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A highly diverse molluscan seagrass fauna from the early Burdigalian (early Miocene) of Banyunganti (south-central Java, Indonesia)

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(With 2 figures and 20 plates)

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Abstract

The faunal composition of an early Miocene shallow marine mollusc fauna from central-south Java (Indonesia) is investigated. Age determination is based on the accompanying assemblage of large benthic foraminifers. The mollusc assemblage includes 184 species represented by 4,428 individuals of which 158 species (4,086 individuals) are gastropods. In species numbers the fauna is dominated by carnivorous gastropods, but herbivorous gastropods, including grazers and detritivores, dominate in terms of abundance. The ecological composition as well as the presence and abundance of certain gastropod taxa (*Smaragdia*, *Bothropoma*, Bittiinae) points to seagrass environments. The excellent preservation of the material hints to relatively low energetic depositional conditions. The mollusc taxa are briefly characterized and/or discussed. Four gastropod species, *Bothropoma mediocarinata*, *Plesiotrochus hasibuani*, *Rissoina* (*Rissoina*) *banyungantiensis*, and *Rissolina reticuspiralis*, are described as new.

Keywords: biodiversity, faunal composition, Gastropoda, Bivalvia, new species, Indo-Pacific, Miocene

Zusammenfassung

Die Zusammensetzung einer früh-miozänen Fauna mariner Flachwasser-Mollusken aus süd-zentral Java (Indonesien) wird untersucht. Die Altersbestimmung basiert auf der begleitenden Vergesellschaftung benthischer Großforaminiferen. Die Molluskenvergesellschaftung setzt sich aus 184 Arten und 4.428 Individuen zusammen, von denen 158 Arten (4.086 Individuen) zu den Gastropoden zählen. In der Artenverteilung dominieren carnivore Gastropoden, aber herbivore Gastropoden, einschließlich Weidegänger und Detritusfresser, representieren die höchsten

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Individuenzahlen. Die ökologische Zusammensetzung der Fauna, ebenso wie das Vorhandensein und die Häufigkeit bestimmter Gastropodenarten (*Smaragdia*, *Bothropoma*, Bittiinae) weisen darauf hin, dass die Fauna mit Seegräsern vergesellschaftet war. Die außergewöhnlich gute Erhaltung des Materials führt zu der Annahme, dass die Schalen in einem niedrig energetischen Milieu eingebettet wurden. Die vorhandenen Molluskenarten werden kurz charakterisiert und diskutiert. Die vier Gastropodenarten *Bothropoma mediocarinata*, *Plesiotrochus hasibuani*, *Rissoina* (*Rissoina*) *banyungantiensis* und *Rissolina reticuspiralis* werden als neue Arten eingeführt.

Schlüsselwörter: Biodiversität, Faunenzusammensetzung, Gastropoda, Bivalvia, neue Arten, Indo-Pazifik, Miozän

Introduction

The Progo Mountains west of Yogyakarta (Java, Indonesia) contain fossil-rich Paleogene and Neogene deposits that have been subject of various classical palaeontological studies (*e.g.,* MARTIN 1916, MARTIN 1917). The mountains form the western flank of the deep Yogyakarta Basin. During a fieldwork in 2006 performed by F. P. WESSELINGH and W. RENEMA a rich and well preserved Miocene mollusc fauna was encountered in one of the outcrops located near the village of Banyunganti. The fauna, attributed to the early Miocene, contained a shallow marine assemblage and sheds light on the mollusc diversity during those times. Currently, Java is located in the modern centre of maximum marine biodiversity. The new fauna might contribute to the understanding of the development of this diversity hotspot.

The scope of this study is the characterization of the Miocene mollusc fauna sampled in Banyunganti, Java in terms of abundances, diversity and ecology. A complete overview of the fauna including rare and poorly preserved specimens is given. The aim is to make the material accessible and reproducible for future taxonomists working on specific Indo-Pacific molluscan groups. Although, many taxa are described in open nomenclature it is highly likely that the vast majority represents undescribed species. A full taxonomic review of the fauna is beyond scope of this work.

Study Area

The studied sample was collected from marine Miocene deposits of the Jonggrangan Formation (KADAR 1986) that are exposed on the eastern flank of the Menoreh Mountains west of Yogyakarta (Java, Indonesia, Fig. 1). Samples were collected near the village of Banyunganti in the western side of the road from Jongranggan to Niten (7°45′39″ S, 110°07′42″ E), close to Goa Kiskendo.

The lower part of the Jonggrangang Formation comprises a thick succession of Oligocene–lowermost Miocene andesitic volcaniclastics, overlying the middle–upper Eocene marls of the Nanggulan Formation (KADAR 1986). The fauna was collected from a 1.5 m thick interval of not consolidated to slightly consolidated carbonate rich fine-middle sand grainstone with very common shells, coral fragments and larger benthic foraminifera.

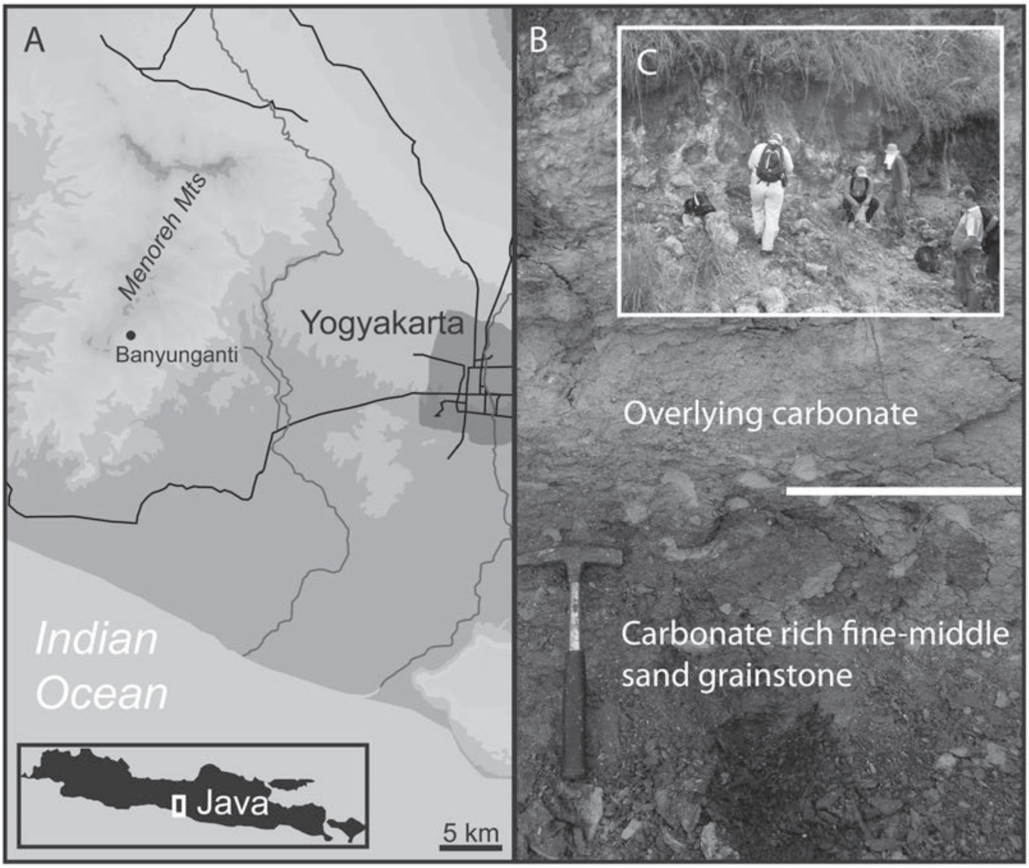

Fig. 1. A: Locality map with overview map of Java included below. B: Close-up of the sampled interval and the overlying carbonate (2006). C: Overview of the sampled outcrop (2006).

This interval was about 20 m above the volcaniclastic interval in a transitional zone that contains volcaniclastics with calcareous sand and lignite intervals. The calcareous sands increase in thickness up section, until the first massive carbonate bank, directly above the layer which was sampled. Above this carbonate no lignites and only very fine clastic sediments were observed.

Accompanying larger benthic foraminifera (LBF) were among others *Miogypsina kotoi* HANZAWA, 1935, *Austrotrillina howchini* (SCHLUMBERGER, 1893), *Flosculinella globulosa* RUTTEN, 1917, and *Planogypsina* sp. In the overlying carbonates also *Cycloclypeus eidae* TAN, 1930 was present, accompanied by *Nephrolepidina* spp., but *Eulepidina* and *Spiroclypeus* species are lacking. This association is a typical LBF zone Tf1 fauna, approximately equivalent to early Burdigalian (LUNT & ALLEN 2004; RENEMA 2007, 2008a). Strontium isotope stratigraphy analysis on two well preserved isolated molluscs from the same sample as investigated here both resulted in an age of ~18.9 Ma.

Active volcanism in the area has been dated at ~25–29 Mya (Smyth *et al.* 2005). This indicates that the Jonggrangan Formation forms a transgressive sequence over extinct volcanic cores. During the oldest phase of the transgression, where the Banyunganti fauna was sampled, a coastal environment with considerable terrestrial influence, with local patch reefs and branching coral gardens existed. The younger part of the section represents a more open marine succession.

Material and Methods

The original sample size is 5.9 kg. The fraction > 1 mm was sorted following procedures outlined in Rueda *et al.* 2009a: Zuschin *et al.* 2009; Janssen *et al.* 2011. The sampled assemblage is dominated by gastropods followed by bivalves, whereas just two scaphopod and one polyplacophoran species where found. Other faunal components are benthic foraminifers, corals, articulated bryozoans, echinoderms, crustaceans (ostracods, decapods), and fish remains (otoliths, one tooth). The non-molluscan fauna is under further investigation. The molluscan specimens were counted and identified to at least superfamily level. Whenever possible incomplete or poorly preserved material was included.

