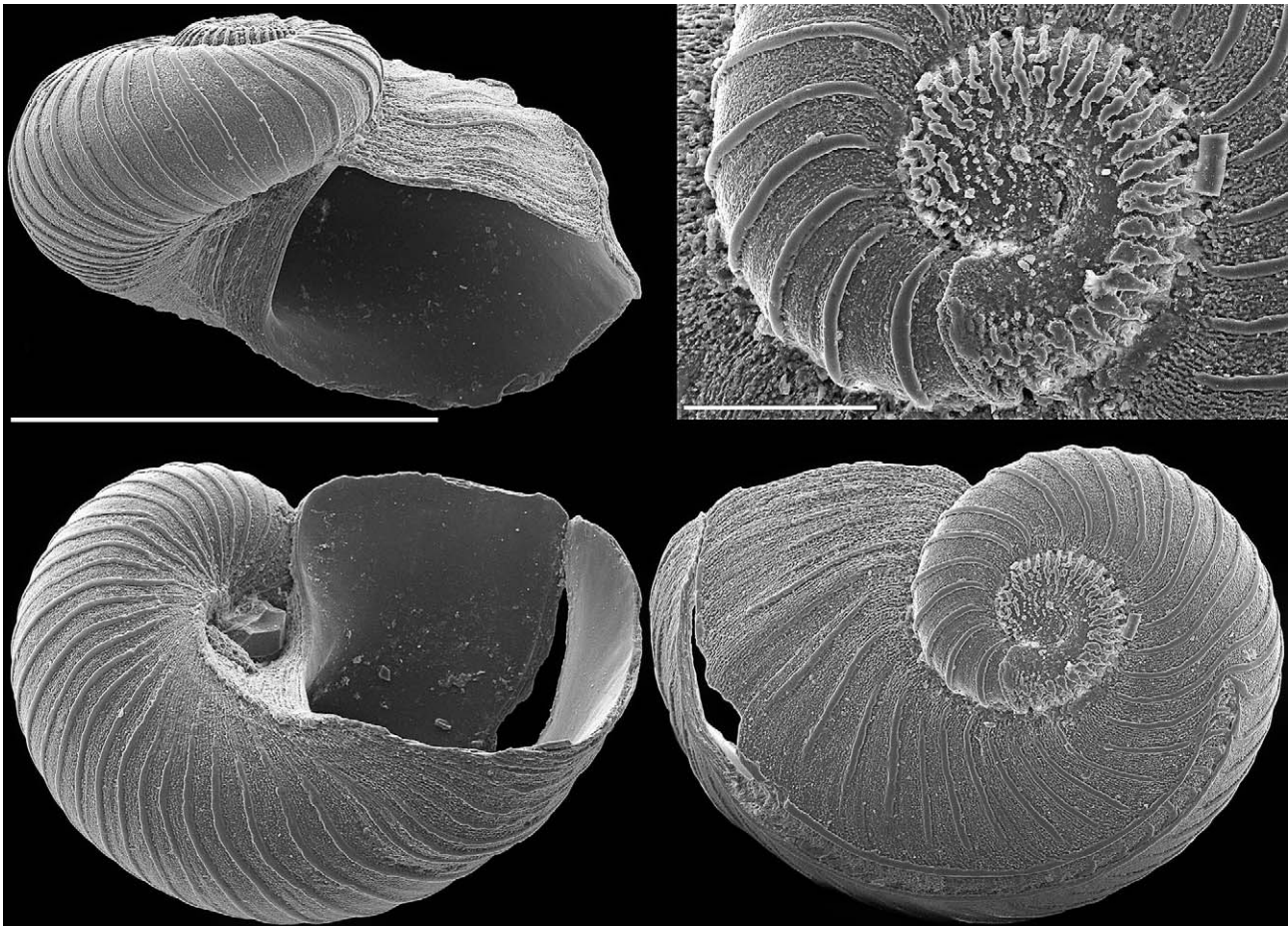


FIGURE 4. *Sinezona mechanica* new species. Holotype. Ocean Bay, Chatham Island, New Zealand, 12–15 m, (NMNZ M.174828). Scale bar shell = 0.5 mm. Scale bar protoconch = 100 μ m.

Distribution. Pleistocene to Recent of New Zealand, 12–106 m.

Specimen records. New Zealand. Ranfurly Bank, East Cape, 37.546°S, 178.812°E, 94 m (NMNZ M.303294, 1); Ranfurly Bank, 37.551°S, 178.825°E, 89–94 m (NMNZ M.303293, 15); Ranfurly Bank, 37.553°S, 178.838°E, 71–76 m (NMNZ M.303295, 50); Ranfurly Bank, 37.556°S, 178.805°E, 103–106 m (NMNZ M.303327, 5); Ocean Bay, Chatham Island, 43.833°S, 176.783°W, 12–15 m (NMNZ M.174828, 1); Saunders Canyon, off Otago Peninsula, 45.766°S, 170.900°E, 360 m (NMNZ M.160300, 2); NE of Cape Saunders, off Otago Peninsula, 45.833°S, 170.933°E, 105 m (NMNZ M.045402, 2); off Taieri, S of Dunedin, 46.250°S, 170.483°E, 91 m (NMNZ M.066283, 2); off Poutama Island, South Cape, Stewart Island, 47.266°S, 167.383°E, 55 m (NMNZ M.303296, 60). Macquarie Island. Aerial Cove, 54.483°S, 158.950°E (AMS C.404496, 20).

New Zealand, fossil. GS4057, Kaikokopu Shellbed (Castlecliffian, oxygen isotope stage 19, middle Pleistocene), coast E of Omapu Stream mouth, between Castlecliff and Kai-Iwi beaches, Wanganui, 39.907°S, 174.941°E (GNS, 1).

Remarks. *Sinezona mechanica* can be distinguished from New Zealand species as follows. *Sinezona apudornata* (Laws, 1935) from the Miocene has a similar overall shape of the shell and similar overall sculpture of the protoconch, but its spire is much more elevated and it has a greater number of teleoconch II whorls (0.6 vs. 1.1). *Sinezona bandeli* Marshall, 2002 has a more subquadrate shell, much stronger constriction of the base below the selenizone, and lacks the top spiral cord on the protoconch. *Sinezona brevis* has a shorter selenizone (0.1 vs. 0.4

whorl), a more distinct periumbilical cord, and fine spiral threads on the shoulder. *Sinezona enigmatica* has axial cords on teleoconch I not reaching the suture and lacks distinct axial cords on teleoconch II. *Sinezona iota* (Finlay, 1926) is much taller, has strong axial lamellae, and lacks spiral sculpture on the base. *Sinezona laqueus* (Finlay, 1926) has a subquadrate overall shell shape, strong prosocline axial folds, and strong lunules in the selenizone. *Sinezona levigata* has an umbilical callus, has an overall wider shell, and has spiral sculpture on the shoulder and the base. *Sinezona pacifica* (Oliver, 1915) has stronger spiral sculpture on shoulder and base, a narrower umbilicus, and lacks the top spiral cord on the protoconch. *Sinezona pauperata* Powell, 1933 lacks a selenizone, has a round foramen, and a very narrow umbilicus. *Sinezona platyspira* n. sp. has a flatter spire, the umbilicus is produced by the rounded portions of the previous whorls, and the protoconch lacks the top spiral as well as an apertural varix.

The widely distributed subantarctic species *Sin. subantarctica* (Hedley, 1916) has a callus over the umbilicus, a very short (or absent) selenizone, and the protoconch lacks the top spiral cord and an apertural varix.

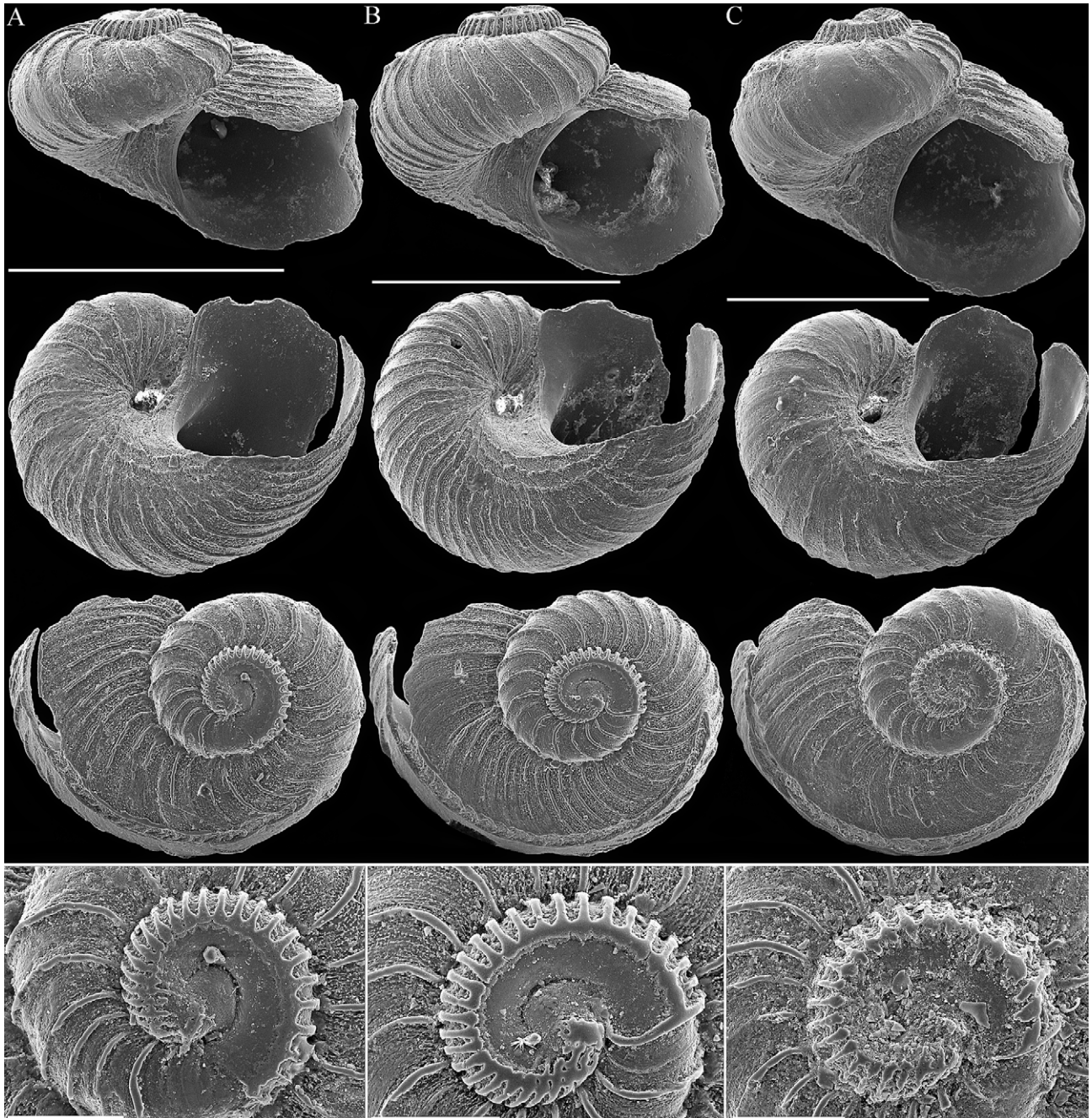


FIGURE 5. *Sinezona mechanica* new species. Paratypes. A–B. NE of Cape Saunders, Otago Peninsula, New Zealand, 45.833°S, 170.933°E, 105 m (NMNZ M.045402). C. Saunders Canyon, off Otago Peninsula, 45.767°S, 170.900°E, 360 m (NMNZ M.160300). Scale bars shell = 0.5 mm. Scale bars protoconch = 100 μ m.

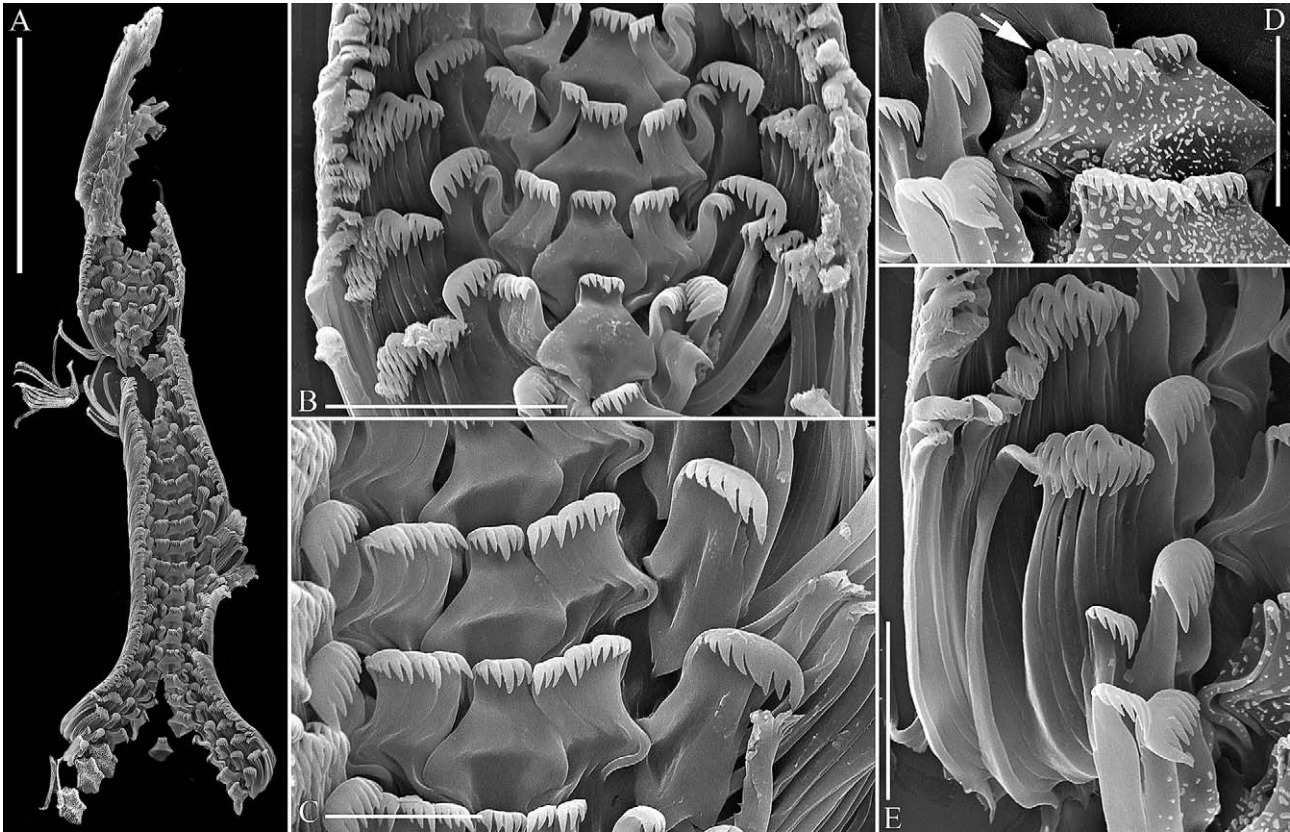


FIGURE 6. *Sinezona mechanica* new species. Radula. A. Entire radula. Scale bar = 100 µm. B. Full width of radula. Scale bar = 20 µm. C. Central field enlarged. Scale bar = 10 µm. D. Lateral tooth 4 (arrow). Scale bar = 10 µm. E. Marginal teeth. Scale bar = 10 µm. Aerial Cove, Macquarie Island (AMS C.404496).

***Sinezona platyspira* new species**

(Figure 7)

Type material. Holotype (NMNZ M.301400: Fig. 7A). 0.95 × 0.6 mm. Paratype from type locality (NMNZ M.301399, 1: Fig. 7B).

Type locality. West Norfolk Ridge, W of Cape Reinga, New Zealand, 34.298°S, 168.430°E, 785–800 m, 2 June 2003, RV *Tangaroa*, comminuted coral and bryozoans.

Etymology. Platy-, flat, -spira, spire: referring to the flat spire of the species. Adjective.

Description. Shell small (to 0.95 mm. Fig. 7), trochiform depressed. Protoconch 1 whorl, strong axials, no apertural varix, apertural margin convex. Teleoconch I of 0.9–1.1 whorls, 12–26 axial lamellae, interstices with finest growth marks, no spirals. Teleoconch II of 0.6 whorl, suture deeply impressed. Shoulder flat; approximately 12–21 axial cords, often restricted to adsutural quarter, in some specimens almost absent; no spirals. Base with distinct constriction below selenizone; on teleoconch I, axial lamellae continuous into umbilicus; on teleoconch II, fewer axial lamellae (approximately 6) fading out towards umbilicus; no spirals. Umbilicus open, deep, cavity produced by rounded portion of previous whorls, underside of protoconch visible, bordered by strong spiral cord. Aperture tilted, D-shaped, roof overhanging. Selenizone above periphery, keels strong, quite elevated; lunules distinct, foramen closed with short anterior raphe.

Animal unknown.

Distribution. West Norfolk Ridge, W of Cape Reinga, northern New Zealand, 785–800 m.

Specimen records. West Norfolk Ridge, W of Cape Reinga, 34.285°S, 168.430°E, 785–800 m (NMNZ M.172128, 31).