Each gastropod columella (including incomplete specimens and fragments) was counted for one individual. Each articulated bivalve was counted for one individual. Disarticulated valves were sorted into right and left valves and counted if the hinge and/or the umbo were preserved in the material. Each valve was counted for a half individual. For each species the higher number of valves (right or left) represents the minimum number of present individuals within the abundance data set. Each fully circular fragment of a scaphopod was counted for one individual. All material for which an attribution to at least superfamily level was possible, and which was clearly distinguishable from other species present in the assemblage, is included in the investigation. Only 20 of 4,448 sampled specimens remain unidentified and are excluded from this work which therefore should present a complete characterization of the mollusc fauna > 1 mm sampled in Banyunganti.

The material was compared to the original type material of mollusc species from Java described by Martin (1879, 1884, 1899, 1905, 1906, 1916, 1917, 1921) and species from East Kalimantan identified or described by Beets (1941, 1986). All type material referred to in the systematic part is housed at Naturalis Biodiversity Center, Leiden, The Netherlands (formerly Rijksmuseum van Geologie en Mineralogie). For more information on the type material by Martin and localities see Leloux & Wesselingh (2009). Material referred to in the systematic part which is identified or described by Beets is mainly from the middle Miocene Menkrawit Beds, northern Mangkalihat Peninsula, East Kalimantan (Beets 1941: Loc. 114; age according to Shuto 1975) or from the late Miocene lower Gelingseh Beds, Sangkulirang area, East Kalimantan (Beets 1986: Loc. B; age according to Leupold & van der Vlerk 1931).

Identifications in open nomenclature are based on the general literature on modern molluscs from the Philippines (POPPE, 2008a, b, 2010a, b), Thailand (ROBBA *et al.* 2003), Japan (OKUTANI 2000), and Australia (BEESLEY *et al.* 1998), and on reviews of certain groups (*e.g.*, LASERON 1957; PONDER 1984; HOUBRICK 1992; PONDER & DE KEYZER 1992).

In total 184 mollusc species where attributed to at least superfamily level. Many of those taxa are described in open nomenclature because of their incomplete preservation, an insufficient number of individuals, or the general lack of knowledge of several molluscan groups in the Cenozoic of the Indo-Pacific which precludes a meaningful taxonomic revision at the moment. For material which could be only attributed to family or superfamily level it remains unresolved if undescribed taxa are represented. The same accounts for material with questionable generic assignments, and for material only containing incomplete, poorly preserved and/or juvenile individuals, although attributed to genus level. For the majority of other taxa described in open nomenclature it is likely that they represent undescribed species, but confirmation would require more material and/or careful taxonomic revisions of several mollusc groups which was beyond scope of this work. We intend with this documentation to enable specialists on different mollusc groups to include the Banyunganti material in their works.

The mollusc fauna has been assigned to five different feeding guilds. The assignments are based on the Neogene Marine Biota of Tropical America molluscan life habits database (TODD 2001) and the comprehensive ecological information provided in BEESLEY *et al.* (1998, and references therein) (see Results – Feeding guilds).

The material is housed at Naturalis Biodiversity Center, Leiden, The Netherlands (indicated by RGM-numbers). Paratypes of the new taxa are housed at Pusat Survei Geologi (Center for Geological Survey), Bandung, Java, Indonesia (indicated by PSG-numbers).

Illustrations of all taxa are provided and remarks are given for all species if their level of identification is superfamily or lower. Remarks often include brief morphological characterizations of the species.

Abbrevations

Institutions: RGM = Naturalis Biodiversity Center (formerly Rijksmuseum van Geologie en Mineralogie), department fossil Mollusca, Leiden, The Netherlands; PSG = Pusat Survei Geologi (Center for Geological Survey), Bandung, Java, Indonesia.

Localities: Loc. 114 = Locality 114, Menkrawit Beds, northern Mangkalihat Peninsula, East Kalimantan (BEETS 1941); Loc. B = Locality B, Gelingseh Beds, Sangkulirang area, East Kalimantan (BEETS 1986).

Material: h = height, w = width, frag./frags = fragment/s, p-t boundary = protoconch-teleoconch boundary, rv = right valve(s), lv = left valves(s), TN = temporary number.

Systematic Palaeontology

For gastropod families we follow the taxonomic order proposed by BOUCHET & ROCROI (2005) with a few exceptions: Colloniidae and Phasianellidae are ranked as families in the superfamily Phasianelloidea (WILLIAMS *et al.* 2008). For the taxonomy of Conoidea we follow BOUCHET *et al.* (2011). The ranking of Pyramidelloidea follows ROBBA (2013). For the taxonomic order of bivalve families we follow BIELER *et al.* (2010).

Class Gastropoda CUVIER, 1795

Clade Vetigastropoda SALVINI-PLAWEN, 1980

Superfamily Fissurelloidea FLEMING, 1822

Family Fissurellidae FLEMING, 1822

Remarks: All specimens in the family Fissurellidae investigated in this study are incomplete and appear in low abundances, therefore it remains unsolved if undescribed taxa are present in the material.

Genus *Scutus* MONTFORT, 1810

***Scutus* sp.**
(Pl. 1, Fig. 1)

Material: RGM 783.219 (1)

Remarks: Approximately half a shell of this ovate, solid species is present. It is partly abraded. The original ornament appears to consist of irregular, narrow spiral ribs with a wavy character.

Subfamily Emarginulinae CHILDREN, 1834

Genus *Emarginula* LAMARCK, 1801

***Emarginula* sp.**
(Pl. 1, Fig. 2)

Material: RGM 784.739 (1); RGM 784.740 (1)

Remarks: Two damaged apical fragments are present in the material. The specimens have a very regular reticulate ornamentation of approximately 15 robust primary and finer secondary ribs, and equally thin concentric ribs that bound square depressions.

Subfamily Fissurellinae FLEMING, 1822

Genus *Puncturella* LOWE, 1827

***Puncturella* sp.**

(Pl. 1, Fig. 3)

Material: RGM 784.741 (1); RGM 784.742 (2)

Remarks: The available specimens are incomplete. The shells are low and ovate with a more or less centered apex and a large elliptical foramen. The ornamentation consists of approximately 30 low radial ribs; fine concentric ribs are drapped over the primaries and have a wavy appearance.

Superfamily Trochoidea RAFINESQUE, 1815

Family Trochidae RAFINESQUE, 1815

Subfamily Cantharidinae GRAY, 1857

Genus *Jujubinus* MONTEROSATO, 1884

***Jujubinus* cf. *polychromus* (A. ADAMS, 1853a)**

(Pl. 1, Fig. 4)

cf. 1853a *Ziziphinus polychromus* A. ADAMS: 168.

For a synonymy of the junior synonym *Trochus gilberti* MONTROUZIER in FISCHER, 1878 see HERBERT (1996: 421).

Material: RGM 784.743 (1); RGM 784.744 (9)

Remarks: The shell is conical with slightly rounded early and straight-sided late teleoconch whorls. It is ornamented with up to 22 regularly spaced, shallow spiral grooves and a slight suprasutural ridge on later teleoconch whorls. The partly preserved color pattern consists of axially orientated brown and narrower white blotches which form a flaming pattern. The aperture is subquadrate, the apertural base slightly contracted. A shallow umbilicus is present. The material resembles the modern Indo-Pacific species *Jujubinus gilberti* (MONTROUZIER in FISCHER, 1878) in shell shape and color pattern (see *e.g.*, POPPE 2008a: pl. 44, fig. 7). The recent specimens illustrated by POPPE & POPPE (1996a) show a high intraspecific variation regarding the strength of the suprasutural ridge which is often distinctively stronger than in our material. *Jujubinus gilberti* is a junior synonym of *Ziziphinus polychromus* A. ADAMS, 1853a described from the Philippines according to HERBERT (1996). The latter author states that the generic affinity of the species is uncertain but assigns it to the *Cantharidus*-*Jujubinus*-*Thalotia*-*Komaitrochus* complex. We place the species in the genus *Jujubinus* because of the high conical spire and the slight constriction of the body whorl well visible in the specimens illustrated by HERBERT (1996: Figs 26–27, 65–66).

Family Calliostomatidae THIELE, 1924

Subfamily Calliostomatinae THIELE, 1924

Genus *Calliostoma* SWAINSON, 1840

***Calliostoma* sp.**

(Pl. 1, Fig. 5)

Material: RGM 784.745 (1)

Remarks: The specimen is incomplete, the body whorl not preserved. It slightly resembles *Calliostoma butacianum* (MARTIN, 1905). The latter shows a more strongly imbricated shell and is ornamented with only five spiral cords containing regularly spaced knobs. The studied specimen has seven spirals on the latest preserved whorl. The protoconch of *Calliostoma* sp. is poorly preserved and therefore lacks the reticulate ornament typical for all calliostomids (HICKMAN & MCLEAN 1990). Considering the relatively poor preservation of the single specimen it is unclear if it might concern an undescribed species.

Trochoidea indet. sp.

(Pl. 1, Fig. 6)

Material: RGM 784.753 (1)

Remarks: The incomplete character and poor preservation of the single specimen only allows an assignment to the superfamily. It concerns a low dome-shaped shell with relatively round whorls and a reticulate ornament dominated by stronger spiral ribs.

Superfamily Phasianelloidea SWAINSON, 1840

Family Colloniidae COSSMANN, 1917

Subfamily Colloniinae COSSMANN, 1917

Genus *Bothropoma* THIELE, 1924

***Bothropoma mediocarinata* REICH & WESSELINGH nov. spec.**

(Pl. 2, Figs 1–7)

Holoype: Rijksmuseum van Geologie en Mineralogie (Naturalis Biodiversity Center) 784.746 (h: 2.3 mm, w: 2.7 mm);

Paratypes: RGM 784.747 (h: 2.5 mm, w: 3.0 mm); RGM 784.748 (h: 2.5 mm, w: 2.8 mm); RGM 784.749 (h: 2.2 mm, w: 2.5 mm); PSG TN1 (h: 2.2 mm, w: 2.6 mm); RGM 784.750 (h: 2.0 mm, w: 2.3 mm).

Additional material: RGM 608.185 (1); RGM 608.186 (1); RGM 608.187 (1); RGM 784.751 (1 operculum); RGM 784.752 (355+2 opercula).

Derivatio nominis: referring to the distinct median spiral ridge characterizing the species.

Locus typicus: western side of road at the village Banyunganti, province Yogyacarta, central-south Java, Indonesia.

Stratum typicum: unnamed fossiliferous bed of medium coarse sand, below Jonggranan Formation, early Burdigalian (early Miocene).

Diagnosis: Small, turbiniform shell; rounded whorl profile with up to three more or less pronounced keels and additional ornamentation of secondary and tertiary spiral threads; median primary ridge forms a strong keel; moderately strong basal cord entrenching a deep umbilicus; large circular aperture with complete peristome.

Description: The species is typically about 2–2.5 mm high and 2.3–3 mm wide. The protoconch is composed of 0.6 whorls. It is shallow and smooth. The p-t boundary is formed by a prosocline riblet, not visible in all specimens. The teleoconch is composed of 2.2–2.4 rounded whorls rapidly increasing in size. The suture is deeply impressed. The shell is ornamented with distinct spiral cords and threads of different order. The ornamentation initiates at approximately 0.3 teleoconch whorls after the p-t-boundary. It consists of three primary spiral cords which soon form pronounced ridges. The upper ridge forms a shoulder at about one third of the whorl. The middle ridge develops into a distinct keel at the body whorl. The lower ridge is situated in the middle between the median ridge and the lower suture. A straight to slightly convex or slightly concave subsutural ramp present. The whorl profile is about straight between the three ridges. Three to four secondary spiral threads are present on the subsutural ramp, increasing up to six on the body whorl. The upper thread is wider than the lower ones. One secondary spiral cord develops between the upper and the middle primary ridge. Usually it becomes nearly as prominent as the upper primary spiral ridge, but in some specimens it remains weak. Tertiary spiral threads might develop on the body whorl between primary and secondary spiral ribs. Two to three spiral cords develop between the median keel and the lower primary spiral ridge. Usually they are of same strenght, but in some specimens the median is strongest. The base of the body whorl is ornamented with six to nine secondary and tertiary spiral threads and a moderately strong basal ridge. Axial ornamentation is generally weak and only developed on the upper half of the subsutural ramp and on the base of the body whorl. The subsutural ramp is ornamented with low prosocline axial ribs which form low roundish tubercles with the upper and sometimes the middle primary spiral rib. Thin, prosocline axial ribs are present on the base of the body whorl. They are most pronounced when overrunning the basal ridge where distinct roundish tubercles are formed. The growth lines are prosocline and best visible at the interspaces of the spiral ornamentation. In some specimens the color pattern is preserved. It consists of about ten to twelve regularly spaced, somewhat rectangular light brown blotches on the subsutural ramp. Smaller light brown blotches are present along the median keel. The base of the body whorl seems to bear brown markings as well, but those are poorly preserved in the material. The body whorl is almost twice as high as the aperture. The base of the body whorl is straight to slightly convex. The aperture is large, circular, and with a complete thickened peristome. The outer lip coincides with a prosocyrt, smooth varix which is slightly bend outwards. The inner lip is thickened. It forms a rounded, somewhat elongate basal swelling. The umbilicus is open and deep. It is entrenched by the basal ridge. The operculum is circular with a diameter of about 1 mm. The outer surface is rugose with a pit in the middle. The inner surface is flat, showing a multispiral pattern.

Discussion: *Bothropoma mediocarinata* resembles *Bothropoma* cf. *munda* (H. ADAMS, 1873) from the Red Sea (ZUSCHIN *et al.* 2009: pl. 14, figs. 3–5). The latter has approximately a half teleoconch whorl more and a higher spire. Sometimes the shoulder of *B*. cf. *munda* appears smooth (ZUSCHIN *et al.* 2009) while the spiral ornamentation is visible all over the shell of *B*. *mediocarinata*. *Bothropoma* cf. *munda* from Eastern Arabia (BOSCH *et al.* 1995: p. 40, fig. 87) shows an evenly rounded whorl profile without a median keel. *Bothropoma* sp. from the early Miocene of south-west India has a higher spire, the shoulder of the body whorl is sloping, more numerous spiral cords are present, and the median keel is less pronounced (REUTER *et al*., 2010; HARZHAUSER pers. comm.). *Bothropoma pilula* (DUNKER, 1860) sensu BEETS, 1941 (published as *Leptothyra pilula* DUNKER, 1860 from Loc. 114, East Kalimantan) can be easily distinguished from our species by its beaded spiral ornamentation and the less pronounced median primary spiral cord.

Occurrence: *Bothropoma mediocarinata* is only known from the type locality.

Clade Neritimorpha

Superfamily Neritoidea RAFINESQUE, 1815

Family Neritidae RAFINESQUE, 1815

Subfamily Neritininae POEY, 1852

Genus *Smaragdia* ISSEL, 1869

***Smaragdia jogjacartensis* MARTIN, 1916**

(Pl. 2, Fig. 8)

1916 *Neritina jogjacartensis* MARTIN: 259, pl. 3, figs 82–83.
1966 *Smaragdia* (*Smaragdia*) *jogjacartensis* (MARTIN) – LADD: 58, pl. 10, figs 28–31, pl. 11, figs 1–2.
2009 *Neritina jogjacartensis* – LELOUX & WESSELINGH: 146 [cum syn.].

Material: RGM 784.754 (1); RGM 784.755 (28)

Remarks: The species has a thin, convex shell that is strongly flattened at the apertural side. The button-shaped protoconch consists of less than one whorl. The inner lip callus is thickened and restricted to the parietal margin. The inner lip is weakly crenulated. The color pattern consists of three spiral bands on the body whorl, composed of prosocline, tightly packed brown axial lines. The new material shows more variation in coloration than the type series. Especially the juvenile specimens (included in RGM 784.755) show a more simple pattern of more or less curved axial lines that appear at the upper suture.

***Smaragdia* sp.**

(Pl. 2, Fig. 9)

Material: RGM 784.756 (1); RGM 784.757 9 (3)

Remarks: *Smaragdia* sp. has a very similar color pattern as *S. jogjacartensis* MARTIN, 1916 but has an oblique egg-shape and seems to have a more prominent crenulation of the inner lip. However, the inner lip is worn or lacking in the available specimens for which reason this attribute can not be used to distinguish the material. *Smaragdia* sp. resembles *Smaragdia semari* BEETS, 1941 (Loc. 114) in shell shape but can be distinguished by its color pattern. *Smaragdia semari* has a pattern of two spiral bands composed of brown axial lines arranged in blotches. Two more bands appear on the body whorl. Axial lines always develop with some distance below the suture while they appear with contact to the suture in *Smaragdia* sp. (and *S. jogjacartensis*). Neritids often show a high intraspecific variation in color pattern and shell shape (*e.g.,* TAN & CLEMENTS 2008). For that reason the distinction between *Smaragdia* sp. and *S. jogcarcartensis* remains somewhat questionable. *Smaragdia* sp. probably represents an undescribed species.

Superorder Caenogastropoda COX, 1960

Superfamily Cerithioidea FLEMING, 1822

Family Cerithiidae FLEMING, 1822

Remarks: The material investigated in this study that is assigned to Cerithiidae but not identified beyond generic level likely includes undescribed species. Confirmation will require a thorough revision of the Indo-Pacific cerithiids which is beyond scope of this work.

Subfamily Bittiinae COSSMANN, 1906

Genus *Bittium* GRAY, 1847

***Bittium* sp.**

(Pl. 3, Fig. 1)

Material: RGM 784.761 (1); RGM 784.762 9 (1)

Remarks: *Bittium* sp. is represented by relatively thin-shelled specimens with an elongate-conical shell, rounded whorls and a very regular cancellate ornamentation of numerous axial ribs and four spiral cords on early teleoconch and five spiral cords on later teleoconch whorls.

Genus *Cerithidium* MONTEROSATO, 1884

***Cerithidium* cf. *perparvulum* (WATSON, 1886)**

(Pl. 3, Figs 2–3)

cf. 1886 *Bittium perpavulum* WATSON: 555, pl. 38, fig. 4.
For synonymy see VAN AARTSEN (2006: 35).

Material: RGM 784.758 (1); RGM 784.890 (1); RGM 784.759 (534)

Remarks: The shell is small, elongate-conical to slender with an ornamentation of thin, slightly prosocline axial ribs and spiral cords, two on early, four on later whorls, which form a cancellate pattern with beads at the intersections. Varices might be present on later teleoconch whorls. The species shows a variation in shell shape from elongate-conical to slender. The width of the whorls was measured in 15 specimens including conical, slender, and intermediate shells to exclude the possibility that more than a single species is present. The variation in whorl-width initiates after the second teleoconch whorl. This observation leads to the assumption that only one species with a high intraspecific variation in shell shape is present. Our material resembles the Indo-Pacific species *Cerithidium perparvulum* (WATSON, 1886) (VAN AARTSEN 2006: figs 4–5, 10, 13) and *Clathrofenalla cerithina* (PHILIPPI, 1849) from the Red Sea and the Gulf of Aden (JANSSEN *et al.* 2011: pl. 7, figs 3–7). According to BOSCH *et al.* (1995) *C. perparvulum* is a synonym of *C. cerithina*. JANSSEN *et al.* (2011) note a high variability in the ornamentation of their material ranging from two to four spiral elements. They conclude that their material should be attributed to a single, highly variable species with *C. cerithina* being the oldest available name. Since our material does not show a high variability in ornamentation but four spiral cords on later whorls of all 536 specimens, we follow VAN AARTSEN (2006) and use *C.* cf. *perparvulum*.