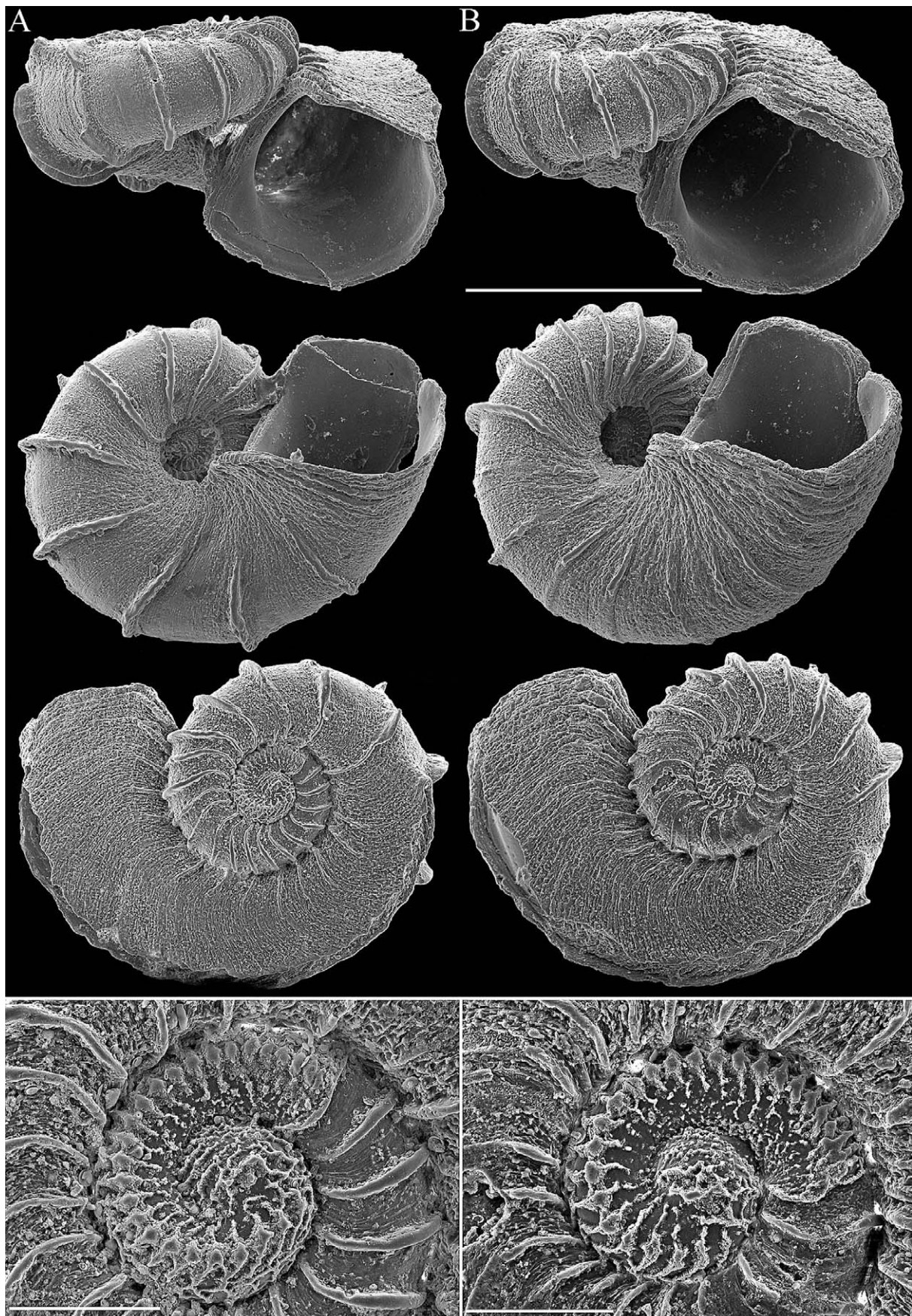


FIGURE 7. *Sinezona platyspira* new species. West Norfolk Ridge, W of Cape Reinga, 34.298°S, 168.430°E, 785–800 m A. Holotype. (NMNZ M.301400). B. Paratype (NMNZ M.301399). Scale bars shell = 0.5 mm. Scale bars protoconch = 100 μ m.

Remarks. *Sinezona platyspira* can be distinguished from New Zealand species as follows. *Sinezona bandeli* has a strong constriction on the base below the selenizone, has an umbilicus with straight walls, and the protoconch has an apertural varix. *Sinezona brevis* has an umbilicus with straight walls, a much shorter selenizone (0.1 vs. 0.4 whorl), and a more elevated spire. *Sinezona iota* has a much taller shell with protruding protoconch, the umbilicus has straight walls, and the protoconch has an apertural varix. *Sinezona laqueus* has a stronger constriction of the base below the selenizone, the umbilicus has straight walls, and has axial folds as opposed to lamellae. *Sinezona levigata* has a callus covering the umbilicus, lacks a constriction of the base below the umbilicus, and has no axial lamellae. *Sinezona mechanica* has an umbilicus with straight walls, about twice as many finer axial cords, and has axial cords over the entire width of the shoulder on teleoconch II. *Sinezona pacifica* has an umbilicus with straight walls, is overall taller, and has a protoconch with apertural varix. *Sinezona pauperata* lacks a selenizone, has a very narrow umbilicus, and lacks axial lamellae.

The subantarctic *Sin. subantarctica* has a callus covering the umbilicus, a very short selenizone (<0.1 whorl), and spiral threads on the lower base. *Satondella minuta* Bandel, 1998 from the Indo-Pacific has much more elevated keels bordering the foramen.

Sinezona wanganellica new species

(Figures 8–9)

Type material. Holotype (NMNZ M.303304: Fig. 8). 0.71 × 0.41 mm. Paratypes from type locality (NMNZ M.178433, 7). Wanganella Bank summit, West Norfolk Ridge, 32.606°S, 167.584°E, 120–126 m (NMNZ M.171826, 14: Fig. 9B–C). Wanganella Bank summit, 32.573°S, 167.517°E, 113 m (NMNZ M.174832, 14: Fig. 9A).

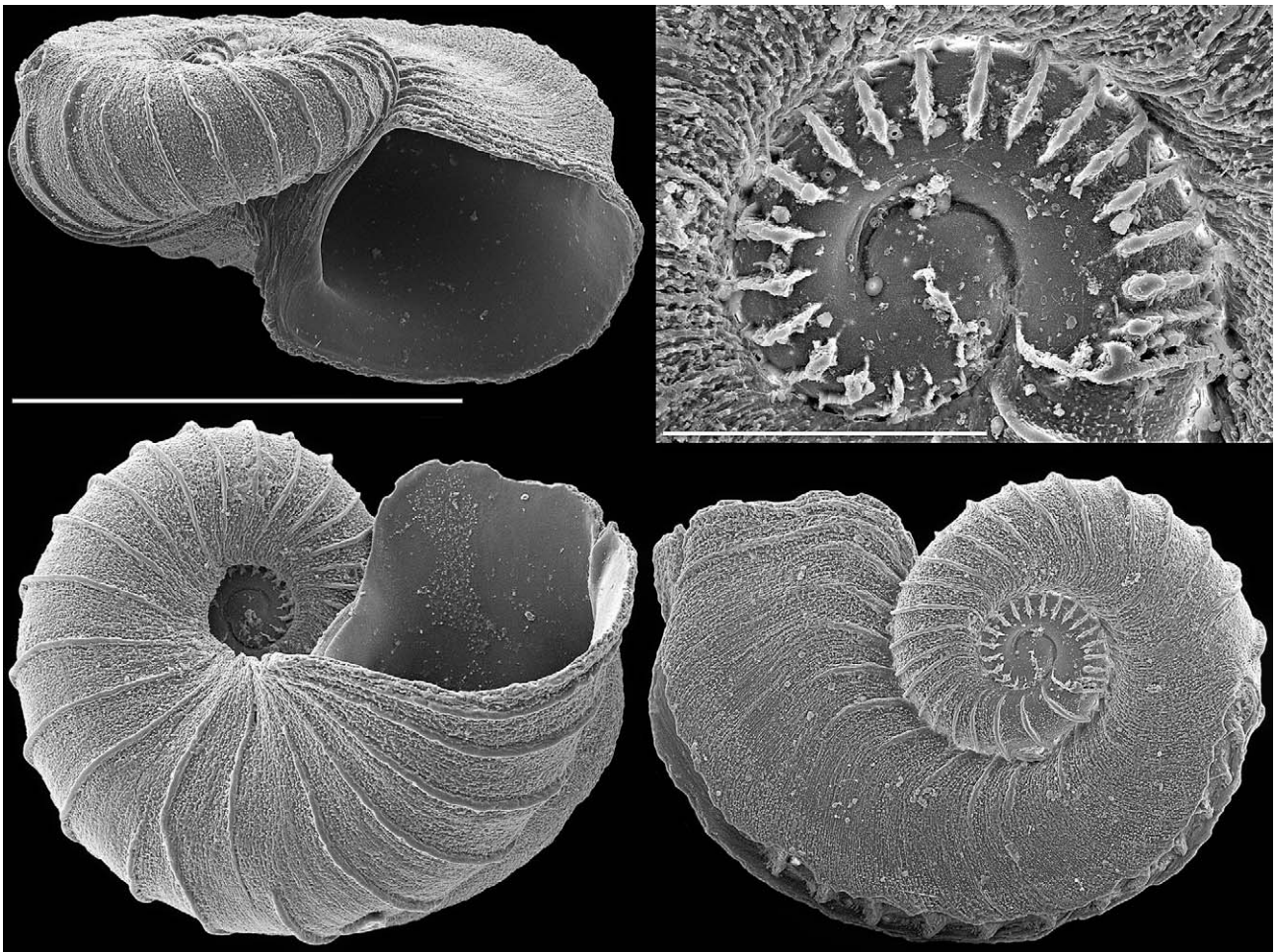


FIGURE 8. *Sinezona wanganellica* new species. Holotype. Wanganella Bank summit, West Norfolk Ridge, 133 m (NMNZ M. 303304). Scale bar shell = 0.5 mm. Scale bar protoconch = 100 μ m.

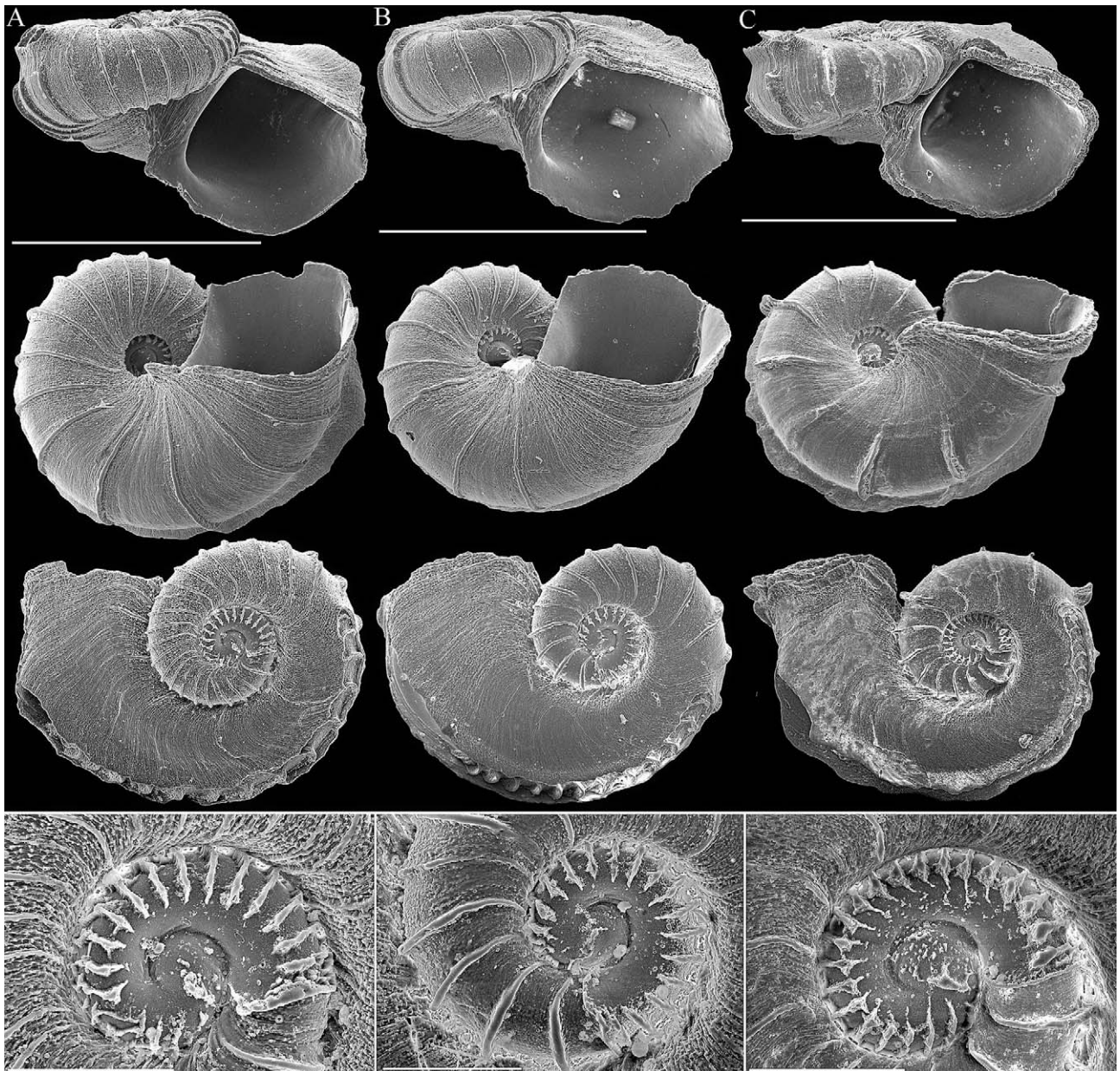


FIGURE 9. *Sinezona wanganellica* new species. Paratypes. A. Wanganella Bank summit, West Norfolk Ridge, 113 m (NMNZ M.174832). B–C. Wanganella Bank summit, 120–126 m (NMNZ M.171826). Scale bars shell = 0.5 mm. Scale bars protoconch = 100 μ m.

Type locality. Wanganella Bank summit, West Norfolk Ridge, NW of Cape Maria van Diemen, New Zealand, 32.543°S, 167.487°E, 133 m, rhodolith gravel and red algae.

Etymology. Named for the type locality; adjective.

Description. Shell small (to 0.7 mm. Figs 8–9), trochiform depressed. Protoconch of 1 whorl, 19–21 sharp axials from midline to outer suture, embryonic cap with some irregular flocculations, no apertural varix, apertural margin slightly convex. Teleoconch I of 0.875–0.9 whorl with 12–22 sharp to elevated axial cords with onset close to suture on early teleoconch I shifting to past position of selenizone with onset of selenizone; interstices with finest growth marks, no spiral sculpture. Teleoconch II of 0.66 whorl, suture impressed. Shoulder overall flat, concave towards selenizone; mainly finest growth marks, 0–12 axial cords in adsutural quarter, no spiral sculpture. Base with distinct constriction below selenizone, same density and strength of axial cords as on teleoconch I; some axial cords not reaching umbilicus. Umbilicus formed by rounded portion of previous whorls, underside of protoconch visible. Selenizone above periphery; keels moderately strong, quite elevated; lunules very strong; slit closed anteriorly to foramen. Aperture rounded D-shaped, roof overhanging. Animal unknown.

Distribution. West Norfolk Ridge, 113–800 m.

Specimen records. West Norfolk Ridge. 32.653°S, 167.528°E, 133 m (NMNZ M.174834, 1); 32.666°S, 167.560°E, 133 m (NMNZ M.174841, 5). ESE of Wanganella Bank, 34.284°S, 168.430°E, 785–800 m (NMNZ M.172128, 31).

Remarks. *Sinezona wanganellica* can be distinguished from New Zealand species as follows. *Sinezona bandeli* Marshall, 2002 has an overall taller shell, has spiral threads on the shoulder and base of the teleoconch, and has a narrower umbilicus occluding the underside of the protoconch. *Sinezona mechanica* lacks a sunken in apex, has a more rounded whorl profile, and has at least 50% more axial cords. *Sinezona platyspira* has a longer teleoconch I (1.125 vs. 0.875 whorl) and has at least 50% more axials on the protoconch. *Scissurella regalis* has a protoconch with at least 50% more axials, which bear strong median thickenings, has a longer teleoconch (1.125 vs. 0.875 whorls), and retains an open slit.

Satondella Bandel, 1998

Type species. *Satondella minuta* Bandel, 1998 (OD).

Subtropical and tropical Atlantic, Indian Ocean through Central Pacific. Eocene, Recent.

Remarks. The genus was recently revised by Luque et al. (2011).

Satondella azonata new species

(Figures 10–11)

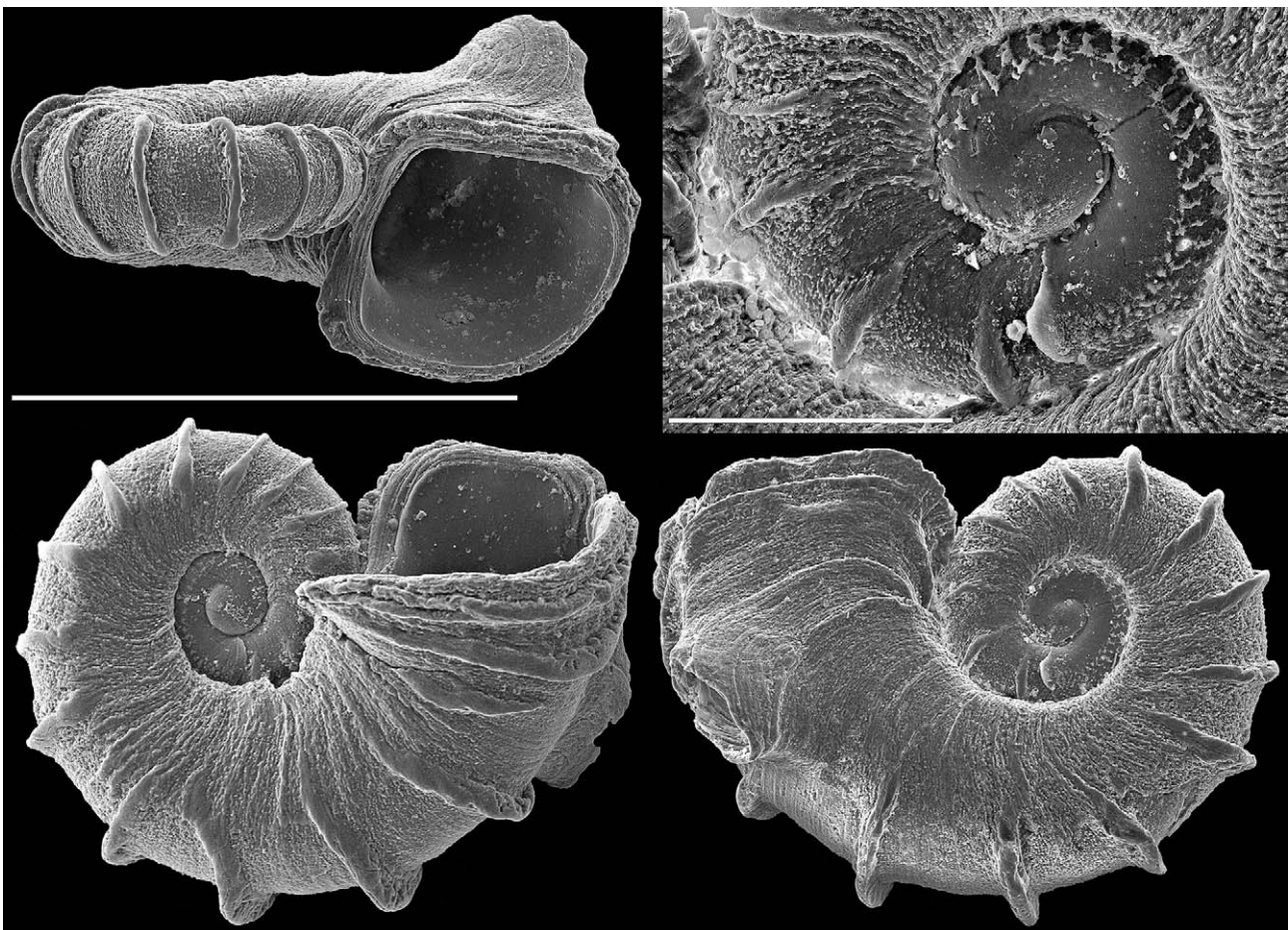


FIGURE 10. *Satondella azonata* new species. Holotype. Wanganella Bank summit, West Norfolk Ridge, 133 m (NMNZ M.174835). Scale bar shell = 0.5 mm. Scale bar protoconch = 100 μ m.

Chresonymy. *Scissurella?* sp.: Spencer et al., 2009: 202.

Type material. Holotype (NMNZ M.174835: Fig. 10). 0.63 × 0.36 mm. Paratypes from type locality (NMNZ M.301398, 4: Fig. 11A–B; NMNZ M.174825, 5: Fig. 11C).

Type locality. Wanganella Bank summit, West Norfolk Ridge, W of Cape Maria van Diemen, New Zealand, 32.543°S, 167.487°E, 133 m, 29 Jan. 1981, RV *Tangaroa*, rhodolith gravel and red algae.

Etymology. A-, Latin prefix for without, -zonata referring to the selenizone. It describes the lack of a selenizone in this species. Adjective.

Description. Shell small (to 0.63 mm: Figs 10–11), trochiform depressed, apex sunken in. Protoconch of 1 whorl, fine irregular axial cords on outer portion, apical cap and inner portion of whorl smooth; no apertural varix, apertural margin sinusoid. Teleoconch I of 1.125 whorls; suture impressed; 12–16 axials, low cords at onset of teleoconch I gradually rising to strong lamellae, onset of lamellae shifting from suture to position of foramen on shoulder, from suture to mid base on underside; interstices with fine irregular growth lines. Teleoconch II of 0.125 whorl. Shoulder flat, sculpture consisting of only fine irregular growth lines. Base with 2–3 strong axial lamellae as on teleoconch I. Umbilicus wide, distinct funiculus, underside of protoconch visible. No selenizone; foramen oblong, raised to chimney. Aperture subquadrate, peristome thickened. Animal unknown.

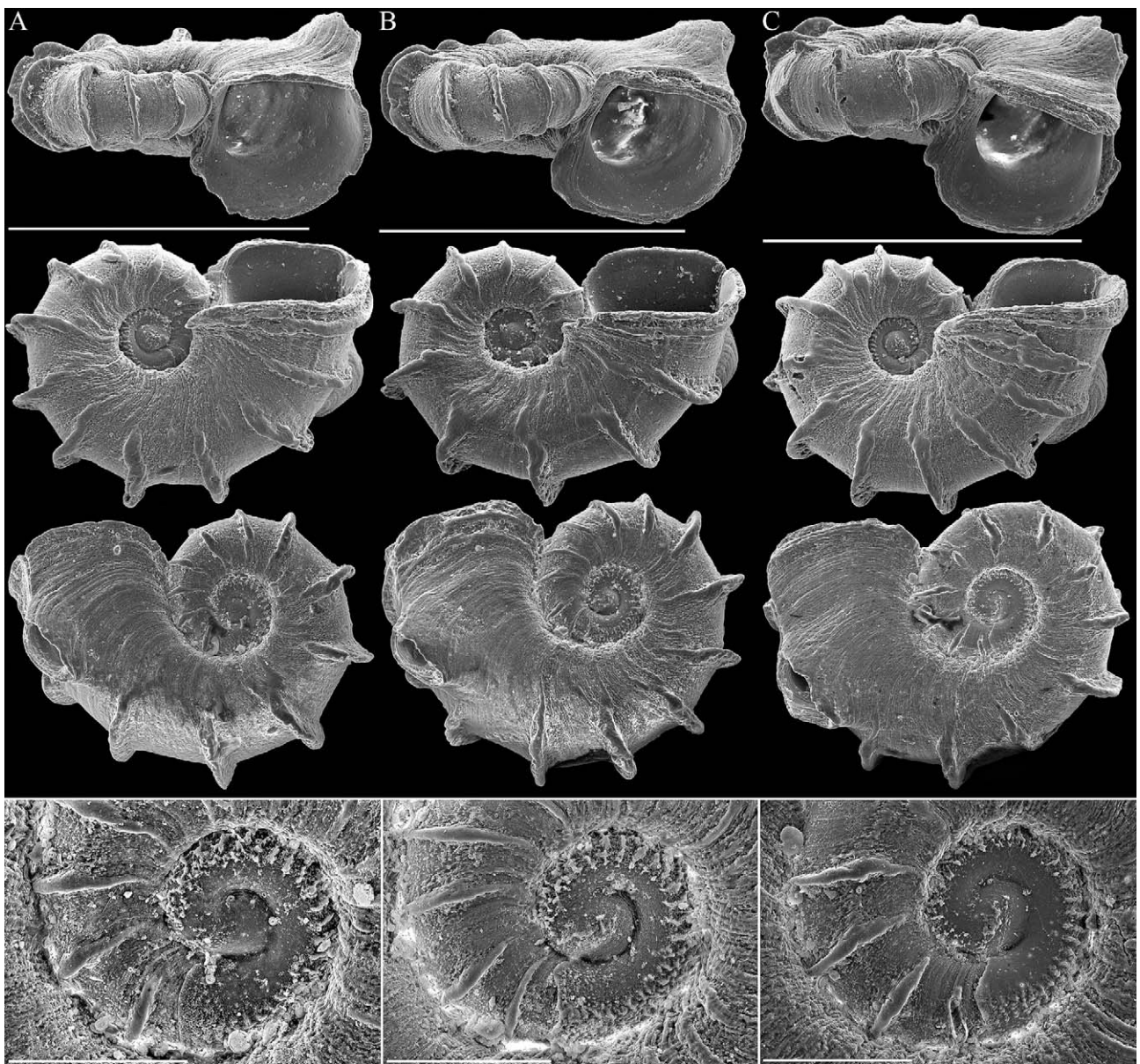


FIGURE 11. *Satondella azonata* new species. Paratypes Wanganella Bank summit, West Norfolk Ridge, 133 m A–B. (NMNZ M.301398). C. (NMNZ M.174825). Scale bars shell = 0.5 mm. Scale bars protoconch = 100 μm.

Distribution. West Norfolk Ridge and northern New Zealand, 33–805 m.

Specimen records. Wanganella Bank, West Norfolk Ridge. 32.536°S, 167.512°E, 113 m (NMNZ M.257269, 1); summit, 32.543°S, 167.487°E, 133 m (NMNZ M.301398, 4; NMNZ M.174835, 1); summit, 32.653°S, 167.528°E, 133 m (NMNZ M.174826, 1); summit, 32.666°S, 167.560°E, 133 m (NMNZ M.174825, 5). New Zealand. Three Kings Islands: Three Kings Trough, 34.000°S, 171.917°E, 805 m (NMNZ M.160302, 1); N of Great Island, 34.016°S, 172.117°E, 622 m (NMNZ M.034601, 2); Middlesex Bank, 34.033°S, 171.733°E, 246–291 m (NMNZ M.148570, 1); reef between Great Island and Farmer Rocks, 34.150°S, 172.167°E, 33 m (NMNZ M.160303, 1).

Remarks. The thickening of the peristome resembles the condition seen in Liotiidae and is a clear sign of fully grown specimens. Accordingly, the absence of a selenizone is not an indication of juvenile specimens, but is a distinct, species-specific character.

Satondella minuta from the Indo-Pacific has a smooth protoconch, has a selenizone, and has distinct spirals over the entire teleoconch. *Satondella bicristata* n. sp. from New Zealand has twice as many but lower axial cords/lamellae and has distinct spirals particularly on the base. *Satondella dantarti* Luque, Geiger & Rolán, 2011, has a selenizone, distinct spiral sculpture on the teleoconch as well as axial lamellae on the shoulder.

Satondella bicristata new species

(Figure 12)

Type material. Holotype (NMNZ M.137457: Fig. 12C). 0.66 × 0.37 mm. Paratypes from type locality (NMNZ M.301393, 2: Fig. 12A–B).

Type locality. Seamount 130 km S of Esperance Rock, Kermadec Ridge, NE of New Zealand, 538 m, 32.472°S, 179.265°W, 15 Apr. 1997, FV *Santa Maria*, hardground, foraminiferal sand, sponges and bryozoans.

Etymology. Bi-, Latin for two; -cristata, Latin for crest-bearing, referring to the two elevated ridges formed on shoulder and base by the axial lamellae.

Description. Shell small (to 0.67 mm. Fig. 12), depressed trochiform, almost planispiral. Protoconch sunken in, 1 whorl, fine axials from highest point centrifugally to suture, no apertural varix, apertural margin sinusoid. Teleoconch I of 1.25–1.5 whorls; approximately 32–36 axials, near suture and peripherally as axial cords, in position of selenizone and on mid-base as raised lamellae; spiral cordlet in position of selenizone and on mid-base, crossing with tallest portion of axial lamellae; occasionally some additional spiral threads. Teleoconch II of 0.125 whorl, suture deeply impressed. Shoulder convex, same sculpture as on teleoconch I. Base with distinct constriction below foramen, sculpture as on teleoconch I. Umbilicus open, underside of protoconch visible, towards base bordered by strong bulge, no distinct wall. Aperture rounded D-shaped. Selenizone absent, foramen above periphery, anteriorly closed by raphe; keels strongly elevated, moderately strong.

Animal unknown.

Distribution. Kermadec Ridge, New Zealand. 538 m.

Remarks. The generic placement is suggested by the high elevation of the keels of the foramen.

Satondella minuta from the Indo-Malayan Archipelago has less depressed shell, fewer axial lamellae, and a distinct selenizone. *Satondella azonata* from New Zealand has about half as many raised axial lamellae and lacks spirals on the base. *Scissurella condita* Laws, 1939 from the Miocene of New Zealand has a similar overall shell shape, but has a distinct selenizone and an open slit. All other *Satondella* species are markedly more elevated.

Anatomidae McLean, 1989

Anatoma Woodward, 1859

Type species. *Scissurella crispata* Fleming, 1828 (M).

Arctic to Antarctic of all oceans, (Cretaceous?) Paleocene though Recent.

Remarks. A neotype for the controversial type species was designated by Høisaeter & Geiger (2011), who also pointed out that the distinction of *Anatoma* and *Thielella* Bandel, 1998 can no longer be supported. We follow them and use the single genus *Anatoma*.

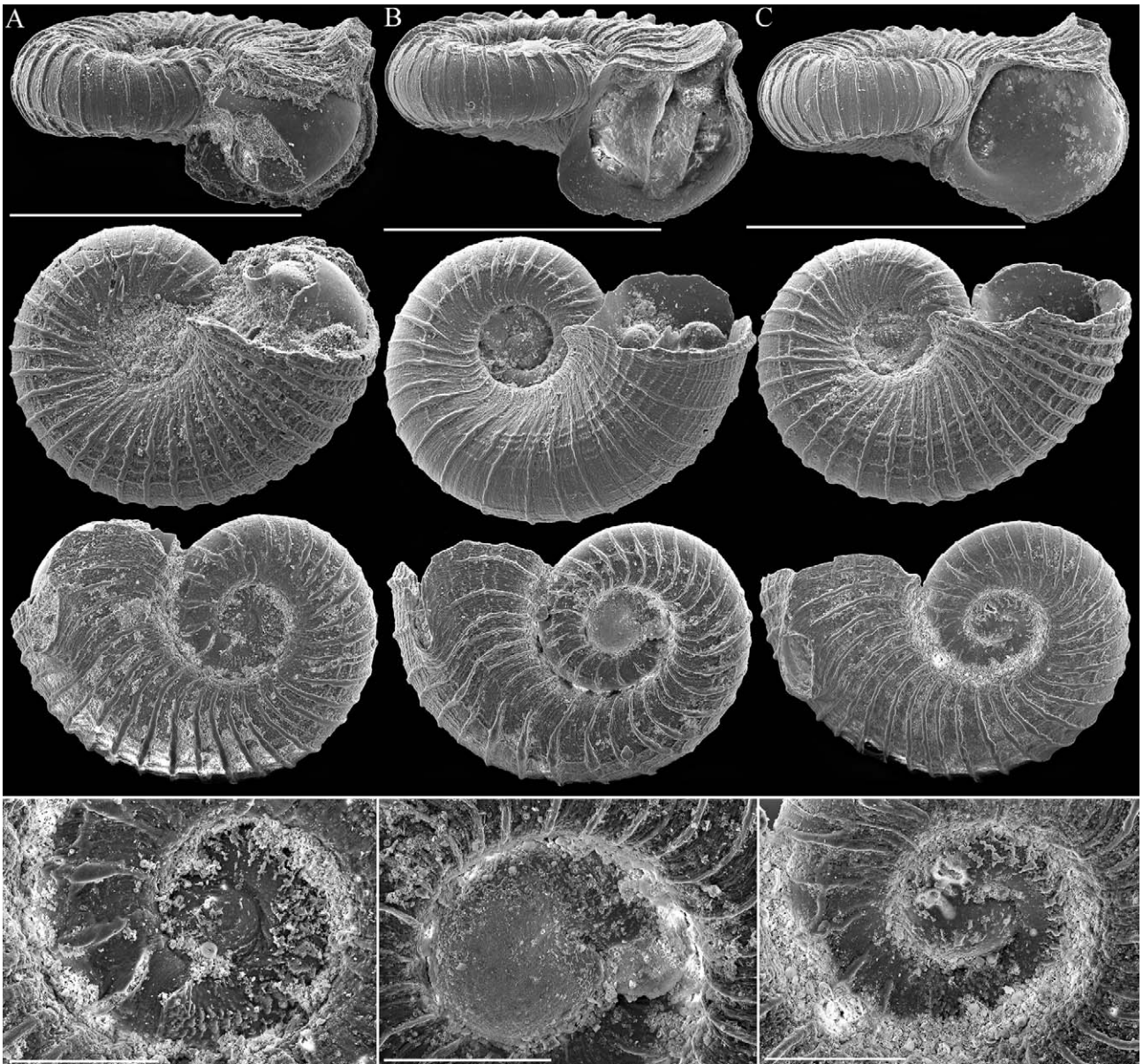


FIGURE 12. *Satondella bicristata* new species. Seamount 130 km S of Esperance Rock, Kermadec Ridge, NE of New Zealand, 538 m. A–B. Paratypes (NMNZ M.301393). C. Holotype (NMNZ M.137457). Scale bars shell = 0.5 mm. Scale bars protoconch = 100 µm.

Anatoma amydra new species

(Figures 13–15)

Type material. Holotype (MNHN 24957: Fig. 13). 2.21 × 1.81 mm. Paratypes: New Caledonia, 22.883°S, 167.283°E, 570–610 m, (MNHN 24958, 18; NMNZ M.303303, 1: Fig. 14).

Type locality. Northern New Caledonia, Grand Passage, 18°49'S, 163°15'E, 600–616 m, 5 Aug 1994, N.O. *Alis* (BATHUS 4 stn DW914).

Etymology. Amydros, Greek for indistinct, dim, obscure. Refers to the lack of prominent features.