***Cerithidium* sp.**

(Pl. 3, Fig. 4)

Material: RGM 784.760 (1)

Remarks: *Cerithidium* sp. resembles *C.* cf. *perparvulum* (WATSON, 1886), but it lacks the upper middle spiral cord on the penultimate whorl and only shows weakly developed beads at the intersections of axial and spiral ribs. The whorls are less rounded and tend to have a steep subsutural ramp.

Subfamily Cerithiinae FLEMING, 1822

Genus *Cerithium* BRUGUIÈRE, 1789

***Cerithium* aff. *balteatum* PHILIPPI, 1848**

(Pl. 3, Fig. 5)

aff. 1848 *Cerithium balteatum* PHILIPPI: 22–23.
For synonymy see ROBBA *et al.* (2003: 26).

Material: RGM 784.763 (1); RGM 784.764 (1); RGM 784.765 (1)

Remarks: The material includes subadult shells only. ROBBA *et al.* (2003) illustrated a juvenile shell of *C. balteatum* (Pl. 2, Fig. 8). The identification of the former authors is based on a juvenile individual illustrated by HOUBRICK (1992: fig. 18 D). The material from Banyunganti agrees quite well with both illustrated specimens. However, the present shells are lacking varices and seem to have more slender and regularly spaced axial ribs than *C. balteatum*. The species ranges from Australia to the Tonga Islands in the east and the Ryukyu Islands in the north. It is known from the Miocene of Saipan (Northern Mariana Islands), the Quaternary of Indonesia, and the Holocene of Thailand (ROBBA *et al.* 2003).

***Cerithium deningeri* (MARTIN, 1916) nov. comb.**

(Pl. 3, Fig. 6)

1916 *Potamides* (*Terebralia*) *deningeri* MARTIN: 249, pl. 2, figs 56–58.
2009 *Clypeomorus deningeri* (MARTIN, 1916) – LELOUX & WESSELINGH: 132 [cum syn.].

Material: RGM 784.766 (1), RGM 784.767 (5)

Remarks: The shell is characteristically cerithiiform: slender-conoidal and clearly tapering towards the apex. Early teleoconch whorls are ornamented with regularly spaced low axial ribs that become wider spaced and rounded on later teleoconch whorls. Low spiral ribs develop over the wide spaced axial ribs on later whorls. The species was assigned to *Clypeomorus* JOUSSEAUME, 1888, by SHUTO (1978) based on its conoidal shape and moderately high spire. The assignment is doubtful, because typical characteristics for the genus such as a spire/aperture ratio of 2:1, a large aperture, a prominent spiral ornamentation, and beads formed at the intersections of axial and spiral elements (after HOUBRICK 1985) are lacking. Assignment to *Cerithium* is favoured, because the species shows resemblance with modern representatives of this genus (see HOUBRICK 1992 for comparison).

***Cerithium dolfusi* (MARTIN, 1916)**

(Pl. 3, Fig. 7)

1916 *Potamides* (*Terebralia*) *dolfusi* MARTIN: 250, pl. 3, fig. 61.
2009 *Cerithium dolfusi* (MARTIN, 1916) – LELOUX & WESSELINGH: 130 [cum syn.].

Material: RGM 784.768 (1)

Remarks: The shell is slender-conoidal with a weakly rounded whorl profile. The ornamentation of realatively low axial and spiral ribs is poorly preserved, but roundish knobs at the intersections of axial and spiral ribs are seen on late teleoconch whorls. The body whorl of the Banyunganti specimen is damaged.

?*Cerithium* “*ickei*” (Martin, 1916) nov. comb.

(Pl. 3, Fig. 8)

1916 *Potamides* (*Terebralia*) *ickei* Martin: 252, pl. 3, fig. 6.
2009 *Potamides* (*Terebralia*) *ickei* Martin, 1916 – Leloux & Wesselingh: 130 [cum syn.].

Material: RGM 784.778 (1)

Remarks: The studied specimen has a strongly convex whorl profile and is ornamented with wide, rounded axial ribs and numerous spiral cords. The material is tentatively assigned to *Cerithium*, but it is not sufficiently preserved. Furthermore, the strongly convex whorl profile is unusual for the genus. Houbrick (1978) suggested an assigment of *Clava ickei* (Schepman, 1906) to the genus *Cerithium* which would make *C. ickei* (Schepman, 1906) the oldest valid name. However, Houbrick (1985) later stated that the available material is insufficient to make a generic assignment of the species. Anyhow, the name *C. ickei* has been used also for *C.* (*Ptychocerithium*) *ickei* Martin, 1914 (accepted as *Cerithium coralium* Kiener, 1841, see Houbrick 1992: 61–68). In case of an attribution to the genus *Cerithium* a new name has to be attributed to the specimen from Banyunganti.

***Cerithium progoense* (Martin, 1916)**

(Pl. 3, Fig. 9)

1916 *Potamides* (*Cerithidea*) *progoënsis* Martin: 253, pl. 3, figs 67–68.
1941 *Cerithium* (*Ptycocerithium*) *progoënse* – Beets: 52, pl. 2, figs 95–98.
2009 *Cerithium progoense* – Leloux & Wesselingh: 2009: 131 [cum syn.].

Material: RGM 784.769 (1); RGM 784.771 (2); RGM 784.770 (22)

Remarks: The species is a relatively wide *Cerithium* with subrounded whorls and an ornament of regularly spaced, slightly wavy, opisthocline axial ribs and some varices. Most specimens from Banyunganti are represented by small apical fragments (RGM 784.770), but two relatively large specimens with a maximum height of 43 mm are present in the material (RGM 784.771).

***Cerithium teschi* (Martin, 1916)**

(Pl. 4, Fig. 1)

1916 *Potamides* (*Terebralia*) *teschi* Martin: 252, pl. 3, fig. 65.
2009 *Cerithium* (*Cerithium*) *teschi* (Martin, 1916) – Leloux & Wesselingh: 130 [cum syn.].

Material: RGM 784.772 (1); RGM 784.773 (1)

Remarks: The relatively large species is represented by two incomplete specimens with a maximum height of 34 mm. The whorls are prominently shouldered. The teleoconch ornamentation consists of widely spaced axial ribs overrun by narrow, sharp spiral cords. Along the shoulder distinct upward pointing spines are formed at the intersections of the axial ribs and the upper primary spiral cord. Given the identical shape and ornamentation the Banyunganti material was assigned to *C. teschi*, although spines are not present in the type material. The possession or lack of spines lies within the intraspecific variation of cerithiid species and might be linked to their occurrence in different habitats [see *Cerithium zonatum* (WOOD, 1828) in HOUBRICK 1992].

***Cerithium* s.s. sp. 1**
(Pl. 4, Fig. 2)

Material: RGM 784.774 (1); RGM 784.775 (141)

Remarks: The specimens are medium-sized cerithiids with a subrounded whorl profile and a slightly impressed suture. The ornament is rather low and consists of regularly spaced, orthocline to slightly opisthocline, slightly sigmoidal axial and three to ten spiral ribs. Varices are present and most prominent on the body whorl which is damaged in all specimens.

***Cerithium* s.s. sp. 2**
(Pl. 4, Fig. 3)

Material: RGM 784.776 (1); RGM 784.777 (7)

Remarks: All present specimens are damaged. They are characterized by relatively flat whorls and an ornamentation of rounded axial ribs and regularly spaced spiral cords. The body whorl is slightly constricted below the penultimate whorl with an almost straight outline. The axial ribs become more slender and irregular on the body whorl.

***Cerithium* s.l. sp. 1**
(Pl. 4, Fig. 4)

Material: RGM 784.779 (1)

Remarks: The single individual is incomplete and relatively poorly preserved but can be easily distinguished from the other Banyunganti cerithiids by its high, slender spire and an ornament of few orthocline axial ribs.

***Cerithium* s.l. sp. 2**
(Pl. 4, Fig. 5)

Material: RGM 784.780 (1)

Remarks: The single shell is too incomplete for an accurate classification. Its ornamentation consists of relatively wide spaced, narrow, roundish axial ribs crossed by two spiral cords on early teleoconch whorls and up to five spiral cords and additional spiral threads on later whorls. The specimen shows slight resemblance with *Cerithium* aff. *balteatum* PHILIPPI, 1848 from Banyunganti (see above) but has wider and more rounded axial ribs.

Genus *Clypeomorus* JOUSSEAUME, 1888

***Clypeomorus* sp. 1**

(Pl. 4, Fig. 6)

Material: RGM 784.781 (1); RGM 784.782 (5)

Remarks: The shell is conical with straight-sided early and slightly rounded later teleoconch whorls. The ornament consists of low, prosocline axial ribs and three distinct primary spiral ribs which form tubercles at the intersections with the axial ribs. Varices are present. The material has been assigned to *Clypeomorus* rather than to *Cerithium* according to a spire/aperture ratio of 2:1, a large aperture, and the presence of three prominent primary spiral cords, although the beaded ornamentation characteristical for the genus is not developed (see HOUBRICK 1985 for comparison).

?*Clypeomorus* sp. 2

(Pl. 4, Fig. 7)

Material: RGM 784.783 (1); RGM 784.784 (2)

Remarks: ?*Clypeomorus* sp. 2 is a relatively wide, straight-sided cerithiid with a narrow subsutural ridge and relatively evenly and widely spaced orthocline axial ribs. The material resembles *Clypeomorus* sp. 1 with which it shares features like a spire/aperture ratio of 2:1 and a large aperture, although it is larger in *Clypeomorus* sp. 1. However, the prominent spiral ornament and hence a beaded ornamenation are lacking in ?*Clypeomorus* sp. 2 for which reason an assignment to the genus remains open for future scrutiny.

Family Dialidae KAY, 1979

Genus *Diala* ADAMS, 1861

***Diala semistriata* s.l. (PHILIPPI, 1849)**

(Pl. 4, Figs 8–9)

1849 *Rissoa semistriata* PHILIPPI: 34–35.
2011 *Diala semistriata* (PHILIPPI, 1849) – JANSSEN *et al.*: 395.

Material: RGM 784.785 (1); RGM 784.786 (1); RGM 784.787 (107)

Remarks: The material falls within the morphological variation as illustrated and described by PONDER & DE KEYZER for this highly variable species (1992: 1022, figs 1A–E, 2B, C, E, G, H, 3I–P, 4, 5D–I, 6A–F, 7, 8C, D, 9A, B). For instance, six to 11 spiral lirae separated by grooves are present on the base of the body whorl which range from being “about equal in width to lirae to linear” (PONDER & DE KEYZER 1992). Due to the high variation within a genus with few shell characteristics it remains unclear if *D. semistriata* does not include more than a single species. The species is widely distributed in the tropical Indo-West Pacific (PONDER & DE KEYZER 1992). *Diala semistriata* is known since the early Miocene from Bikini and Eniwetok Atolls (LADD 1972).

***Diala* sp.**

(Pl. 4, Fig. 10)

Material: RGM 784.788 (1); RGM 784.789 (6)

Remarks: *Diala* sp. is easily distinguished from *D. semistriata* s.l. (PHILIPPI, 1849) by its subrounded whorl profile and the smooth shell. Potentially, the specimens represent an undescribed species.

Family Modulidae FISCHER, 1884

Genus *Modulus* GRAY, 1840

***Modulus* sp. 1**

(Pl. 4, Fig. 11a–b)

Material: RGM 784.794 (1); RGM 784.795 (12)

Remarks: The available specimens have trochiform shells with a straight whorl profile of early teleoconch whorls that become slightly convex on later whorls. The shell is ornamented with regularly spaced, narrow spiral ribs and fine spiral threads, and regularly spaced, wide, pronounced axial ribs initiating on later teleoconch whorls. The spiral ornamentation forms a cancellate pattern with the growthlines at the base of the body whorl. The aperture is large and semi-circular. The umbilicus is shallow and slitlike. Up to 16 well-developed ridges are present in the interior of the outer lip. The material neither resembles any of the modern Indo-Pacific species nor *Modulus praeangerensis* MARTIN, 1905 from the Miocene of Java and might belong to an undescribed species.

***Modulus* sp. 2**

(Pl. 4, Fig. 12)

Material: RGM 784.796 (1)

Remarks: A single incomplete specimen with a relatively high spire is present. The specimen has more strongly inflated whorls and lower, more closely spaced axial ribs than *Modulus* sp. 1, resulting in an undulating appearance of the spiral ornamentation. It resembles *Modulus praeangerensis* Martin, 1916, but the latter species has a lower spire with clearly shouldered whorls. Additional material is needed to verify whether it concerns an undescribed species.

Family Planaxidae Gray, 1850

Subfamily Planaxinae Gray, 1850

Genus *Planaxis* Lamarck, 1822

***Planaxis* s.l. sp.**

(Pl. 5, Fig. 1)

Material: RGM 784.797 (1)

Remarks: The material contains a single incomplete spire with a wide apical angle and an ornamentation of regularly spaced spiral grooves. The assignment to Planaxidae is based on the resemblance of our material with *Fissilabia decollata* (Quoy & Gaimard, 1833) (Poppe 2008a: pl. 94, fig. 10). Additional material is needed to verify whether it concerns an undescribed species.

Family Potamididae Adams & Adams, 1854

Genus *Cerithideopsilla* Thiele, 1929

?*Cerithideopsilla* sp.

(Pl. 5, Figs 2–3)

Material: RGM 784.798 (1); RGM 784.799 (1); RGM 784.800 (1); RGM 784.801 (1)

Remarks: The shells have an almost straight outline, an overall beaded ornamentation with three primary spiral cords of which the median one is weaker on early teleoconch whorls, and a strong columellar fold. The material is fragmented and insufficient for an accurate classification but resembles modern *Cerithideopsilla* species illustrated in Poppe (2008a: pl. 87, figs 5, 9; pl. 88, figs 1–3).

Family Scaliolidae Jousseaume, 1912

Genus *Finella* A. Adams, 1860

***Finella* cf. *pupoides* A. Adams, 1860**

(Pl. 5, Figs 4–5)

cf. 1860 *Finella pupoides* A. Adams: 336.
For synonymy see Janssen *et al.* (2011: 399).

Material: RGM 784.802 (1); RGM 784.803 (1); RGM 784.804 (1)

Remarks: The studied material contains thin-walled, elongate-ovate shells with a subrounded whorl profile and a low reticulate ornament of spiral cords and rather prominent growth marks. The species shows quite some variation in shell shape from being more ovate to more elongate. The most characteristic feature of the species is the constriction of the last one to two whorls. One specimen from Banyunganti (RGM 784.803) resembles well a specimen of *F. pupoides* illustrated by JANSSEN *et al.* (2011) from the Red Sea (Pl. 7, Fig. 10a). The other two specimens in the material are more ovate.

***Finella* sp. 1**
(Pl. 5, Fig. 6)

Material: RGM 784.805 (1); RGM 784.805 (1)

Remarks: The shells are elongate and slender. Although they show some resemblance with *F.* cf. *pupoides* from Banyunganti and a specimen of *F. pupoides* from the Red Sea (JANSSEN *et al.* 2011: pl. 7, fig. 9) the material was separated due to its profile of early teleoconch whorls which differs from the above mentioned species. Furthermore, a constriction of the last whorls was not observed. Additional material is needed to verify whether it concerns an undescribed species.

***Finella* sp. 2**
(Pl. 5, Fig. 7)

Material: RGM 784.807 (1)

Remarks: The body whorl of the available specimen is damaged and the protoconch and earliest whorls are lacking. The specimen shows resemblance with the modern South African species *Finella natalensis* SMITH, 1899 (POPPE & POPPE 1996b) in shell shape and whorl profile but differs from that species by having an ornamentation of more numerous axial ribs and weaker spiral cords. *Finella* sp. 2 can be distinguished from the other *Finella* material from Banyunganti by having an ornamentation of relatively pronounced axial ribs. The matarial is insufficient to confirm an undescribed species.

Family Turritellidae LOVÉN, 1847

Subfamily Turritellinae LOVÉN, 1847

Genus *Archimediella* SACCO, 1895

***Archimediella spolongensis* (MARTIN, 1916)**
(Pl. 5, Fig. 8)

1916 *Turritella spolongensis* MARTIN: 256, pl. 3, fig. 73.
2009 *Archimediella spolongensis* (MARTIN, 1916) – LELOUX & WESSELINGH: 127 [cum syn.].

Material: RGM 784.808 (1); RGM 784.809 (1); RGM 784.810 (24)

Remarks: All present specimens are incomplete. The species is characterized by a strong median spiral ridge which forms a pronounced keel on early teleoconch whorls that weakens gradually on later whorls. A weaker but still distinct suprasutural spiral ridge is present and a subsutural spiral ridge might be pronounced as well. Secondary spirals grow in number and are relatively regularly spaced.

Genus *Haustator* MONTFORT, 1810

***Haustator* sp.**
(Pl. 5, Fig. 9)

Material: RGM 784.811 (1); RGM 784.812 (74)

Remarks: The apex as well as the body whorl is damaged or lacking in our material. The teleoconch is preserved with at most nine whorls. The specimens have a strong spiral ridge creating a slightly sub-median angulated whorl profile. The spiral ornamentation consists of very subtle sub- and suprasutural ridges and a median spiral ridge which is located at approxiamtely 45 % of the height of the whorl. The latter is often the strongest on late teleoconch whorls. Additional weaker spiral threads and strongly curved growth-lines are present all over the whorls, but the spiral threads are worn on most specimens. The material is easily distinguished from *Archimediella spolongensis* (MARTIN, 1916) by its sub-median angulated whorl profile. Possibly it concerns an undescribed species, but a thorough revision of Indo-Pacific turritellids would be required for confirmation.

Cerithioidea indet. sp. 1
(Pl. 5, Fig. 10)

Material: RGM 784.813 (1); RGM 784.814 (2)

Remarks: The specimens are conical-ovate, have a slightly convex whorl profile and an ornamentation dominated by slender, well defined axial ribs and two spiral cords on early teleoconch whorls. A single suprasutural spiral cord is present on later whorls. A siphonal notch is developed. The classification remains open. The material is for now placed in the superfamily Cerithioidea because of the presence of two distinct spiral cords on early whorls.

Cerithioidea indet. sp. 2
(Pl. 5, Fig. 11)

Material: RGM 784.815 (1)

Remarks: The single specimen is too incomplete for an accurate classification. It has an evenly convex whorl profile and a low ornamentation of thin axial ribs and four to five primary spiral cords and secondary threads forming a slightly irregular cancellate pattern. The axial ribs are about the same strenght as the primary spiral cords. Low varices are present. The base of the last preserved whorl appears flat and smooth.

Cerithioidea indet. sp. 3

(Pl. 5, Fig. 12)

Material: RGM 784.816 (1)

Remarks: The single specimen is too incomplete for an accurate classification. The species is characterized by evenly convex whorls separated by a deep suture, and a weak ornamentation of prosocline, thin, low axial ribs and spiral cords and threads of different order forming an irregular cancellate pattern. The two spiral cords on the lower half of the whorl are most prominent. Varices are absent. The material shows some resemblance to Cerithioidea indet. sp. 2 regarding the whorl profile and the overall appearance of the ornament.

?Cerithioidea sp. 4

(Pl. 6, Fig. 1)

Material: RGM 784.790 (1); RGM 784.791 (1)

Remarks: Only the spire is present in the material. It is conical with an almost straight whorl profile and an ornamentation of two dominant spiral cords on early whorls and a low cancellate ornamentation of dominant regular, prosocline axial ribs and weaker spiral cords on later whorls. Low varices are present. The classification remains open.