Description. Shell medium size (to 3.4 mm: Figs 13–14) trochiform turreted. Protoconch of 0.75 whorl, flocculent sculpture, apertural varix barely connected to embryonic cap, apertural margin shallow sinusoid. Teleoconch I of 0.66 whorl, 13–19 axial cords, spiral cord in position of selenizone. Teleoconch II of 2.75 whorls, suture little impressed, sutsel less than width of selenizone on early shell showing 1 or 2 spiral threads, 2–3× width of selenizone at apertural margin, showing approximately 6 spiral threads. Shoulder convex, many fine axial cords extending onto keels of selenizone, interstices as wide as cords at suture, twice as wide near selenizone; first spiral

thread after 0.1–0.2 teleoconch II whorl, 4–10 after first whorl, 12–15 at apertural margin, evenly distributed over width of shoulder; spiral threads running over axial cords. Base barely constricted below selenizone, continuously sloping with umbilicus, dense axial cords extending onto keels of selenizone, interstices twice as wide as cords near selenizone, less than width of cords near umbilicus; approximately 25 spirals from immediately below selenizone into umbilicus, spiral threads from selenizone to mid-base, then turning into steps, increasing in strength twofold towards umbilicus. Umbilicus of moderate width, no funiculus. Aperture rounded, adumbilical portion flared, roof overhanging. Selenizone at periphery, keels moderately elevated, moderately strong; slit open, margins converging in fully-grown specimens.

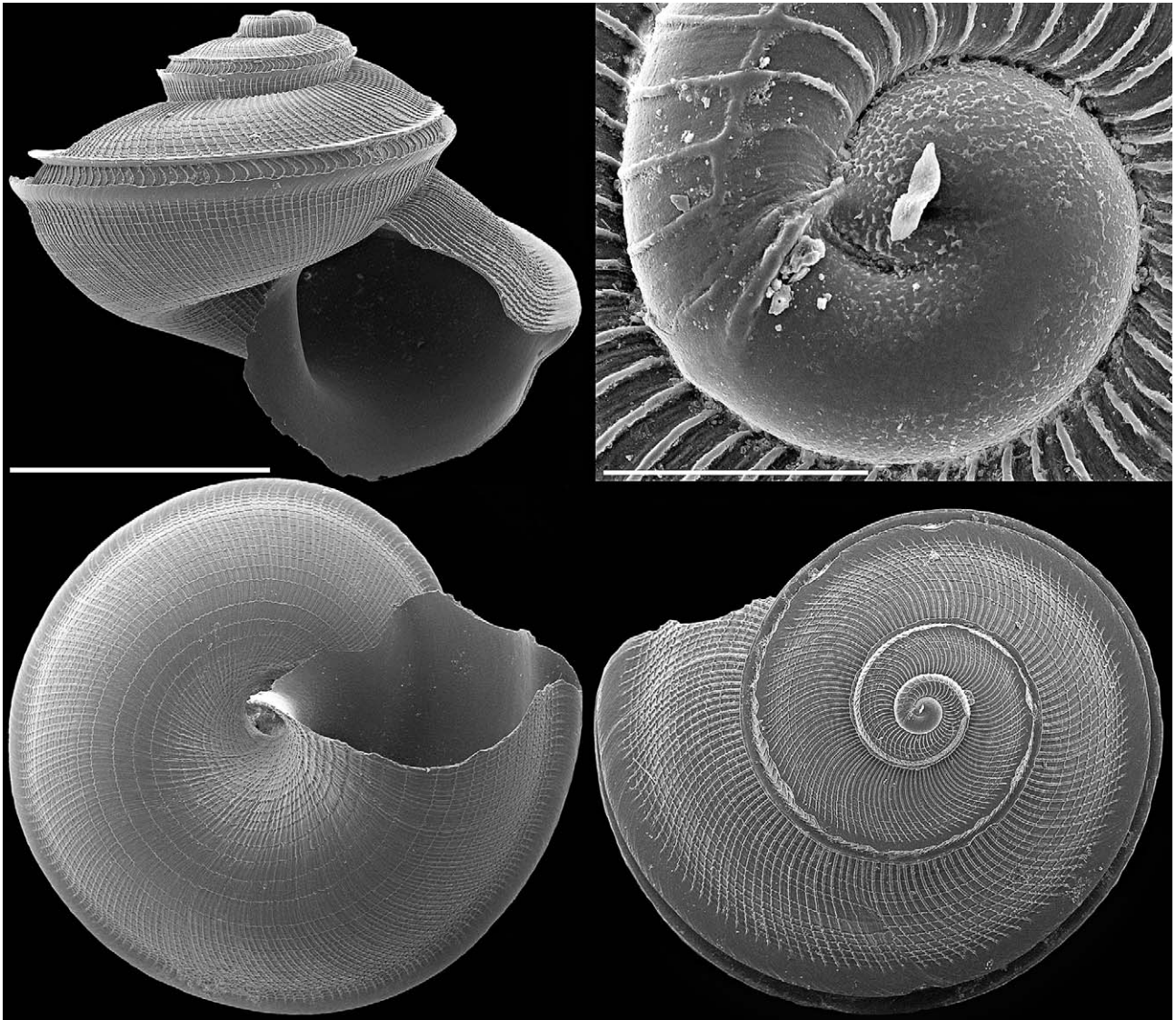


FIGURE 13. *Anatoma amydra* new species. Holotype. Off northern New Caledonia, 600–616 m, (MNHN 24957). Scale bar shell = 1 mm. Scale bar protoconch = 100 μ m.

Operculum (Fig. 15D) corneous, thin, multispiral, with central nucleus.

Radula (Fig. 15A–B). Rachidian trapezoid, central cusp slightly larger, 3–4 cusps on each side, arranged as fan. Lateral teeth 1–3 similar, apical cusp largest, 3–2 cusps on outer edge, 1 minute point at inner edge. Lateral tooth 4 reduced, hook-shaped, apical cusp largest, 1 minute point on each side. Lateral tooth 5 somewhat enlarged, apical cusp largest, 4 cusps along inner edge, 1 small point on outer edge. Inner marginal teeth with triangular tip, apical cusp largest, 1–2 cusps on inner margin, 3–5 along outer margin; outer marginal teeth spoon-shaped, with many fine bristles along edge. Radular interlock of central field moderate.

Jaw (Fig. 15C) teardrop shaped composed of many small rhomboid platelets.

Distribution. Indo-Malayan Archipelago and Western Pacific, 250–1000 m.

Specimen records. Philippines. 12.516°N, 120.650°E, 92–97 m (MNHN, 7); Cervera shoal, West Palmilacan Island, 9.488°N, 123.858°E, 95–128 m (PANGLAO 2004 T36, MNHN, 22); Cervera shoal, 9.495°N, 123.837°E, 110–112 m (PANGLAO 2004 T41, MNHN, 3); Cervera shoal, 9.501°N, 123.840°E, 100–138 m (MNHN, 1); Cervera, 9.501°N, 123.840°E, 100–138 m (PANGLAO 2004 T39, MNHN, 1); Pamilacan Island, 9.501°N, 123.918°E, 60 m (MNHN, 1); Balicasag Island, 9.515°N, 123.680°E, 87–111 m (PANGLAO 2004 L613/30/201164, MNHN, 2); Balicasag Island, 9.515°N, 123.687°E, 90–110 m (MNHN, 2); Balicasag Island, 9.515°N, 123.687°E, 90–110 m (PANGLAO 2004 L46, MNHN, 1); Maribohoc Bay, Bohol Island, 9.600°N, 123.750°E, 90–200 m (PANGLAO 2004 P1, MNHN, 3); off Momo Beach, Panglao Island, 9.608°N, 123.755°E, 90 m (MNHN, 3); Bigag/Tabalong, Panglao Island, 9.628°N, 123.800°E, 62 m (PANGLAO 2004 L51–60, MNHN, 4); 15.943°N, 121.837°E, 473 m (AURORA 2007 CP 2749, MNHN, 1); off Aligbay Island, Bohol-Sulu sill, 8.770°N, 123.268°E, 624–647 m (PANGLAO 2005 CP 2384, MNHN, 1); Solomon Islands. 8.665°S, 160.065°E, 396–411 m (SALOMON 1 DW 1762, MNHN, 3); 9.795°S, 160.842°E, 53 m (MNHN, 1). New Caledonia. Grand Passage, 18.600°S, 163.160°E, 501 m (CONCALIS CP 3005, MNHN, 1); 18.650°S, 163.183°E, 550 m (MNHN, 2); 18.700°S, 163.217°E, 668 m (MNHN, 1); 18.816°S, 163.250°E, 600–616 m (MNHN, 1); 18.816°S, 163.267°E, 613–647 m (BATHUS 4 DW 918, MNHN, 2); 18.916°S, 163.400°E, 370–405 m (MNHN, 1); 18.916°S, 163.400°E, 344–360 m (MNHN, 15); 20.566°S, 166.900°E, 435 m (MNHN, 11); east coast, 20.583°S, 165.117°E, 380–400 m (MNHN, 1); east coast, 20.583°N, 165.117°E, 408–440 m (MNHN, 1); 20.583°S, 166.883°E, 735 m (MNHN, 1); 20.583°S, 166.900°E, 460 m (MNHN, 1); Loyalty Basin, 20.583°S, 166.917°E, 470–480 m (MNHN, 1); between Lifou and Uvea, 20.616°N, 166.967°E, 538 m (MNHN, 2); Loyalty Ridge, 20.633°S, 167.117°E, 490 m (MNHN, 1); Touho Sector, 20.733°S, 165.233°E, 49–59 m (MNHN, 1); Santal Bay, Lifou, 20.763°S, 167.028°E, 20 m (MNHN, 1); Santal Bay, Lifou, 20.763°S, 167.028°E, 27–31 m (MNHN, 5); Santal Bay, 20.773°S, 167.033°E, 20 m (MNHN, 11); Touho Sector, 20.775°S, 165.263°E, 45–56 m (MNHN, 1). Touho Sector, 20.781°S, 165.230°E, 0–1 m (MNHN, 1); Poindimie Sector, 20.816°S, 165.317°E, 105–110 m (MNHN, 1); Santal Bay, 20.821°S, 167.173°E, 25–30 m (MNHN, 4); Santal Bay, 20.873°S, 167.133°E, 40–60 m (MNHN, 2); Santal Bay, 20.875°S, 167.135°E, 5–20 m (MNHN, 7); Touho Sector, 20.878°S, 165.325°E, 5–25 m (MNHN, 1); Santal Bay, 20.891°S, 167.045°E, 12–32 m (MNHN, 10); Santal Bay, 20.920°S, 167.012°E, 5–30 m (MNHN, 2); east coast, 20.950°S, 165.583°E, 160–222 m (MNHN, 2); east coast, 20.966°S, 165.600°E, 302–335 m (MNHN, 5); 21.116°S, 164.467°E, 320–344 m (MNHN, 1); Loyalty Ridge, 21.150°S, 167.917°E, 310 m (MNHN, 1); Loyalty Basin, 21.533°S, 166.483°E, 310–315 m (MNHN, 1); Loyalty Basin, 21.533°S, 166.483°E, 310–315 m (MNHN, 6); 22.166°S, 167.550°E, 2100–2110 m (MNHN, 1); Aboré Grand Reef, Nouméa Lagoon, 22.371°S, 166.265°E, 12–37 m (MNHN, 2); 22.583°S, 166.450°E, 465–525 m (BATHUS 2 DW 739, MNHN, 50); Loyalty Basin, 22.650°S, 166.567°E, 570 m (MNHN, 1); 22.750°S, 167.200°E, 380–410 m (MNHN, 1); 22.766°S, 167.200°E, 390–400 m (MNHN, 1); SW of Île des Pins, 22.766°S, 167.333°E, 410 m (MNHN, 1); 22.783°S, 167.233°E, 440 m (MNHN, 20); 22.783°S, 167.233°E, 440 m (MNHN, 1); 22.783°S, 167.233°E, 440–450 m (MNHN, 30); 22.783°S, 167.233°E, 440 m (MNHN, 5); 22.800°S, 167.267°E, 444–445 m (BATHUS 2 DW 719, MNHN, 40); 22.866°S, 167.200°E, 400 m (MNHN, 1); 22.866°S, 167.200°E, 400 m (BATHUS 2 DW 729, MNHN, 1); 22.866°S, 167.267°E, 530–541 m (MNHN, 3); south-eastern Reef, Île des Pins, 22.875°S, 168.208°E, 414–436 m (MNHN, 3); 22.883°S, 167.283°E, 570–610 m (MNHN, 19); 22.883°S, 167.283°E, 570–610 m (MNHN, 1); 22.900°S, 167.283°E, 525–547 m (BATHUS 2 DW 721, MNHN, 5); NORFOLK 1 DW 1733, 22.933°S, 167.250°E, 427–433 m (MNHN, 16); 22.983°S, 167.317°E, 525 m (MNHN, 1); Île des Pins, SE South Reef, 22.991°S, 168.367°E, 491–558 m (MNHN, 3: complete). 23.000°S, 167.250°E, 360 m (MNHN, 1). Norfolk Ridge, 23.033°S, 166.983°E, 295–306 m (BATHUS 3 DW 836, MNHN, 2); 23.050°S, 167.317°E, 503 m (MNHN, 1); 23.050°S, 167.317°E, 503 m (MNHN, 10); 23.050°S, 167.317°E, 503 m (MNHN, 1); 23.083°S, 167.750°E, 680–700 m (MNHN, 1); 23.083°S, 167.750°E, 680–700 m (MNHN, 1); Île des Pins, 23.150°S, 167.450°E, 1004–1009 m (NORFOLK 2 DW 2144, MNHN, 3); Norfolk Ridge, 23.283°S, 168.233°E, 405–456 m (NORFOLK 2 DW 2132, MNHN, 7); Norfolk Ridge, 23.300°S, 168.017°E, 540 m (NORFOLK 1 DW 1722, MNHN, 10); Aztec Bank, 23.300°S, 168.083°E, 305–310 m (MNHN, 30); Aztec Bank, 23.300°S, 168.100°E, 400–402 m (MNHN, 7); Norfolk Ridge, P Bank, 23.300°S, 168.250°E, 266–267 m (MNHN, 5); Aztec Bank, 23.308°S, 168.083°E, 305–367 m (MNHN, 1); 23.308°S, 168.083°E, 305–367 m (MNHN, 100); 23.308°S, 168.083°E, 320–367 m (SMIB 8 DW 182–184, MNHN, 7); Norfolk Ridge, 23.316°S, 168.000°E, 601–608 m (MNHN, 50); Norfolk Ridge, 23.333°S, 168.017°E, 361–365 m (MNHN, 40); Norfolk Ridge, 23.333°S, 168.267°E, 347–1063 m (NORFOLK 1 DW 1732, MNHN, 3); Norfolk Ridge, 23.350°S, 168.033°E, 386–390 m (MNHN, 20); Norfolk Ridge, 23.366°S, 168.017°E, 381–469 m (MNHN, 20); Norfolk

Ridge, 23.366°S, 168.017°E, 381–469 m (BATHUS 3 DW 827, MNHN, 4); 23.416°S, 167.883°E, 965 m (MNHN, 1); 23.583°S, 167.200°E, 695–705 m (MNHN, 1); Loyalty Ridge, 23.583°S, 169.617°E, 655 m (MNHN, 1); Norfolk Ridge, Stylaster Bank, 23.616°S, 167.700°E, 447–450 m (MNHN, 1); Stylaster Bank, 23.633°S, 167.650°E, 571–610 m (NORFOLK 2 DW 2036, MNHN, 3); S of Stylaster Bank, 23.633°S, 167.717°E, 433–450

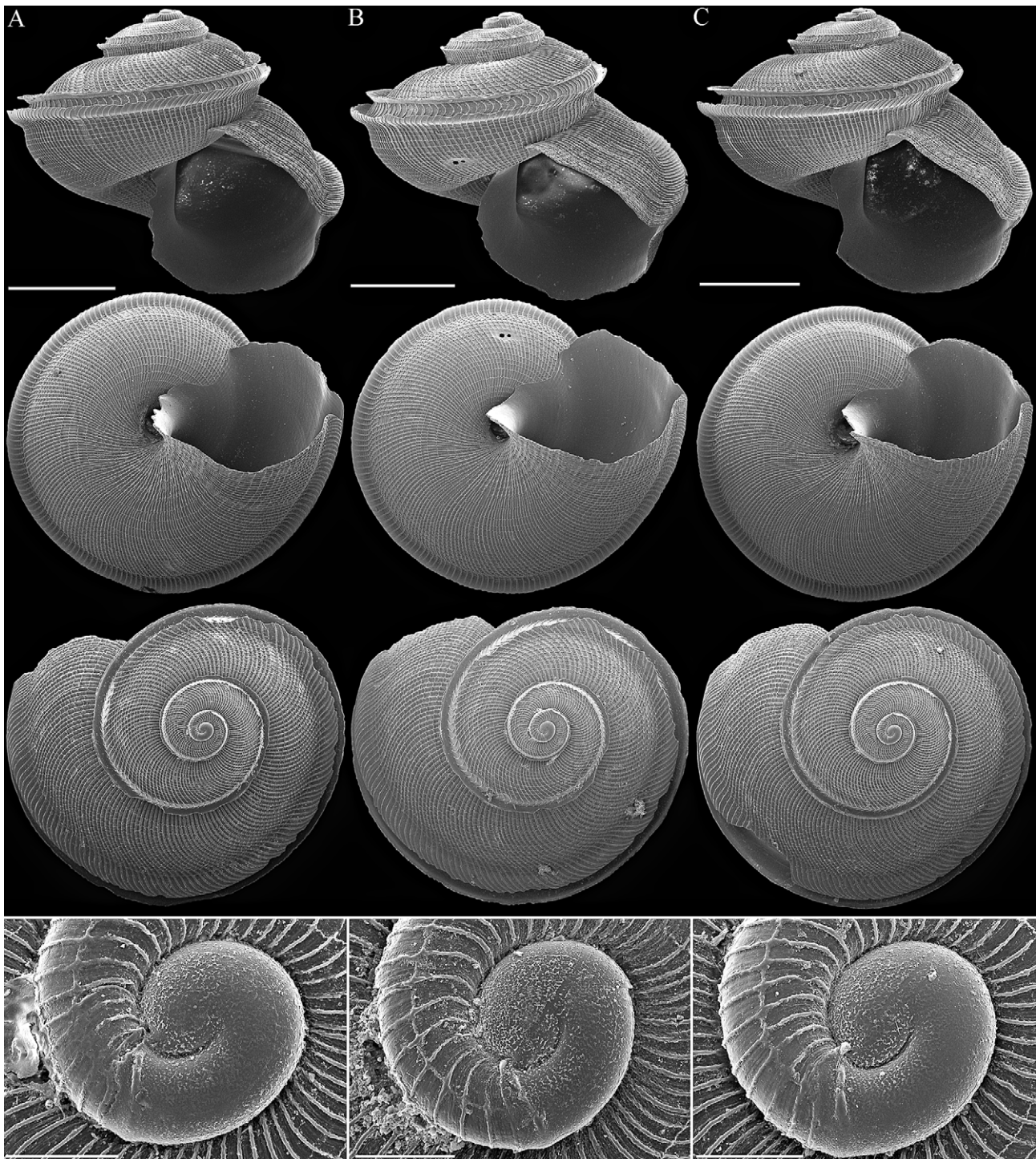


FIGURE 14. *Anatoma amydra* new species. Paratypes. A–C. New Caledonia, 570–610 m (MNHN 24958). Scale bars shell = 1 mm. Scale bars protoconch = 100 μ m.