?Cerithioidea sp. 5

(Pl. 6, Fig. 2)

Material: RGM 784.792 (1); RGM 784.793 (2)

Remarks: Only the spire is preserved. The material can be distinguished from ?Cerithioidea sp. 4 by slightly more rounded whorls, a shallow suture, and more numerous, less regularly spaced axial ribs. The classification remains open, but it is assumed that ?Cerithioidea sp. 5 and ?Cerithioidea sp. 4 belong to the same genus.

Superfamily Campaniloidea Douvillé, 1904

Family Ampullinidae Cossman, 1918

Genus *Ampullina* Bowdich, 1822

Ampullina s.l. sp.

(Pl. 6, Fig. 3)

Material: RGM 784.817 (1); RGM 784.818 (2)

Remarks: The material contains apical fragments too incomplete for a further identification. The generic assignment is based on the thin shell, the rounded whorls and the deeply impressed suture which distinguishes ampullinids from otherwise similar naticids. The specimens can be easily distinguished from the other ampullid material from Banyunganti (?*Cernina* sp., see below) by its lower spire consisting of fewer whorls and the larger protoconch. Today the family is represented by a single living Philippine species *Cernina fluctuata* (SOWERBY I, 1825) (*e.g.,* KASE & ISHIKAWA 2003).

Genus *Cernina* GRAY, 1840

?*Cernina* sp.

(Pl. 6, Fig. 4)

Material: RGM 784.819 (1)

Remarks: Eight fragments of a single individual are present. The material is insufficient for a complete reconstruction. The thin shell is approximately 3 cm high. It is globular with a relatively low spire, although the spire is more elevated than in *Ampullina* s.l. sp. The whorls are well rounded with a deeply impressed suture. The number of whorls is significantly higher and the protoconch is smaller in ?*Cernia* sp. than in *Ampullina* s.l. sp.

Family Plesiotrochidae HOUBRICK, 1990

Genus *Plesiotrochus* FISCHER, 1878

Remarks: Three *Plesiotrochus* species from Banyunganti are described in open nomenclature due to insufficient specimen numbers and poor preservation. The material yields potentially undescribed species.

Plesiotrochus hasibuani REICH & WESSELINGH nov. spec.

(Pl. 6, Figs 5–10)

Holotype: Rijksmuseum van Geologie en Mineralogie (Naturalis Biodiversity Center) 784.820 (h: 6.7 mm, w: 3.5 mm);

Paratypes: RGM 784.821 (h: 7.4 mm, w: 3.6 mm); RGM 784.822 (h: 6.7 mm, w: 3.4 mm); RGM 784.823 (h: 5.9 mm, w: 3.0 mm); RGM 784.824 (h: 6.2 mm, w: 3.3 mm); PSG TN2 (h: 5.7 mm, w: 3.2 mm).

Additional material: RGM 608.188 (1); RGM 608.189 (1); RGM 608.190 (1); RGM 784.825 (150).

Derivatio nominis: in honour of Prof. FAUZIE HASIBUAN, geologist at the Pusat Survei Geologi (Center for Geological Survey), Bandung, Java.

Locus typicus: western side of road at the village Banyunganti, province Yogyacarta, central-south Java, Indonesia.

Stratum typicum: unnamed fossiliferous bed of medium coarse sand, below Jongranan Formation, early Burdigalian (early Miocene).

Diagnosis: Small, elongate-conical *Plesiotrochus* species; whorl-profile angular on early teleoconch whorls and evenly rounded on later whorls; ornamentation of regularly spaced, rounded axial ribs, increasingly pronounced and more widely spaced on later whorls; spiral ornamentation of regularly spaced cords; pronounced basal spiral cord.

Description: The elongate-conical shell is typically 6–7 mm high and 3–3.5 mm wide, but all shells are damaged in the present material and may have been higher. The protoconch is composed of about one smooth whorl. The p-t boundary is poorly delimited. The teleoconch is composed of about six convex whorls separated by a well-defined suture. The initial teleoconch whorls show a clear angulation at about one third to one fourth of the whorl height, and a straight subsutural ramp. The angulation weakens gradually, later teleoconch whorls are evenly rounded. The shell is ornamented with up to 15 axial ribs on early and eight to ten axial ribs on later whorls. Early axial ribs are narrow, low, prosocline, and relatively regularly spaced with their interspaces about as wide as the ribs. Later ribs become more pronounced, more rounded, and slightly more irregular in shape. The width of their interspaces becomes more variable: from approximately the width of the rib to twice that width. On average, later ribs are wider spaced than early ribs. Spiral ornamentation consists of numerous, thin, regularly spaced, low cords. While it is uniform on early whorls, some spiral elements become more distinct on the penultimate whorl and finally up to five spiral cords are more pronounced on the body whorl. One additional spiral cord is situated at the body whorl's periphery and another distinct roundish cord runs along the base. Growthlines are prosocline and best visible on the body whorl where they form an irregular rectangular pattern with the spiral ornament. The subovate aperture occupies two fifth of the shell height. The outer lip is damaged in the material. The siphonal canal is short and oblique.

Discussion: The studied material is easily distinguishable from modern *Plesiotrochus* species known from the Philippines and Japan by its well rounded profile of later teleoconch whorls (see POPPE 2008a: pl. 97; OKUTANI 2000: pl. 67). The shell shape of *Plesiotrochus tomlini* BEETS, 1941 from Loc. 114, East Kalimantan shows some resemblance to *P. hasibuani*. However, the former has clearly weaker axial ribs than *P. hasibuani* and varices are present (not seen in the latter).

Occurrence: *Plesiotrochus hasibuani* is only known from the type locality.

***Plesiotrochus* sp. 1**
(Pl. 6, Fig. 11)

Material: RGM 784.826 (1); RGM 784.827 (6)

Remarks: The available specimens are easily distinguished from the other *Plesiotrochus* material from Banyunganti by the presence of a distinct suprasutural keel and numerous, narrow, relatively weak axial ribs. Furthermore, *Plesiotrochus* sp. 1 is the only *Plesiotrochus* from Banyunganti having varices. The material shows some resemblance with the modern *Plesiotrochus unicinctus* (A. ADAMS, 1853a) (POPPE 2008a: pl. 97, figs 1–2) concerning shell shape and ornament, although the latter lacks varices.

***Plesiotrochus* sp. 2**

(Pl. 6, Fig. 12)

Material: RGM 784.828 (1)

Remarks: The single specimen is poorly preserved but can be distinguished from the other *Plesiotrochus* material from Banyunganti by the presence of widely spaced, low, roundish axial ribs which are thickened at about one third above the suture caused by an indistinct overrunnig spiral cord. The whorls are less convex than in *P. hasibuani* nov. spec.

?*Plesiotrochus* sp. 3

(Pl. 6, Fig. 13)

Material: RGM 784.829 (1)

Remarks: The present specimen differs from the other *Plesiotrochus* forms from Banyunganti by having flat whorls with a distinct suprasutural carina and an ornament of dominant thin, narrow spaced spiral threads and weak axial elements. We are not entirely sure about the assignment to the genus *Plesiotrochus*. There are some similarities with the planaxid genus *Fissilabia* as well.

Clade Hypsogastropoda PONDER & LINDBERG, 1997

Clade Littorinimorpha GOLIKOV & STAROBOGATOV, 1975

Superfamily Capuloidea FLEMING, 1822

Family Capulidae FLEMING, 1822

Genus *Capulus* MONTFORT, 1810

***Capulus* sp.**

(Pl. 7, Fig. 1)

Material: RGM 784.830 (1)

Remarks: A juvenile shell is present that can not be further identified. It can be distinguished from the javanese *C. junghuhni* MARTIN, 1905 by the following characters: *Capulus junghuhni* has a rather round than ovate aperture like in our specimen, and a small, narrowly coiled protoconch of more than one whorl while the protoconch in the present specimen is bulbiform and consists of 0.7 whorls. Furthermore, *Capulus* sp. changes the direction of the coiling axis after the p-t boundary, a feature lacking in *C. junghuhni*.

Superfamily Cingulopsoidea Fretter & Patil, 1958

Family Eatoniellidae Ponder, 1965

Remarks: Eatoniellids are present in low numbers. This and the few shell characters present in the family impede an accurate taxonomic revison of the material from Bayunganti.

Genus *Eatoniella* Dall, 1876

***Eatoniella* s.l. sp. 1**

(Pl. 7, Fig. 2)

Material: RGM 784.831 (1); RGM 784.832 (2)

Remarks: The shell is ovate-conical with a subrounded whorl profile and has no ornamentation apart from fine slightly sigmoid growthlines. The protoconch is poorly delimited. The aperture is ovate and occupies about two fifth of the shell height. A rimate umbilicus is present. The few characters of the shell make attribution to a genus and family somewhat difficult. Several families and some genera of for example Rissoidae have very similar appearances. However, the smooth nature of the protoconch and the lack of a clear p-t boundary are typical of *Eatoniella* and some related genera (Beesley *et al.* 1998).

***Eatoniella* s.l. sp. 2**

(Pl. 7, Fig. 3)

Material: RGM 784.833 (1); RGM 784.834 (3)

Remarks: The material is distinguished from *Eatoniella* s.l. sp. 1 by its elongate-conical shell, a slightly rounded whorl profile, and a spire/aperture ratio of 2:1. The illustrated specimen RGM 784.833 contains numerous predation scars possibly caused by decapod crustaceans.

Superfamily Cypraeoidea Rafinesque, 1815

Family Cypraeidae Rafinesque, 1815

Cypraeidae indet. sp.

(Pl. 7, Figs 4–5)

Material: RGM 784.835 (1 frag.); RGM 784.836 (1 frag.); RGM 784.837 (9 frags)

Remarks: The material contains several fragments and is too incomplete for identification.