m (MNHN, 21); 23.633°S, 167.717°E, 430–452 m (MNHN, 20); 23.650°S, 168.000°E, 230–360 m (BERYX 11 CH 41, MNHN, 1); Norfolk Ridge, 23.683°S, 168.000°E, 237–550 m (BATHUS 3 CH 802, MNHN, 1); Norfolk Ridge, 23.683°S, 168.017°E, 278–310 m (MNHN, 8); Norfolk Ridge, 23.683°S, 168.017°E, 285 m (NORFOLK 2 DW 2040, MNHN, 27); Norfolk Ridge, Jumeau East, 23.750°S, 168.267°E, 400–420 m (MNHN, 4); Norfolk Ridge,

23.750°S, 168.283°E, 410–415 m (MNHN, 1); Norfolk Ridge, Banc Introuvable, 24.650°S, 168.633°E, 569–616 m (MNHN, 3); Norfolk Ridge, 24.666°S, 168.150°E, 943–1080 m (MNHN, 2); Loyalty Ridge, 24.716°S, 170.117°E, 750–760 m (MNHN, 1); 24.733°S, 168.117°E, 430–450 m (MNHN, 100), 24.733°S, 168.167°E, 320–350 m (BERYX 11 DW 11, MNHN, 12); Kaimon-Marua Bank, Norfolk Ridge, 24.750°S, 168.150°E, 231–233 m (NORFOLK 1 DW 1675, MNHN, 6); 24.800°S, 168.150°E, 250–270 m (BERYX 11 DW 18, MNHN, 3); Sponge Bank, B mound, 24.916°S, 168.367°E, 508–532 m (MNHN, 3); Norfolk Ridge, 24.933°S, 168.367°E, 518–586 m (NORFOLK 2 DW 2087, MNHN, 4). Coral Sea. South Lansdowne, 21.100°S, 160.767°E, 569–583 m (EBISCO DW 2629, MNHN, 1). Vanuatu. NW of Tutuba Island, 15.550°S, 167.278°E, 92 m (SANTO 2006 DS105, MNHN, 2); E of Aoré Island, 15.604°S, 167.150°E, 45–101 m (SANTO 2006 EP10, MNHN, 1); NW coast of Malo Island, Palikulo Bay, 15.633°S, 167.083°E, 90–110 m (SANTO 2006 DB77 EP28, MNHN, 1). New Zealand. Three Kings Rise, 31.866°S, 172.433°E, 780–790 m (NMNZ M.173749, 9). Louisville Ridge. 41.450°S, 164.133°E, 950–1000 m (NMNZ M.119213, 4). Moluccas. Molucca Pass, off March Island, 0.616°N, 127.250°E, 796 m (USNM 312781, 1). Fiji. S of Viti Levu, 18.206°S, 178.550°E, 144–150 m (MNHN, 1); 19.016°S, 178.433°W, 395–540 m (BORDAU 1 DW 1486, MNHN, 1); 19.050°S, 178.500°W, 700–707 m (BORDAU 1 DW 1485, MNHN, 1). Wallis and Futuna. Wallis Island, 13.350°S, 176.150°W, 286 m (MNHN, 2); Wallis Island, 13.350°S, 176.133°W, 415–420 m (MNHN, 6). French Polynesia. Mount Ari'i Moana, Tarava Seamounts, 19.250°S, 151.517°W, 557–569 m (TARASOC DW 3318, MNHN, 1).

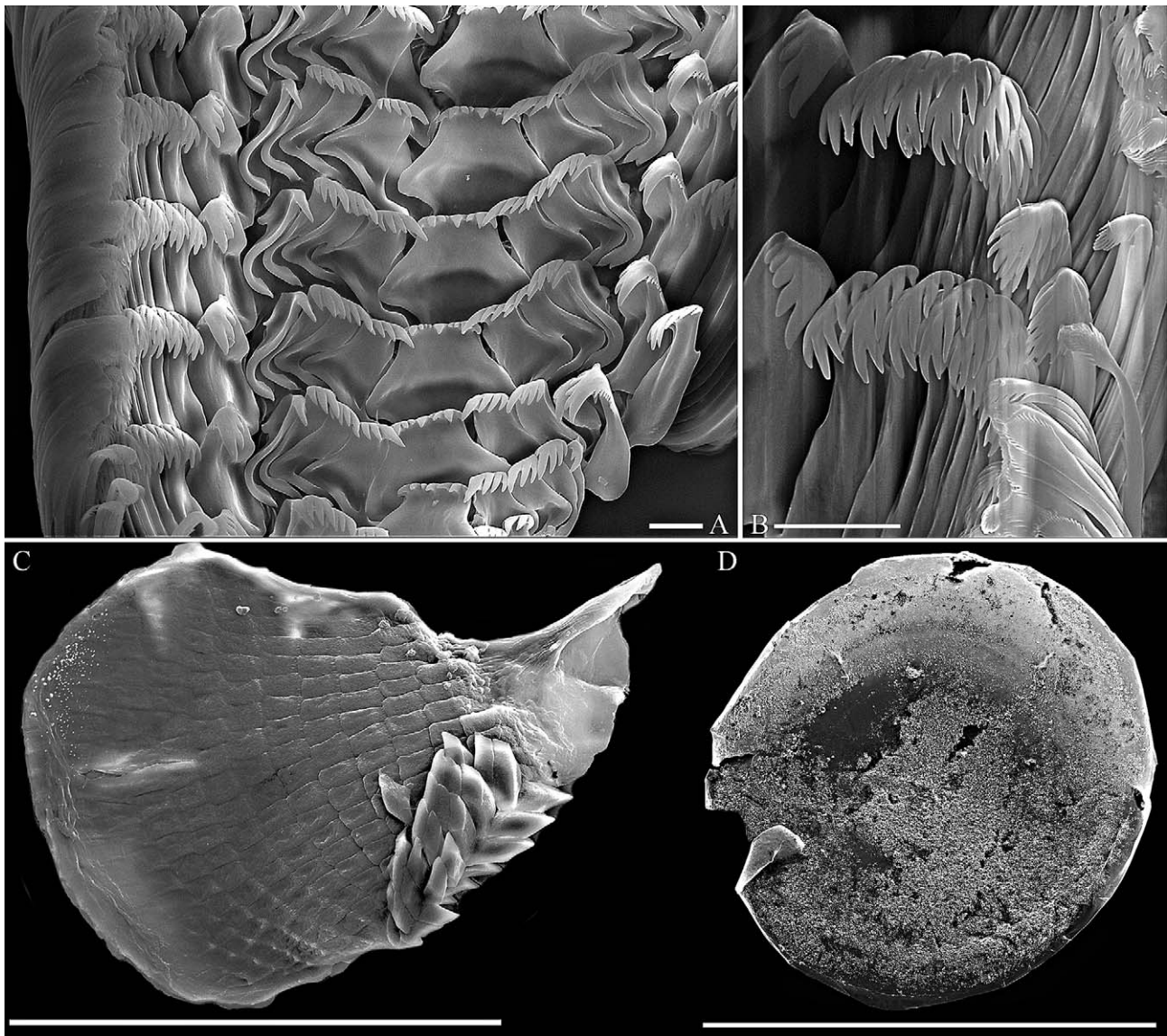


FIGURE 15. *Anatoma amydra* new species. A–B. Off northern New Caledonia, 344–360 m (MNHN). A. Full width of radula with central field. Scale bar = 10 μ m. B. Marginal teeth. Scale bar = 10 μ m. B–C. Norfolk Ridge, Jumeau East, New Caledonia, 400–420 m (MNHN). C. Jaw. Scale bar = 100 μ m. D. Operculum. Scale bar = 1 mm.

Remarks. Juvenile specimens as usual have a more lenticular overall shell shape than adults. The details of the early teleoconch permit ready identification of the species: protoconch with flocculent sculpture, teleoconch I of 0.66 whorl, with spiral in position of selenizone, and first spiral threads appearing on outer half of shoulder.

Anatoma australis (Hedley, 1903) from Australia has a longer teleoconch I (0.5 vs. 0.75 whorl), on teleoconch I has multiple spiral threads, and has more widely spaced spiral threads on the base (3 vs. 7 on sutsel of 1.5× width of selenizone).

Anatoma equatoria (Hedley, 1899) from the Indo-Malayan Archipelago has a sutsel about as wide as the selenizone at the onset of the selenizone, with axial and spiral sculpture about half as dense. *Anatoma flexidentata* Geiger & Sasaki, 2008, from the Indian Ocean and Western Pacific lacks the apertural varix on the protoconch, has a shorter teleoconch I (0.25 vs. 0.5 whorl), has more widely spaced axial cords particularly on the shoulder, with a sutsel that is at least 50% narrower. *Anatoma pseudoequatoria* (Kay, 1979) from the Indo-Malayan Archipelago to Central Pacific has a shorter teleoconch I (0.25 vs. 0.5 whorl), has a sutsel that is at least 50% narrower, and the intersection of the axials and spirals on the shoulder form distinct points. *Anatoma japonica* (A. Adams, 1862) from the Indian Ocean and the Indo-Malayan Archipelago has a very narrow umbilicus, has a narrower sutsel after one whorl (<0.5× vs. >0.5× width of selenizone, and has axial cords that are about 50% more widely spaced (interstices approximately as wide as or wider than cords vs. narrower than cords). *Anatoma rainesi* Geiger, 2003, from Indo-Central Pacific has a protoconch with distinct axial cords, has axial cords on teleoconch I that decrease in strength with growth, and the axial cords on the base are at least twice as widely spaced. *Anatoma atlantica* (Bandel, 1998) from the NW Atlantic has a much narrower sutsel (<0.5× width of selenizone), has a longer teleoconch I (0.5 vs. 0.75 whorl), and lacks a spiral cord in the position of the selenizone on teleoconch I. *Anatoma proxima* (Dall, 1927) from the Caribbean and the south-western Atlantic has an overall more globular shape, and has more widely spaced axial cords on the shoulder and base. *Anatoma tobeyoides* Geiger & Jansen, 2004, from south-eastern Australia has a protoconch with reticulate sculpture, has fine, obliquely radiating fine threads on teleoconch I, and has a narrower selenizone. *Anatoma yaroni* Herbert, 1986, from the Indian Ocean has a sutsel <0.5× width of selenizone, has an overall more discoidal shape, and has more widely spaced axial cords on the base.

Anatoma kopua new species

(Figures 16–17)

Type material. Holotype (NMNZ M.174848: Fig. 16). 4.26 × 4.53 mm. Paratypes: off Sydney, New South Wales, Australia, 33.600°S, 152.083°E, 1143–1106 m (AMS C.453747, 5: Fig. 17A); Lord Howe Rise, SE of Lord Howe Island, Tasman Sea, 34.272°S, 163.102°E, 1186 m (NMNZ M.174864, 1: Fig. 17B); Challenger Plateau, New Zealand, 40.835°S, 168.247°E, 1005–1009 m (NMNZ M.174847, 1: Fig. 17C).

Type locality. Challenger Plateau, New Zealand, 40.713°S, 167.933°E, 1029 m, 18 Apr. 1980, RV *Tangaroa*, foraminiferal ooze.

Etymology. Deep (New Zealand Maori). Adjective.

Description. Shell large (4.27 × 4.58 mm: Figs 16–17), trochiform biconical turreted. Protoconch large (275 µm), 0.75 whorl, flocculent sculpture, no apertural varix, apertural margin straight. Teleoconch I of 0.3–0.4 whorl, 12–15 axial cords, spiral cord in position of selenizone. Teleoconch II of 4 whorls, suture moderately impressed, sutsel less than width of selenizone on early whorls, about twice as wide as selenizone at apertural margin of large specimen. Shoulder moderately convex, regular axial cords, approximately 40 on first whorl, interstices about 4 times as wide as cords; after 1–2 teleoconch II whorls, about 2–5 at apertural margin, irregularly spaced. Base with constriction below selenizone, same strength and density of axial cords, spiral threads regularly spaced, stronger than those on shoulder, approximately 20, noticeable absence of spirals from a gap immediately below selenizone. Umbilicus open, narrow, obscured by reflexed adumbilical portion of peristome. Selenizone slightly above periphery, rather wide, lunules rather strong, keels moderately strong, rather elevated (Fig. 17A). Animal unknown.

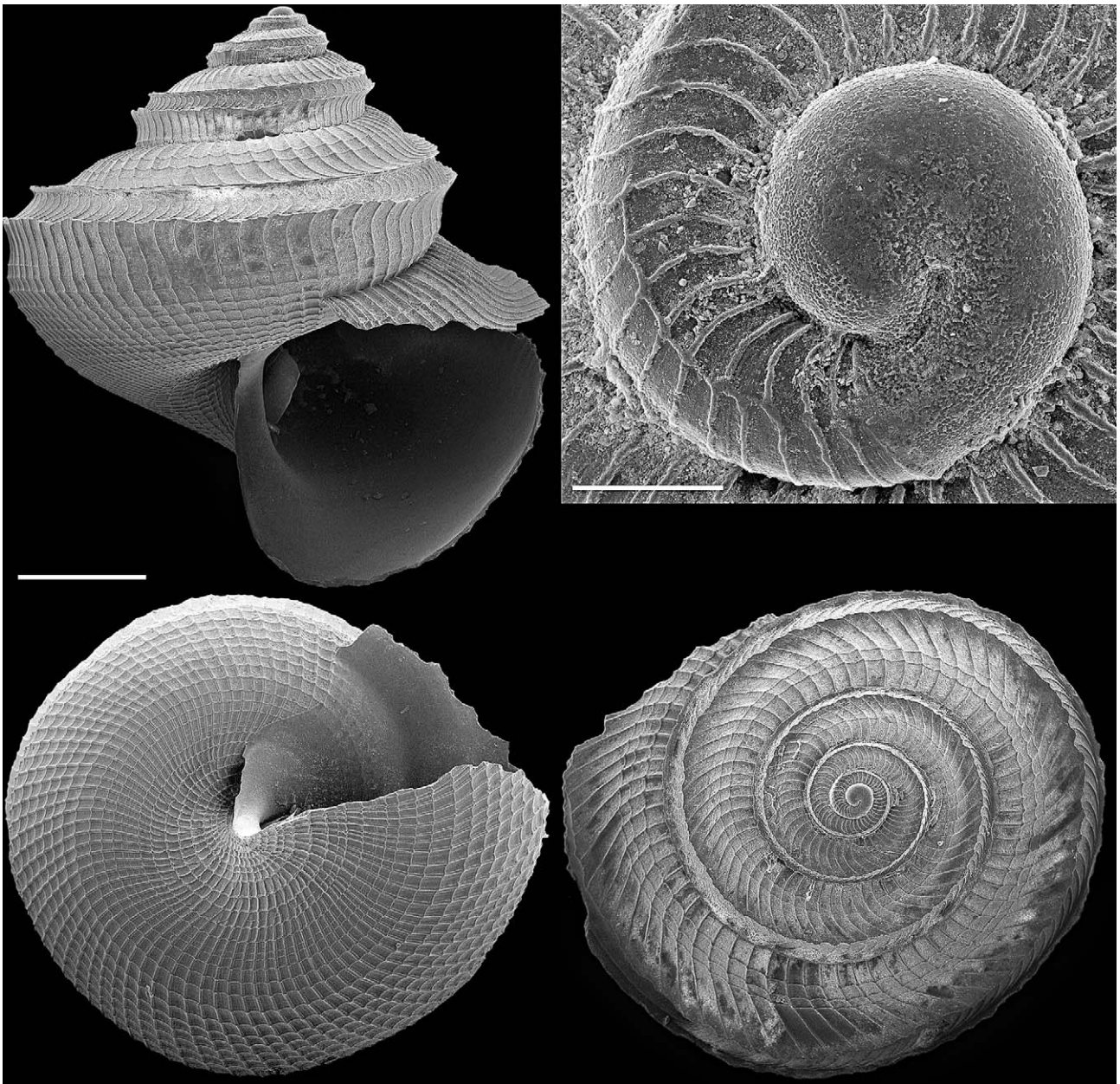


Figure 16. *Anatomia kopua* new species. Holotype. Challenger Plateau, New Zealand, 1029 m (NMNZ M.174848). Scale bar shell = 1 mm. Scale bar protoconch = 100 μ m.