Superfamily Naticoidea GUILDING, 1834

Family Naticidae GUILDING, 1834

Remarks: Little naticid material is known from Banyunganti. All taxa are documented in open nomenclature. A revision of Indo-Pacific Naticidae might reveal that undescribed species are present.

Genus *Natica* SCOPOLI, 1777

***Natica* s.l. sp. 1**

(Pl. 7, Fig. 6)

Material: RGM 784.839 (1)

Remarks: The single specimen contains a weakly shouldered body whorl and has a well visible ornamentation of fine growthlines which form weak grooves on the upper part of the body whorl.

***Natica* s.l. sp. 2**

(Pl. 7, Fig. 7)

Material: RGM 784.840 (1); RGM 784.841 (1)

Remarks: The specimens are distinguished from *Natica* s.l. sp. 1 by their larger size, an evenly rounded body whorl which lacks a shoulder, and most characteristicly by their smooth shells.

Genus *Naticarius* DUMÉRIL, 1805

***Naticarius* sp.**

(Pl. 7, Fig. 8)

Material: RGM 784.838 (1)

Remarks: The specimen resembles *Naticarius marochiensis* (GMELIN, 1791) sensu BEETS, 1986 (Loc. B, East Kalimantan). That species is also known as *Natica* (*Natica*) *marochiensis* (GMELIN, 1971) sensu BEETS, 1941 (Loc. 114). The most characteristic feature of the Banyunganti specimen and *N. marochiensis* are the well-defined, regularly spaced grooves radiating from the suture. The Banyunganti material is distinguished from *N. marochiensis* by its more rounded shell, a slightly lower spire, and a less open crescent shaped umbilical chink.

Naticidae indet.

(Pl. 7, Fig. 9)

Material: RGM 784.842 (1 operculum)

Remarks: One generically unassigned naticid operculum is found in the Banyunganti material. It is larger than the naticid shells present in the assemblage and might belong to a different species.

Superfamily Rissooidea Gray, 1874

Family Rissoidae Gray, 1874

Remarks: Rissoids from Banyunganti that are described in open nomenclature only contain single, damaged specimens that are regarded as insufficient for a further taxonomic assignment.

Subfamily Rissoininae Stimpson, 1865

Genus *Rissoina* d'Orbigny, 1840

Subgenus *Rissoina* d'Orbigny, 1840

***Rissoina* (*Rissoina*) *banyungantiensis* Reich & Wesselingh nov. spec.**

(Pl. 7, Fig. 10, Pl. 8, Figs 1–4)

Holotype: Rijksmuseum van Geologie en Mineralogie (Naturalis Biodiversity Center) 784.843 (h: 5.5 mm, w: 2.2 mm);

Paratypes: RGM 784.844 (h: 6.2 mm, w: 2.8 mm); RGM 784.845 (h: 5.7 mm, w: 2.3 mm); RGM 784.846 (h: 5.6 mm, w: 2.3 mm); RGM 784.847 (h: 5.7 mm, w: 2.6 mm); PSG TN3 (h: 5.7 mm, w: 2.4 mm).

Additional material: RGM 608.191 (1); RGM 608.192 (1); RGM608.193 (1); RGM 784.848 (1414).

Derivatio nominis: referring to the type locality.

Locus typicus: western side of road at the village Banyunganti, province Yogyacarta, central-south Java, Indonesia.

Stratum typicum: unnamed fossiliferous bed of medium coarse sand, below Jongranan Formation, early Burdigalian (early Miocene).

Diagnosis: Small, elongate-conical, high-spired *Rissoina* species; whorl profile almost straight; shell with slender but robust, slightly opisthocline axial ribs and very weak spiral threads; strong varix just behind the outer lip; wide and shallow spiral depression just above base of the body whorl.

Description: The elongate-conical, high-spired shell is on average 5.7 mm high and typically 2.2–2.8 mm wide. The dome-shaped protoconch is composed of 1.3–1.5 whorls and smooth. The p-t boundary is defined by an indistinct opisthocline line. The teleoconch consists of 6.5–7 whorls. The whorl profile is straight to convex. The suture is moderately deep impressed and undulating. The shell is ornamented with regularly spaced, slender axial ribs; interspaces are as wide as the ribs. About 15 axial ribs are present on early teleoconch whorls, increasing to up to 20–25 on the body whorl. The ribs are slightly opisthocline and continue on the base of the body whorl. The spiral ornamentation is very weakly developed. Numerous regular fine spiral threads are present between the interspaces of the axial ribs, best visible on the slightly rounded body whorl. A wide spiral depression is developed at the base of the body whorl. The fusiform to subovate aperture occupies about one third of the height of the shell. The outer lip is rounded. A very heavy opisthocline varix is present just behind the apertural margin, covered by up to six additional axial ribs which are less prominent and narrower spaced than the regular axial ribs. The former are often worn in the material. The inner lip is narrow, moderately thickened and slightly curved. The base of the inner lip is located to the left of the shell's axis. A moderately deep, wide basal apertural notch is present. It is entrenched by a slight swelling at the lower part of the inner lip. A shallow posterior canal is well-defined.

Discussion: *Rissoina* (*R.*) *banyungantiensis* nov. spec. resembles *Rissoina indrai* Beets, 1941 (various Miocene localities, East Kalimantan). The latter species is clearly larger being around 10 mm high. The holotype of *R. indrai* (RGM 312.250) is ornamented with widely spaced axial ribs on early whorls. The ribs become progressively more close-set. The body whorl bears more than 30 axial ribs that become weaker on the base of the body whorl. The spiral ornamentation becomes clearly evident on the base of the body whorl where it forms a reticulate pattern with the weak axials, a feature lacking in *R.* (*R.*) *banyungantiensis*. The modern Japanese species *Rissoina* (*Rissoina*) *rosea* (Deshayes, 1862) (Okutani 2000: pl. 75, fig. 19) resembles *R.* (*R.*) *banyungantiensis* superficially but has a lower number of axial ribs and a more convex whorl profile.

***Rissoina* (*Rissoina*) sp.**

(Pl. 8, Fig. 5)

Material: RGM 784.856 (1)

Remarks: The shell is fusiform with a relatively rounded whorl profile and an ornamentation of distinct axial ribs and weak spiral threads. The convex whorls and the strong axial ornament clearly distinguish the specimen from *Rissoina* (*R.*) *banyungantiensis* nov. spec.

?*Rissoina* s.l. sp.
(Pl. 8, Fig. 6)

Material: RGM 784.855 (1)

Remarks: The shell is fusiform with a subrounded whorl profile and strong axial ribs and weaker spiral threads. The specimen resembles *Rissoina* (*Rissoina*) sp. but can be distinguihed by a lower number of stronger spiral threads and weaker axial ribs. Due to the incomplete preservation of the body whorl a distinction on genus level based on the presence or absence of a basal spiral ridge is not possible.

Genus *Rissolina* GOULD, 1861

***Rissolina reticuspiralis* REICH & WESSELINGH nov. spec.**
(Pl. 8, Figs 7–11)

Holotype: Rijksmuseum van Geologie en Mineralogie (Naturalis Biodiversity Center) 784.849 (h: 3.5 mm, w: 1.4 mm);

Paratypes: RGM 784.850 (h: 3.9 mm, w: 1.6 mm); RGM 784.851 (h: 3.2 mm, w: 1.4 mm); RGM 784.852 (h: 3.6 mm, w: 1.5 mm); RGM 784.853 (h: 3.2 mm, w: 1.3 mm); PSG TN4 (h: 3.5 mm, w: 1.5 mm).

Additional material: RGM 608.194 (1); RGM 608.195 (1); RGM 608.196 (1); RGM 784.854 (72).

Derivatio nominis: referring to the presence of well-developed spiral cords that form a reticulate pattern with the axial ribs.

Locus typicus: western side of road at the village Banyunganti, province Yogyacarta, central-south Java, Indonesia.

Stratum typicum: unnamed fossiliferous bed of medium coarse sand, below Jongranan Formation, early Burdigalian (early Miocene).

Diagnosis: *Rissolina* species with small, elongate-conical high-spired shell; whorl profile convex; with sharp, slightly opisthocline axial ribs, thinner but sharply delimited spiral cords, and microscopic, very densely spaced spiral striae; outer lip coinciding with strong varix, ornamented with well defined low knobs; strong, beaded spiral ridge at base of body whorl.

Description: The elongate-conical, high-spired shell is typically about 3–4 mm high and on average 1.5 mm wide. The dome-shaped protoconch is smooth apart from thin irregular axial folds which are often worn in the material. The p-t boundary at about 1.2–1.5 whorls is indistinct and appears to coincide with the onset of the teleoconch ornamentation. The teleoconch consists of 5.5 to 6 convex whorls. A subtle subsutural angulation is present. The suture is moderately deep impressed. The shell is ornamented with regularly spaced, very slender and sharp axial ribs, with concave interspaces that are about four times as wide. About 13 axial ribs are present on early teleoconch whorls, increasing up to about 18 on the body whorl. The ribs are slightly opisthocline and extend on the base of the body whorl. The thin and sharp, regularly spaced spiral cords are visible in the axial interspaces and overrun the axials on the terminal part of the body whorl. They are well visible on the outer lip as small pointed knobs. The shell is furthermore covered by a dense micro-ornamentation of numerous thin spiral threads with their interspaces equating their width (see Pl. 8, Fig. 11c). The fusiform to subovate aperture is about one quarter the height of the shell. The outer lip is rounded. It coincides with an opisthocline varix containing the ultimate two to four (usually three) narrow spaced axial ribs. The spiral ornamentation is well developed on the entire terminal varix. The inner lip is slightly curved. A shallow and wide basal apertural notch is present. A shallow posterior canal is moderately well defined. The base of the body whorl contains a very robust spiral ridge. The ornamentation on the ridge is very well developed. Where axial and spiral ribs meet narrow, low beads are formed.