Distribution. New South Wales, Australia and New Zealand, approximately 1000 m.

Remarks. *Anatoma equatoria* from the Indo-Malayan Archipelago has a more turreted shell shape, has spiral threads on the base immediately below the selenizone, and has a more inflated base. *Anatoma flexidentata* Geiger & Sasaki, 2008 from the Indo-West Pacific has a shorter teleoconch I (0.3 vs. 0.5 whorl), has a more globular whorl profile, and has spiral threads on the base immediately below the selenizone. *Anatoma maxima* (Schepmann, 1908) from the Indo-Malayan Archipelago and Western Pacific has the selenizone closer to the periphery, has an overall more discoidal shell shape, and has at least four times as many spiral threads on the shoulder. *Anatoma aedonia* (Watson, 1886) from the Caribbean and off Brazil has a more turreted overall shell shape, a wider sutsel on early whorls (2 \times vs. 1 \times widths of selenizone), has a longer teleoconch I (0.75–1 vs. 0.5 whorl), and has a narrower selenizone. *Anatoma amoena* (Thiele, 1912) from Antarctica has a protoconch with reticulate sculpture, a longer teleoconch I (1 vs. 0.5 whorl), and has spiral threads immediately below the selenizone on the base.

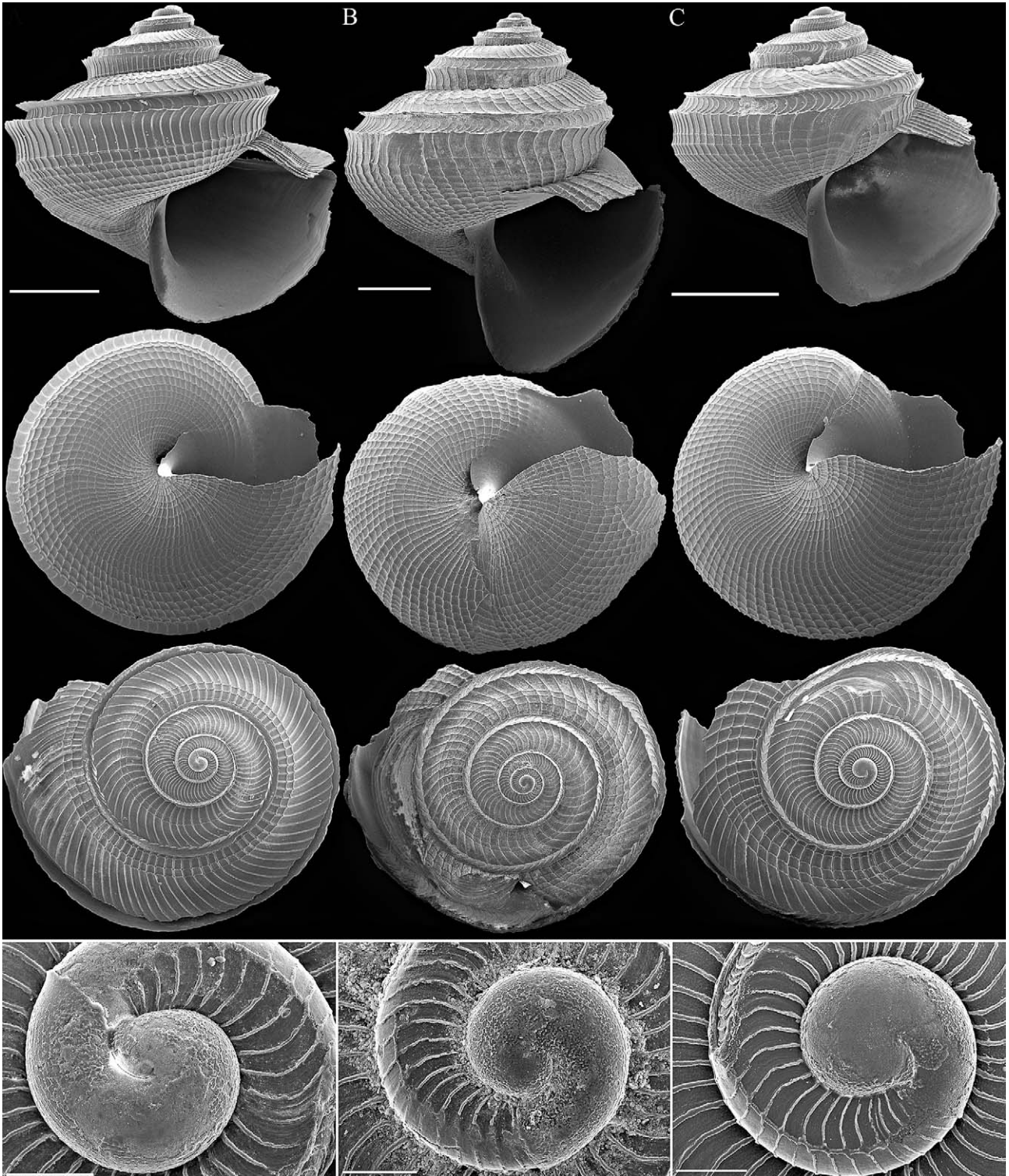


FIGURE 17. *Anatoma kopua* new species. Paratypes. A. Off Sydney, New South Wales, Australia, 1143–1106 m (AMS C.453747). B. Lord Howe Rise, SE of Lord Howe Island, Tasman Sea, 1186 m (NMNZ M.174864). C. Challenger Plateau, New Zealand, 1005–1009 m (NMNZ M.174847). Scale bar shell = 1 mm. Scale bar protoconch = 100 μ m.

Anatoma megascutula new species

(Figures 18–20)

Type material. Holotype (MNHN 24954: Fig. 18). 5.03 × 3.36 mm. Paratypes: Norfolk Ridge, 24.867°S, 168.183°E, 820–1220 m (MNHN 24959, 1: Fig. 19A); Tongatapu, Tonga, 21.083°S, 175.367°W, 456–510 m (MNHN 24955, 1: Fig. 19B); Fiji, 17.300°S, 179.550°W, 820–863 m (MNHN 24956, 1: Fig. 19C).

Type locality. E of Rapa, Austral Islands, French Polynesia, 27.618°S, 144.257°W, 800–850 m, 7 Nov. 2002, N.O. Alis (BENTHAUS stn CP1891).

Etymology. Mega-, Greek prefix for large; -scutula, Latin for saucer, shallow bowl, referring to the large size of this flat-shelled species. Noun in apposition.

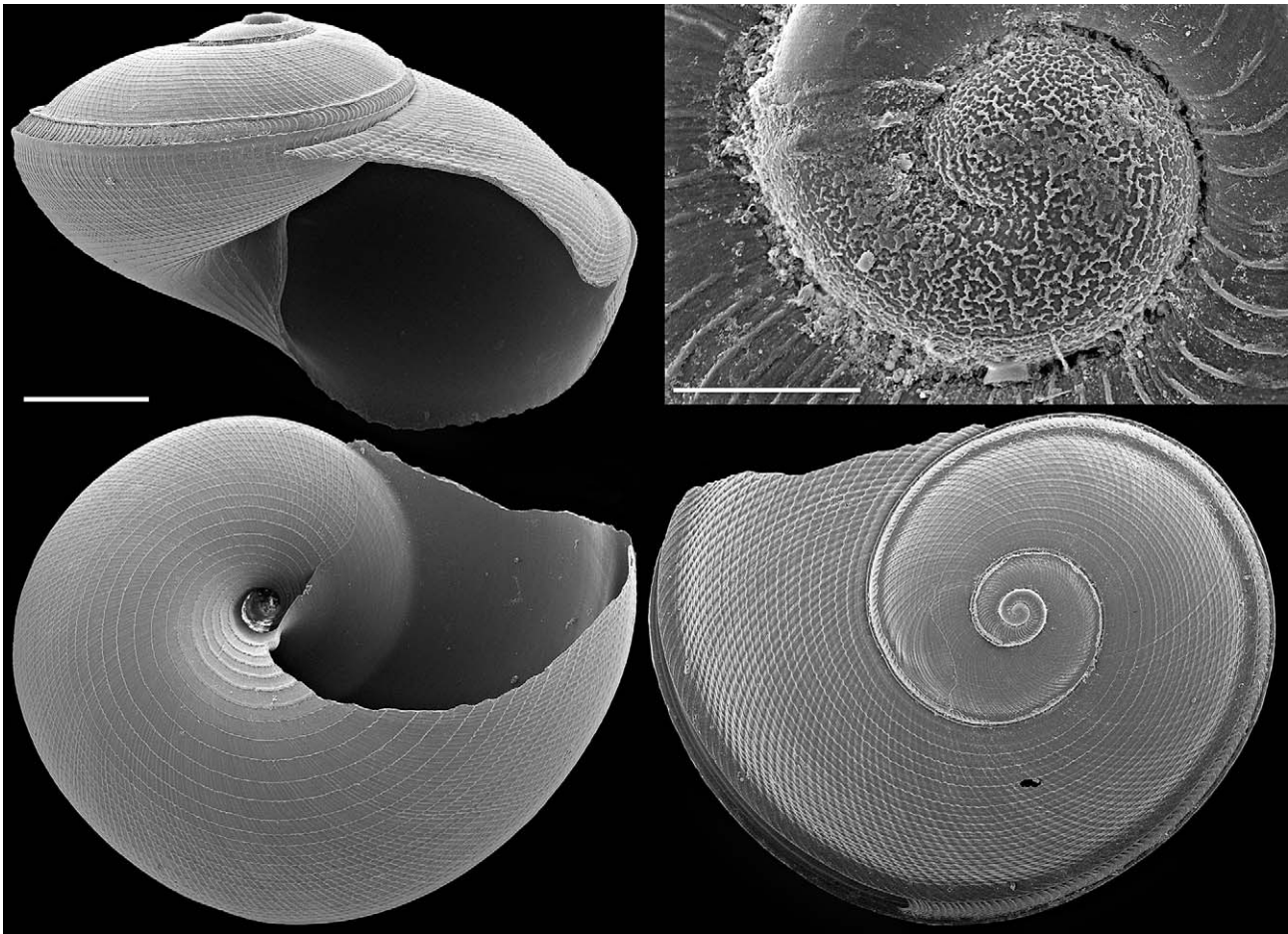


FIGURE 18. *Anatoma megascutula* new species. Holotype. 800–850 m, east of Rapa, Austral Islands, French Polynesia, 27.618°S, 144.257°W (MNHN 24954). Scale bar shell = 1 mm. Scale bar protoconch = 100 µm.

Description. Shell large (to 6.8 mm. Figs 18–19), trochiform depressed, discoidal. Protoconch of 0.75 whorl, flocculent sculpture, apertural varix not connected to embryonic cap, apertural margin shallow sinusoid. Teleoconch I of 0.75–0.875 whorl, approximately 20–30 axial cords, no spirals. Teleoconch II of 3.3 whorls, suture lightly impressed, no sutsel except for last quarter whorl with slight descent showing 1 spiral thread. Shoulder broadly convex, many barely perceptible, low axial cords becoming somewhat more noticeable with growth; first low spiral thread after 0.125–0.8 whorl, increasing in strength to become low to distinct spiral cords, approximately a dozen after first teleoconch I whorl, approximately 25 at apertural margin, forming indistinct thickenings at intersection with axials. Base without constriction below selenizone, continuously sloping with umbilicus; axial sculpture as on shoulder if usually somewhat stronger; approximately 22 spirals, distinct threads from selenizone onwards, changing at mid-base into steps. Umbilicus variable; open, bordered by carina, walls straight, smooth; additionally with distinct funiculus; closed by parietal callus [see Remarks]. Aperture oblong D-shaped. Selenizone at periphery, keels moderately strong, moderately elevated (usually low due to erosion); lunules distinct; slit open, margins converging.

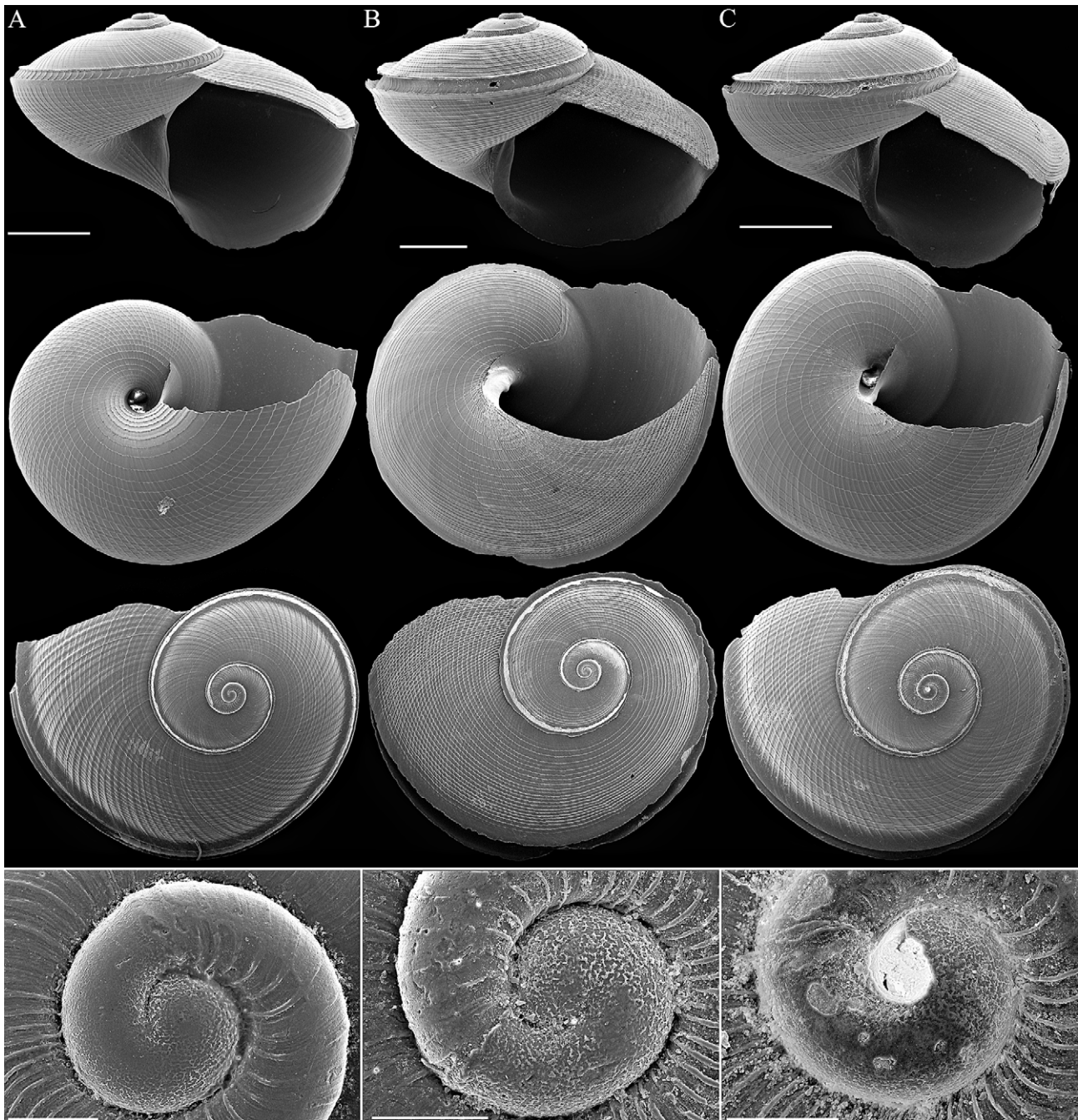


FIGURE 19. *Anatoma megascutula* new species. Paratypes. A. Norfolk Ridge, New Caledonia, 820–1220 m (MNHN 24959). B. Tongatapu, Tonga, 456–510 m (MNHN 24955). C. Fiji, 820–863 m (MNHN 24956). Scale bars shell = 1 mm. Scale bars protoconch = 100 μ m.

Radula (Fig. 20). Rachidian tooth trapezoid, apical cusp largest, 4–5 on each side in continuous arc. Lateral tooth 1 broadened, apical cusp slightly larger than 7–8 distal ones on cutting edge. Lateral teeth 3–4 similar, apical cusp largest, 3–5 along outer margin of cutting edge. Lateral tooth 4 reduced, apical cusp largest, three small ones on each side. Lateral tooth 5 enlarged by moderate broadening, apical cusp largest, about 12 small cusps along inner edge, approximately 8 not reaching apical cusp along outer edge. Inner marginal teeth with triangular tip, apical cusp largest, approximately 8 minor cusps on each side. Outer marginal teeth with indistinct separation of shaft and tip, tip with multiple fine bristles. Radular interlock of central field moderate.

Operculum corneous, thin, round, multispiral, with central nucleus, covering approximately 70% of aperture.

Distribution. Western Pacific, 450–1650 m.

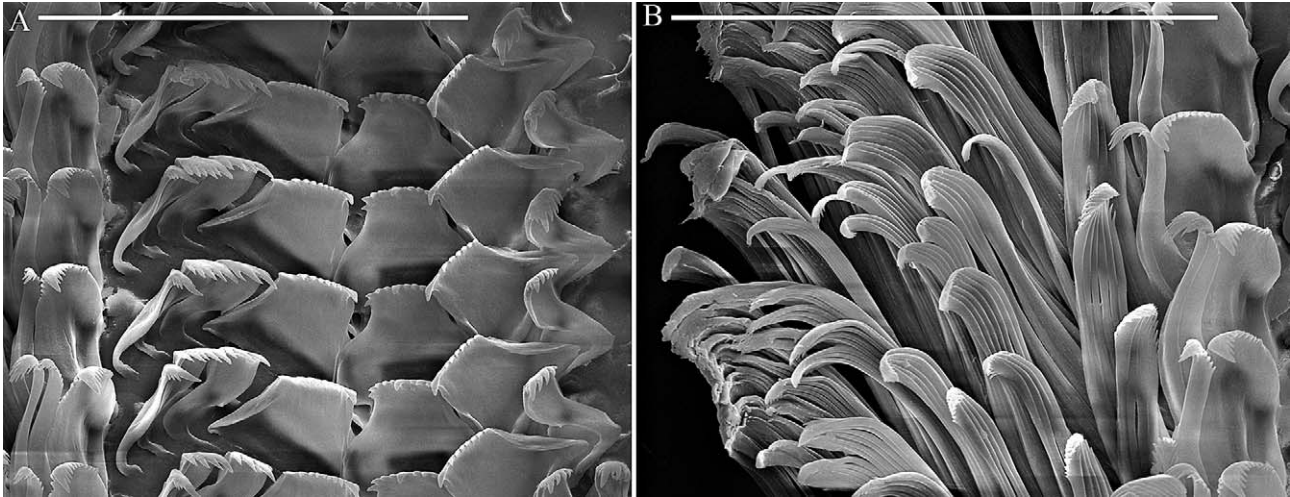


FIGURE 20. *Anatoma megascutula* new species. Radula. Porthos Bank, Norfolk Ridge, New Caledonia, 680–980 m (MNHN). A. Central field. B. Marginal teeth. Scale bars = 100 μ m.

Specimen records. Australia. N of Norfolk Island, Norfolk Ridge, 26.432°S, 167.181°E, 750–774 m (NMNZ M.301394, 7). Coral Sea. 21.317°S, 157.967°E, 970 m (MNHN, 1). New Caledonia. Grand Passage, 18.808°S, 163.190°E, 683–669 m (MNHN, 2). 18.900°S, 163.317°E, 525 m (MNHN, 1); Loyalty Basin, 20.983°S, 166.983°E, 1600–1640 m (MNHN, 3); 23.050°S, 167.533°E, 825–830 m (MNHN, 1); Loyalty Ridge, 24.767°S, 170.117°E, 850–855 m (MNHN, 1); Norfolk Ridge, 24.867°S, 168.183°E, 820–1220 m (MNHN, 1); Porthos Bank, Norfolk Ridge, 25.333°S, 168.950°E, 680–980 m (NORFOLK 2 DW 2068, MNHN, 1). New Zealand. Graveyard Seamount Complex, Chatham Rise, 42.766°S, 179.989°W, 757–875 m (NMNZ M.174849, 1). Fiji. 17.300°S, 179.550°W, 820–863 m (MNHN, 1). Tonga. 20.633°S, 178.050°W, 476–478 m (MNHN, 1). Tongatapu, 21.083°S, 175.367°W, 456–510 m (MNHN, 1). French Polynesia. E of Rapa, Austral Islands, 27.618°S, 144.257°W, 800–850 m (MNHN, 1).

Remarks. *Anatoma japonica* (A. Adams, 1862) from the Indian Ocean and Indo-Pacific has a wider sutsel on whorl 2 (0.5–1 \times vs. 0 \times width of selenizone), has stronger axial than spiral sculpture, and has a narrower selenizone. *Anatoma maxima* from the Indo-Malayan Archipelago has coarser sculpture (14 vs. 25 spirals on shoulder at apertural margin; distinct vs. indistinct axials) in which axials and spirals form points at intersections, a less rapid expansion of the whorls (1.4 vs. 1.8), and a wider sutsel at the apertural margin showing 2–3 spiral threads. *Anatoma rainesi* from the Eastern and Western Pacific has a sutsel on the early whorls, has strong axial cords on teleoconch I, and the selenizone is closer to the periphery of the shell. *Anatoma rapaensis* Geiger, 2008 from French Polynesia shares the overall discoidal shape with no sutsel, but the protoconch lacks an apertural varix, the teleoconch I is shorter (0.2 vs. >0.75 whorl, the axial sculpture is more pronounced forming sharp points at the intersection with the spirals. *Anatoma regia* (Mestayer, 1916) from New Zealand has a narrower but still noticeable sutsel on early whorls, has a narrower selenizone, and its axial sculpture is stronger than the spiral sculpture. *Anatoma disciformis* (Golikov & Sirenko, 1980) from the boreal north Pacific has an overall taller shell, a protoconch with strong flocculent sculpture, and much stronger axial cords. *Anatoma tenuis* (Jeffreys, 1877) from the temperate north Atlantic has a shorter teleoconch I (0.4 vs. 0.75 whorl), and has stronger axial than spiral sculpture.

The number of axials on teleoconch I is difficult to count due to erosion of the early parts of the whorl. The condition of the umbilicus is quite variable in the limited number of specimens available. The more open condition is found in smaller specimens, while the callus closing the umbilicus is encountered in the largest specimens, which suggest an ontogenetic change. Other conchological characters all suggest that the specimens belong to a single species.

The radula of *A. megascutula* shows an unusual arrangement in the central field. Lateral teeth 1–3 are not similar to one another, lateral tooth 1 is much broadened, and lateral tooth 4 is not as reduced as in most other species.

Anatoma tangaroa new species

(Figures 21–22)

Chresonymy. *Anatoma* sp. 6 Spencer et al. 2009: 201.

Type material. Holotype (NMNZ M.303297 Fig. 21). 1.79 × 1.42 mm. Paratypes from type locality (NMNZ M.150335, 10: Fig. 22A). Additional paratypes: Middlesex Bank, NW of Three King Islands, New Zealand, 34.033°S, 171.733°E, 246–291 m (NMNZ M.148568, 25: Fig. 22C); 28 km S of Great Island, Three King Islands, 34.400°S, 174.280°E, 120 m (NMNZ M.160285, 15: Fig. 22B).

Type locality. NW of Three Kings Islands, northern New Zealand, 34.033°S, 171.806°E, 188 m, 27 June 1978, RV *Tangaroa*, comminuted bryozoans and shell.

Etymology. After RV *Tangaroa*, from which the type material was dredged. Noun in apposition.

Description. Shell medium size (to 2.2 mm: Figs 21–22), trochiform rounded biconical. Protoconch of 0.75 whorl, coarse flocculent sculpture, no apertural varix. Teleoconch I of 0.3 whorl, 5–7 axial cords, spiral in position of selenizone forming thickenings at intersection with axial cords. Teleoconch II of 2.2 whorls, suture moderately impressed; sutsel at onset of selenizone 0.5× width of selenizone, at apertural margin 1–1.5× width of selenizone. Shoulder moderately convex, strong axial cords, approximately 40 on first whorl; first spiral line after 0.2–0.5 teleoconch II whorl, approximately 10–15 at apertural margin, forming small thickenings at intersection with axial cords. Base without constriction below selenizone, same density and strength of axial cords as on shoulder; approximately 20 spiral threads, regularly spaced. Umbilicus open, continuously sloping with base, no funiculus. Aperture rounded, roof overhanging. Selenizone at periphery, rather wide; keels of moderate strength, moderately elevated; lunules distinct; slit open, margins converging towards aperture. Animal unknown.

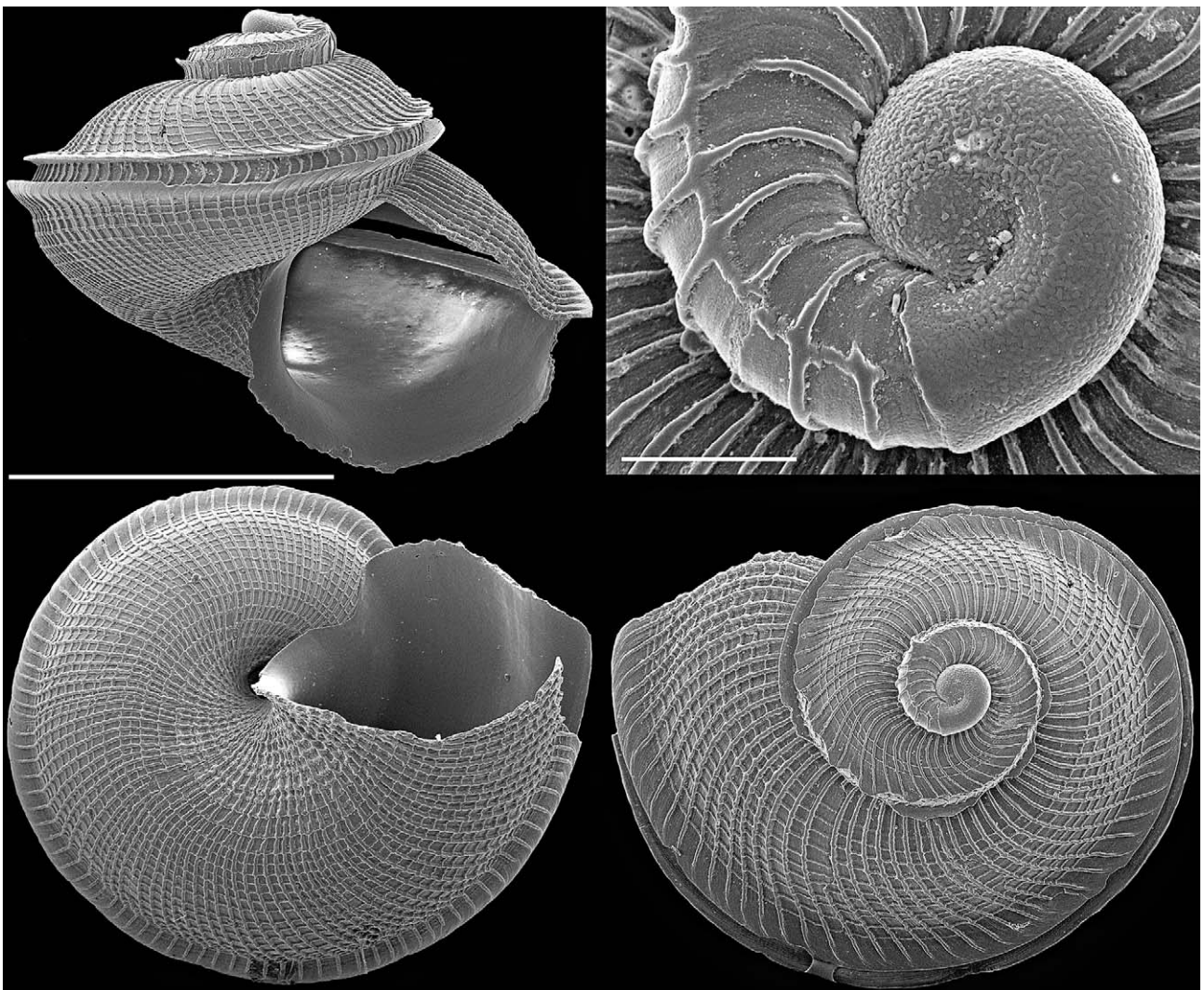


FIGURE 21. *Anatoma tangaroa* new species. Holotype, NW of Three Kings Islands, northern New Zealand, 188 m (NMNZ M.303297). Scale bar shell = 1 mm. Scale bar protoconch = 100 µm.

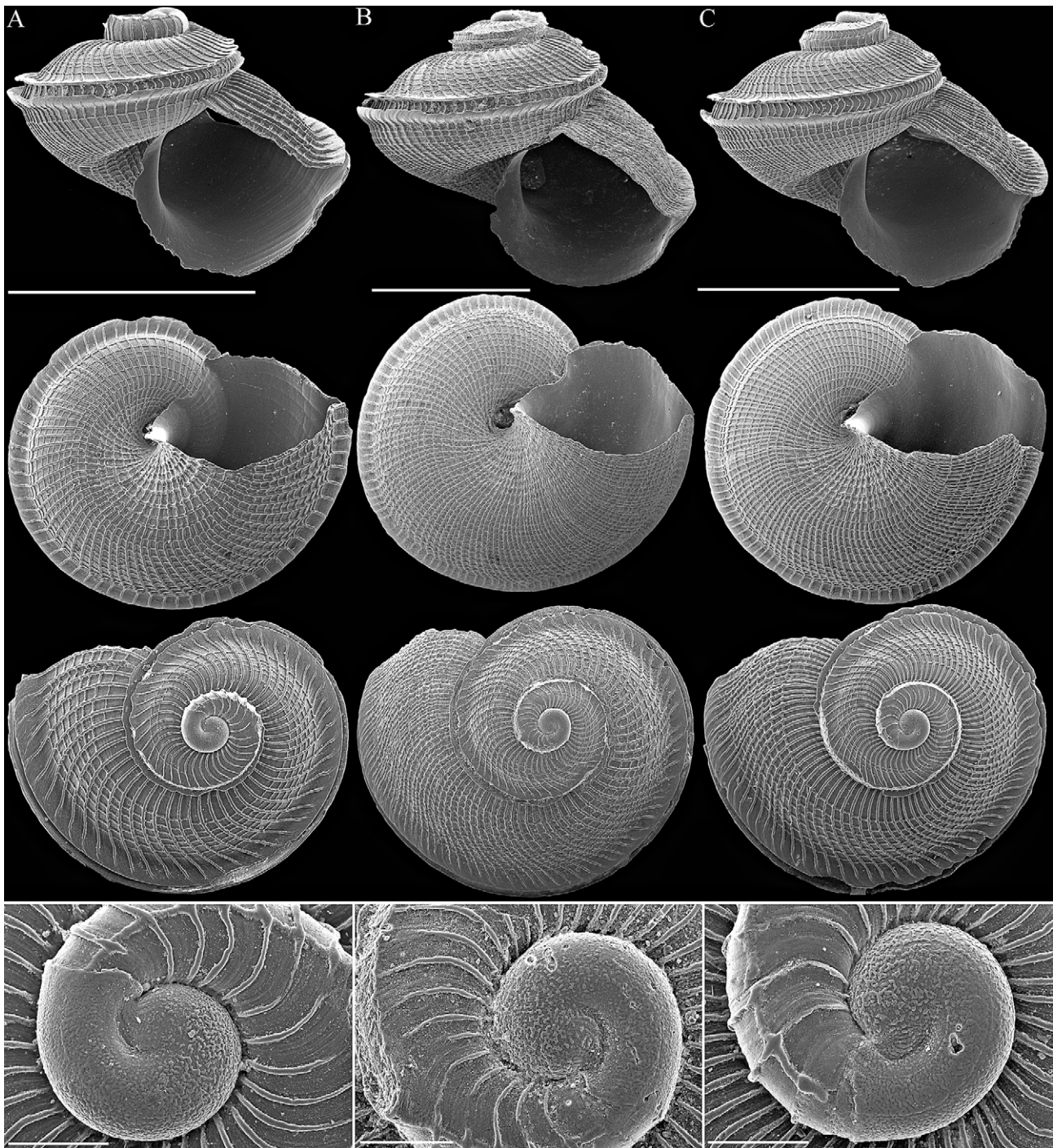


FIGURE 22. *Anatoma tangaroa* new species. Paratypes. A. NW of Three Kings Islands, 188 m (NMNZ M.150335). B. 28 km S of Great Island, Three King Islands, 120 m (NMNZ M.160285). C. Middlesex Bank, NW of Three King Islands, 246–291 m (NMNZ M.148568). Scale bars shell = 1 mm. Scale bars protoconch = 100 μ m.

Distribution. Northern New Zealand, 120–291 m.

Specimen records. New Zealand. S of Great Island, Three King Islands, 34.235°S, 172.150°E, 192–202 m (NMNZ M.160289, 10).

Remarks. *Anatoma amydra* from the Indo-Malayan Archipelago has weaker spiral threads on the base, has a protoconch with an apertural varix, and has a longer teleoconch I (>0.5 vs. 0.3 whorl). *Anatoma flexidentata* from the Indian Ocean to the Western Pacific has a wider selenizone, a narrower sutsel on early whorls (<0.25 \times vs. 0.5 \times width of selenizone), and has weaker axial cords. *Anatoma pseudoequatoria* from the Indo-Malayan Archipelago and Central Pacific has a more subquadrate whorl profile, has no spiral cord in position of the selenizone on teleoconch I, and has a distinct funiculus. *Anatoma japonica* from the Indo-Pacific has a longer teleoconch (>0.5

vs. 0.3 whorl), has a protoconch with an apertural varix, and the protoconch does not project at the apex. *Anatoma maxima* from the Indo-Malayan Archipelago to the Western Pacific has a longer teleoconch I (0.75 vs. 0.3 whorl), and has no sutsel on early whorls. *Anatoma rainesi* from the Eastern and Western Pacific has a protoconch with a varix, and has a longer teleoconch I (0.6 vs. 0.3 whorl). *Anatoma rapaensis* from the Indo-Central Pacific has no sutsel, has a more impressed suture, and has spiral steps on shoulder and base.

Larocheidae Finlay, 1927

Larochea Finlay 1927

New Zealand, Recent.

Type species. *Larochea miranda* Finlay, 1927 (M).

Larochea spirata new species

(Figures 23–25)

Type material. Holotype (NMNZ M.172130: Fig. 23). 1.35 × 1.54 mm. Paratypes from type locality (NMNZ M.172127, 36: Figs 24–25).



FIGURE 23. *Larochea spirata* new species. Holotype West Norfolk Ridge, W of Cape Reinga, New Zealand, 785–800 m (NMNZ M.172130). Scale bar shell = 1 mm. Scale bars protoconch = 100 μ m.

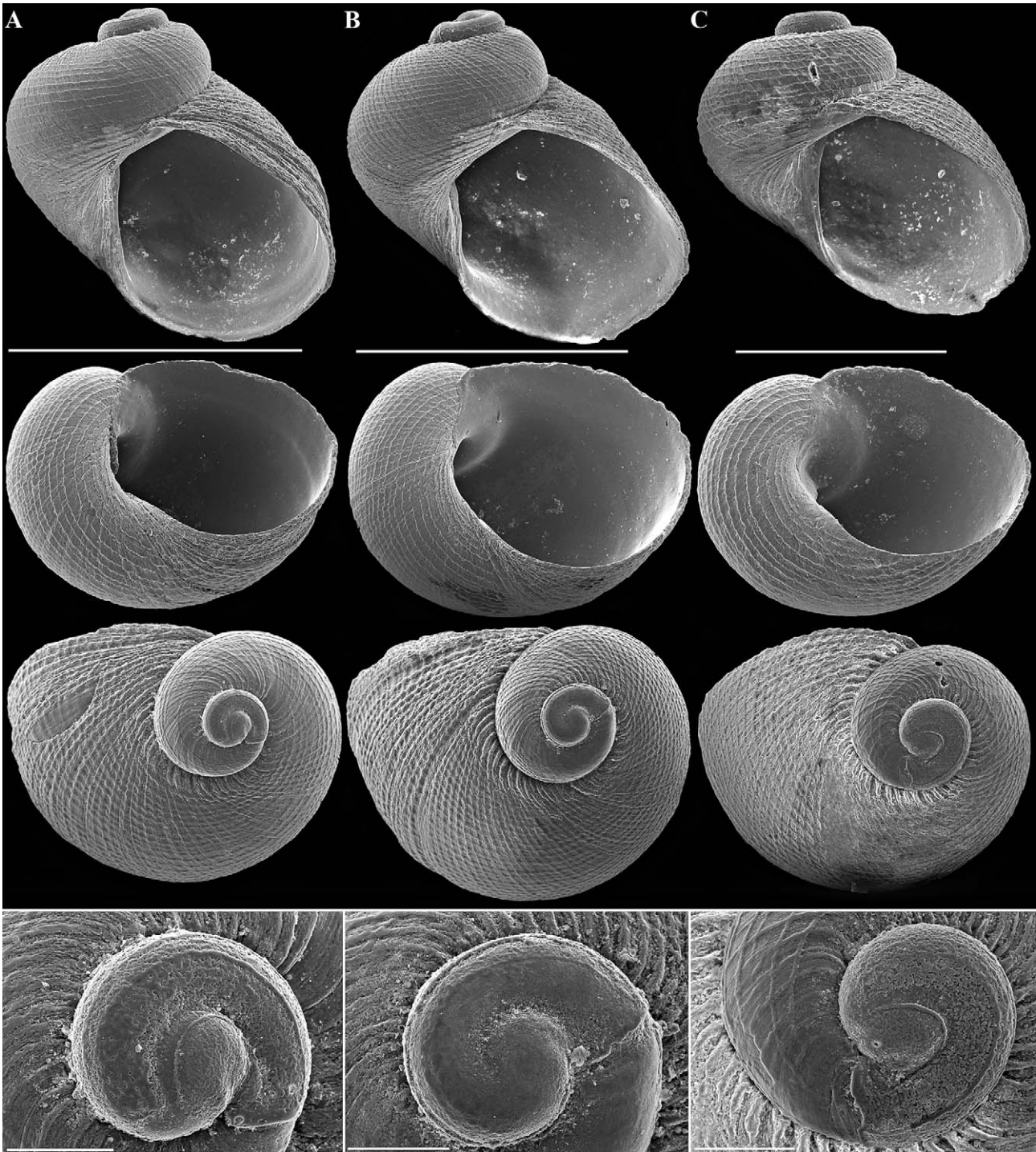


FIGURE 24. *Larochea spirata* new species. Paratypes West Norfolk Ridge, W of Cape Reinga, New Zealand, 785–800 m (NMNZ M.172127). Scale bars shell A–B = 1 mm. Scale bars shell C = 0.5 mm. Scale bars protoconch = 100 μ m.

Type locality. West Norfolk Ridge, W of Cape Reinga, New Zealand, 34.285°S, 168.430°E, 785–800 m, 2 June 2003, RV *Tangaroa*, comminuted coral and bryozoans.

Etymology. Spira, Latin for the spire, referring to the pronounced spire compared to other species in the genus.

Description. Shell medium size (to 1.5 mm. Figs 23–25), trochiform, elevated, up to 20% taller than wide (NMNZ M.172127: tallest specimen not shown). Protoconch of 0.75 whorl, flocculent sculpture with 3 indistinct spiral cords, no apertural varix, apertural margin straight. Teleoconch of up to 1.8 whorls, suture moderately impressed. Early teleoconch with shoulder showing approximately 20–22 indistinct axial cords, becoming more distinct with growth; spirals about $\frac{1}{3}$ strength of axials, first spiral commencing after 0.33–0.5 whorl,

approximately 25 at apertural margin; spirals running over axials forming minute elevated points. Axials becoming less distinct from suture towards base, sometimes vanishing entirely. Spirals transitioning at periphery from cords on shoulder to low steps on base of same density as on shoulder; axials barely perceptible on base. Anomphalous. Aperture oval, roof overhanging.

Animal unknown.

Distribution. West Norfolk Ridge, 785–800 m.

Remarks. The elevated shell shape of large specimens immediately distinguishes this species from any other *Larochaea* species. Additionally among New Zealand species, *La. secunda* Powell, 1937 lacks the spiral sculpture on the protoconch, while *La. scitula* Marshall, 1993, from Wanganella Bank, West Norfolk Ridge has much stronger, more elevated axial cords, and *La. miranda* Finlay, 1927 lacks distinct axial sculpture.

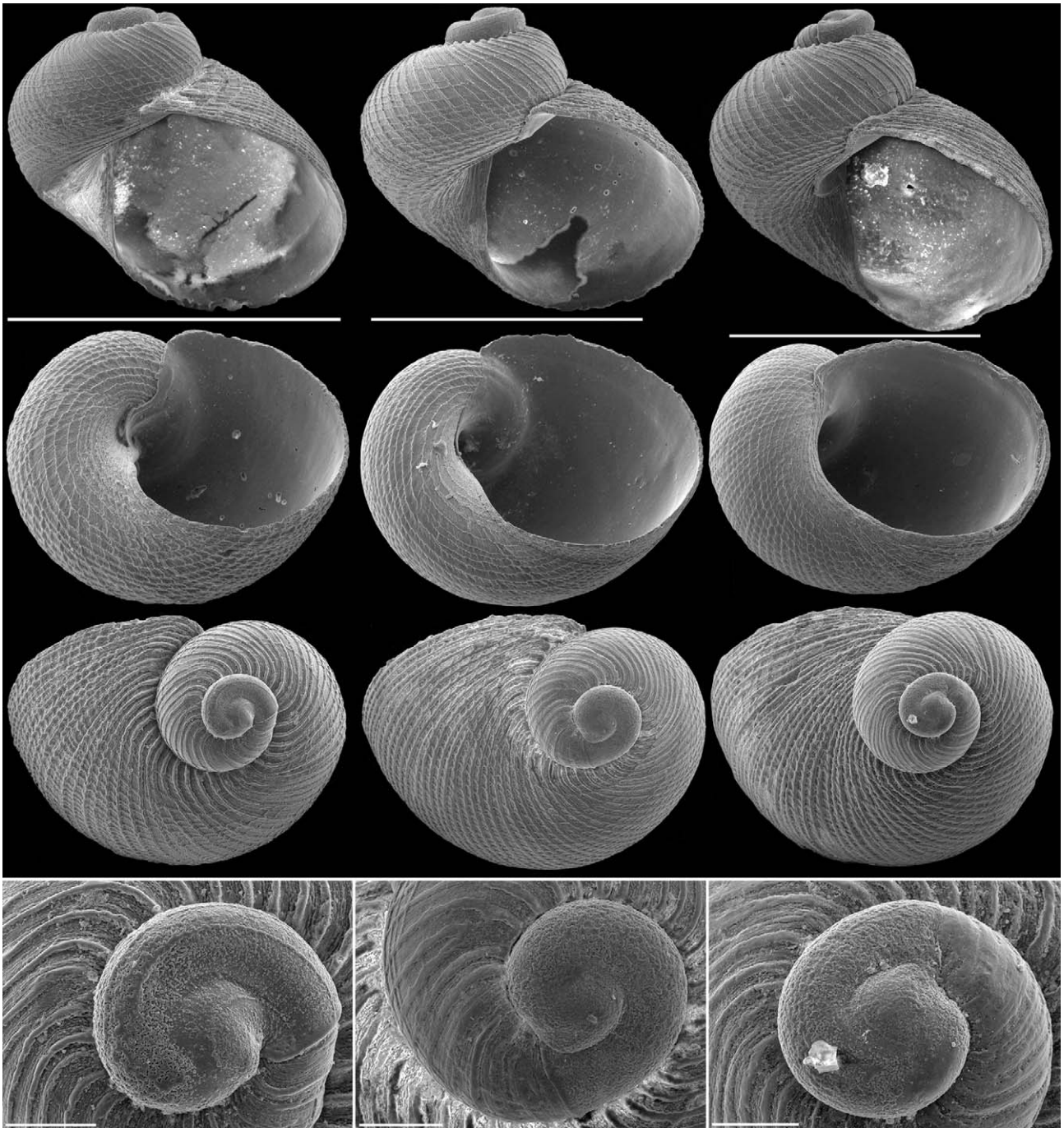


FIGURE 25. *Larochaea spirata* new species. Paratypes (NMNZ M.172127). West Norfolk Ridge, W of Cape Reinga, New Zealand, 785–800 m. Scale bars shell A–B = 1 mm. Scale bars shell C = 0.5 mm. Scale bars protoconch = 100 μ m.

***Larocheopsis* Marshall, 1993**

New Zealand, Recent.

Type species. *Larocheopsis amplexa* Marshall, 1993 (OD).

***Larocheopsis macrostoma* new species**

(Figure 26)

Type material. Holotype (NMNZ M.137435: Fig. 26). 1.22 × 0.79 mm.

Type locality. Seamount 130 km S of Esperance Rock, Kermadec Ridge, New Zealand, 32.472°S, 179.265°W, 538 m, 15 Apr. 1997, FV *Santa Maria*, hardground, foraminiferal sand, sponges and bryozoans.

Etymology. Macro-, Latin prefix for large, -stoma, Latin suffix for mouth or aperture, referring to the comparatively large aperture of the species (OD).

Description. Shell medium size (to 1.2 mm. Fig. 26), trochiform, depressed. Protoconch of 0.75 whorl, smooth, no apertural varix, apertural margin sinusoid. Teleoconch of 1.66 whorls, suture little impressed. Sculpture of first 1.5 whorls consisting of pits, shoulder of last portion with distinct commarginal axial cords, crossed by approximately 8 irregularly-spaced, indistinct spiral threads. Base from periphery to closed umbilicus with up to 16 low, spiral steps, starting after 0.66 teleoconch whorl. Umbilicus closed, covered by callus. Aperture elongate, D-shaped oval, roof overhanging. Animal unknown.

Distribution. Seamount 130 km S of Esperance Rock, Kermadec Ridge, New Zealand, 538 m.

Remarks. *Larocheopsis amplexa* Marshall, 1993, from New Zealand shares a similar protoconch, the pitted early teleoconch and the spiral steps on the base with *Ls. macrostoma*, but *Ls. macrostoma* has a much broader shell, and shows distinct axial sculpture on the shoulder near the apertural margin.

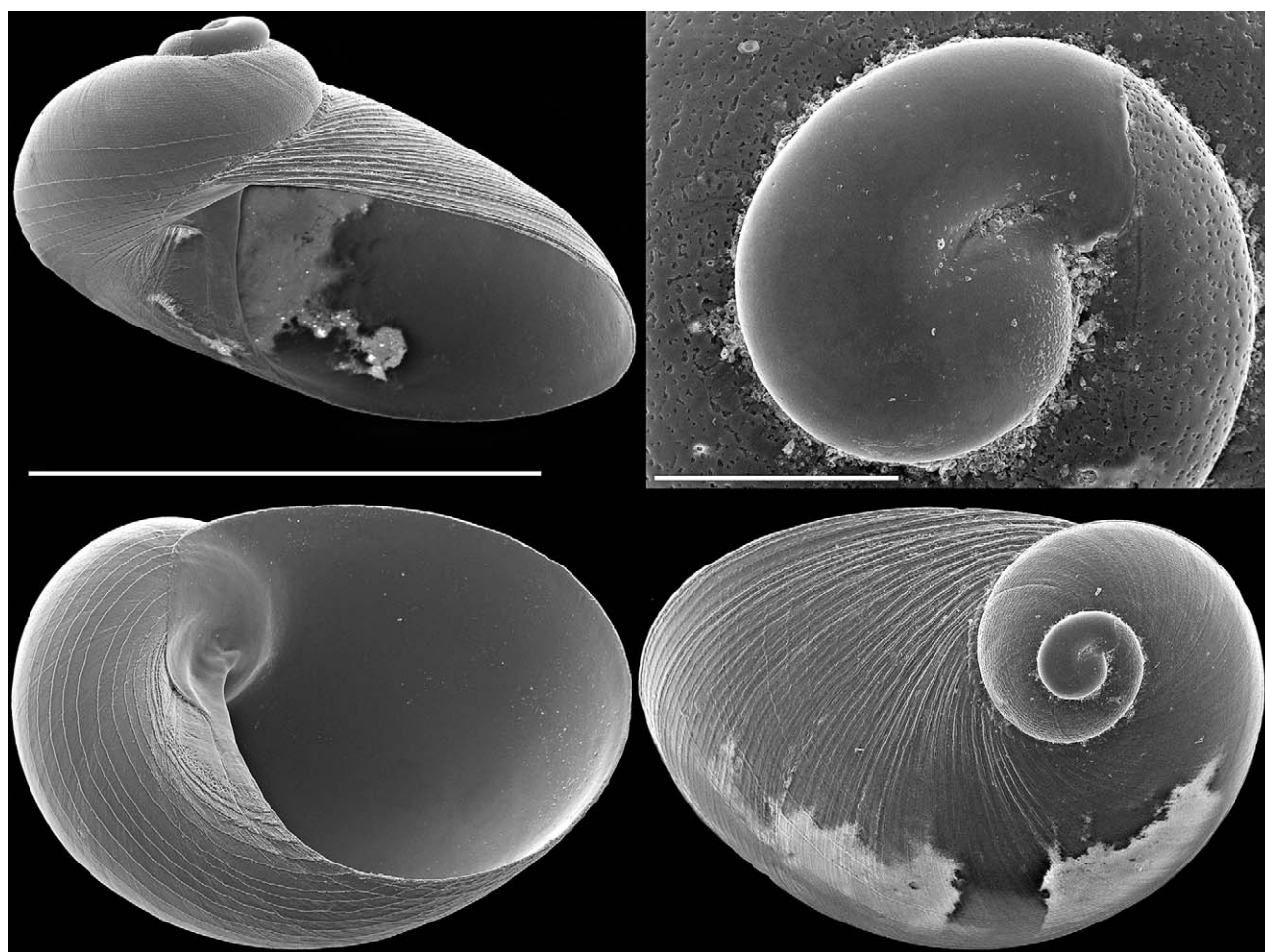


FIGURE 26. *Larocheopsis macrostoma* new species. Holotype. Seamount 130 km S of Esperance Rock, Kermadec Ridge, New Zealand, 538 m (NMNZ M.137435). Scale bar shell = 1 mm. Scale bar protoconch = 100 µm.

Discussion

We introduce here 13 new species of scissurellids new to the fauna of New Zealand. Most species occur in the northernmost portion of the country, including underwater features such as banks and seamounts. Some are only known from a few specimens or lots (*Satondella azonata*, *Sat. bicristata*, *Larocheopsis macrostoma*) and are only known from restricted areas. Some that are known from larger number of specimens and lots (e.g., *Anatoma amydra*) are much more widespread in the general Indo-Malayan Archipelago. It is unclear whether the former species have a truly narrow distribution, or whether it is an artifact of their documented scarcity. Some of those rare, new species are also small even for scissurellids (< 1 mm), which may further account for their absence in collections from elsewhere.

Anatoma has been considered a difficult genus, as characters to recognize species and the extent of intraspecific variability were uncertain. Here we highlight the importance of the area between the suture and the selenizone above. We are unaware of a shorthand term for this character, therefore introduce the term sutsel here. Høisaeter & Geiger (2011) already stressed the importance of this character in the discussion of the extraordinarily confused European species, including the often misidentified type species of the genus, *Anatoma crispata*. In most species, with some notable exceptions (Geiger unpubl. data), the width of the sutsel is rather tightly constrained at a particular growth stage, but usually widens with growth. It is a key attribute of *Anatoma* species, and a key character to be used to identify otherwise similar species.

The radular diversity amongst *Anatoma* spp. first highlighted by Geiger & Sasaki (2008) is here expanded with the very broad lateral tooth 1 in *A. megascutula*. By contrast, the radulae of all Scissurellidae examined to date do not exhibit any novel patterns.

Acknowledgements

Collection visits by DLG to AMS and MNHN were made possible through two visiting curatorships from the respective institutions. Alison Miller and Mandy Reid (AMS), and Virginie Héros (MNHN) assisted with type numbers. Harry Lee and Emilio García pointed out some nomenclatorial points. Two anonymous reviewers helped to improve the manuscript.

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