Discussion: The attribution to *Rissolina* is based on the presence of a well-developed ridge on the lower half of the body whorl (PONDER 1984). The sharply delimited spiral cords are exceptional for the subgenus. The species resembles *Rissolina ramai* (BEETS, 1941) (various Miocene localities, East Kalimantan). The latter species is slightly larger and has a rounded whorl profile. The axial ribs are more numerous and clearly opisthocline while the axial ribs of *R. reticuspiralis* are almost straight. Spiral ribs are usually weaker and more variable in *R. ramai*. That species also has a more clearly defined siphonal notch. The modern Philippine species *Rissoina laevicostulata* PILSBRY, 1904 (POPPE 2010b: pl. 1306, fig. 8) resembles *R. reticuspiralis* in shape but lacks the beaded ornamentation of the varix and the basal ridge. Furthermore, the axial ribs of *R. laevicostulata* seem to be slightly wider but narrower spaced. *Rissoina* s.l sp. from Banyunganti resembles *R. reticuspiralis* in ornamentation but can be distinguished by its fusiform shape, the stronger rounded whorls, and the slightly stronger axial ribs.

Genus *Stosicia* BRUSINA, 1870

Subgenus *Isseliella* WEINKAUFF, 1881

***Stosicia* (*Isseliella*) sp.**

(Pl. 8, Fig. 12)

Material: RGM 784.857 (1)

Remarks: A fragment of a rissoid body whorl is present in the material. It is attributed to the genus *Stosicia* based on the knob in the upper part of the columellar lip. The reticulate ornament typifies subgenus *Isseliella* (PONDER 1984).

Superfamily Stromboidea RAFINESQUE, 1815

Family Strombidae RAFINESQUE, 1815

Genus *Strombus* LINNAEUS, 1758

***Strombus* s.l. sp.**

(Pl. 9, Fig. 1)

Material: RGM 784.858 (1 frag.)

Remarks: One fragment of the outer lip of a relatively large specimen is present. The character of the fragment allows an assignment to Strombidae but is not sufficient for a further classification.

Genus *Varicospira* EAMES, 1952

***Varicospira sokkohensis* (MARTIN, 1916)**

(Pl. 9, Fig. 2)

1916 *Rimella sokkohensis* MARTIN: 247–248, pl. 2, fig. 50.
1931 *Rimella sokkohensis* – VAN DER VLERK: 245.
1994 *Rimella sokkohensis* – SKWARKO & SUFIATI: g10.

Material: RGM 784.859 (1); RGM 784.860 (48)

Remarks: We follow the assignment of *Rimella mordax* MARTIN, 1916 to *Varicospira* made by HARZHAUSER (2007). *Varicospira sokkohensis* was regarded as a synonym of *V. mordax* by VAN DEN HOEK OSTENDE *et al.* (2002) (see also LELOUX & WESSELINGH 2009: *Rimella mordax*; HARZHAUSER 2007). However, here we follow the distinction of the two species made by MARTIN (1916). *Varicospira mordax* has a somewhat squat shell while the shell of *V. sokkohensis* is higher, slender and acuminated. The long posterior canal is almost straight to the shell axis in *V. mordax* while it is clearly inclined towards the axis in *V. sokkohensis*. The material from Banyunganti agrees with the type material of *V. sokkohensis*.

Family Seraphsidae GRAY, 1853

Genus *Terebellum* RÖDING, 1798

***Terebellum* sp. 1**

(Pl. 9, Fig. 3)

Material: RGM 784.861 (1)

Remarks: A relatively large fragment of the spire is present. The distinguishing feature of the material is a low suprasutural ridge clearly demarcated from the upper part of the whorl by a furrow.

***Terebellum* sp. 2**

(Pl. 9, Fig. 4)

Material: RGM 784.862 (1)

Remarks: A fragment of the uppermost part of the spire is present. The specimen can be distinguished from *Terebellum* sp. 1 by the absence of a suprasutural ridge.

Superfamily Tonnoidea SUTER, 1913 (1825)

Family Ranellidae GRAY, 1854

Subfamily Cymatiinae IREDALE, 1913

Genus *Sassia* BELLARDI, 1873

***Sassia* (*Cymatiella*) *fennemai* (MARTIN, 1899)**

(Pl. 9, Figs 5–6)

1899 *Triton* (*Colubraria*) *fennemai* MARTIN: 141, pl. 22, fig. 322.
2009 *Sassia* (*Cymatiella*) *fennemai* (MARTIN, 1899) – LELOUX & WESSELINGH: 107 [cum syn.].

Material: RGM 784.863 (2); RGM 784.864 (23)

Remarks: The present shells are conical with straight to slightly convex tangents. The multispiral protoconch appears smooth and is clearly delimited from the teleoconch. The teleoconch is ornamented with regularly spaced axial and spiral ribs of equal strenght forming a reticulate pattern. Additional spiral threads and varices are present. The Banyunganti specimens are the first record of *S.* (*C.*) *fennemai* from the early Miocene. Previously the species was only known from the middle and late Miocene of Java (BEU 2005) and East Kalimantan (BEETS 1986).

?Ranellidae indet. sp.

(Pl. 9, Fig. 7)

Material: RGM 784.865 (1); RGM 784.866 (1)

Remarks: Two apical fragments that do not allow a further identification are present in the material. The large, smooth paucispiral protoconch in combination with the dense teleoconch ornamentation of axial and spiral elements and the presence of varices suggest a placement in Ranellidae.

Superfamily Vermetoidea Rafinnesque, 1815

Family Vermetidae Rafinesque, 1815

Genus *Vermetus* Daudin, 1800

***Vermetus* s.l. sp.**

(Pl. 9, Fig. 8)

Material: RGM 784.867 (1 frag.)

Remarks: The material contains a single fragment with a slightly ovate cross section and an ornamentation of irregular axial ridges which does not allow a further classification.

Informal group Ptenoglossa Gray, 1853

Superfamily Epitonioidea Berry, 1910

Family Epitoniidae Berry, 1910

Genus *Amaea* Adams & Adams, 1853

***Amaea* sp.**

(Pl. 9, Fig. 9)

Material: RGM 784.868 (1); RGM 784.869 (11)

Remarks: The available specimens have an elongate-conical shell with convex whorls regularly increasing in size and an ornamentation of weak, slender axial ribs and narrowly spaced, fine spiral threads forming a cancellate pattern. Weak tubercles develop on the intersections of axial and spiral ornamentation on later whorls. The body whorl is lacking in all specimens. The material represents a potentially undescribed species.

Genus *Epitonium* Röding, 1798

***Epitonium* sp.**

(Pl. 9, Fig. 10)

Material: RGM 784.870 (1)

Remarks: A single strongly convex teleoconch whorl is present, insufficient for a species assignment. The convex whorl profile and the ornamentation of straight axial ribs which are widely spaced, slender and distinctively elevated are characteristic for the genus.

Superfamily Eulimoidea PHILIPPI, 1853

Family Eulimidae PHILIPPI, 1853

Genus *Melanella* BOWDICH, 1822

***Melanella* sp.**

(Pl. 9, Fig. 11)

Material: RGM 784.871 (1); RGM 784.872 (1)

Remarks: The specimens show typical features for the genus such as an elongate-conical to lanceolate, glossy shell with a straight whorl profile, an indistinct suture, and a spindle-shaped aperture. The protoconch forms a small tip on top of the shell which resembles the modern Indo-Pacific *Melanella teinostoma* (ADAMS, 1853b) (POPPE 2008a: pl. 302, fig. 5–6), but that species has a more cylindrical shape. A careful revision of Indo-Pacific Eulimidae would be required for a further taxonomic assignment of the species.

Eulimidae indet. sp.

(Pl. 9, Fig. 12)

Material: RGM 784.873 (1); RGM 784.874 (2)

Remarks: The small shells are elongate-ovate and have a subrounded whorl profile showing the highest convexity on the lower part of the whorls. The protoconch is incomplete in the material. Together with the first teleoconch whorl it forms a tip which is disctinctively smaller than the following teleoconch whorls. The shell is smooth apart from strongly sinuous growthlines. The aperture is ovate to widely spindle-shaped and anteriorly extended. The columella is twisted. The body whorl is slightly turreted. The material shows resemblance with several genera within the family but could not be assigned to a genus beyond doubt.

Superfamily Triphoroidea GRAY, 1847

Remarks: Triphoroidea from Banyunganti are present in low numbers. Specimens are ofen incomplete and lack important diagnostic characters such as the protoconch. Therefore the material is described in open nomenclature, although undescribed species might be present.

Family Triphoridae GRAY, 1847

Subfamily Metaxiinae MARSHALL, 1977

Genus *Metaxia* MONTEROSATO, 1884

***Metaxia* sp. 1**

(Pl. 9, Fig. 13)

Material: RGM 784.875 (1); RGM 784.876 (1)

Remarks: Up to the last 2–2.5 dextrally coiled teleoconch whorls are preserved in the material. The specimens are characterized by their ornamentation of numerous slender, slightly opisthocline axial ribs and three spiral cords forming a slightly irregular cancellate pattern with tubercles at the intersections of axial and spiral ribs.

***Metaxia* sp. 2**

(Pl. 9, Fig. 14)

Material: RGM 784.877 (1)

Remarks: The single specimen is preserved with 4.7 dextrally coiled teleoconch whorls. The material resembles *Metaxia* sp. 1 but can be distinguished by its more strongly rounded whorl profile and the lower number of axial ribs.

Subfamily Triphorinae GRAY, 1847

Genus *Triphora* DE BLAINVILLE, 1828

***Triphora* s.l. sp. 1**

(Pl. 10, Fig. 1)

Material: RGM 784.878 (1); RGM 784.879 (32)

Remarks: The specimens have a subrounded whorl profile. Protoconch I is smooth and consists of about a half whorl. Protoconch II consists of 1.5 whorls and is ornamented with two spiral ridges and slender sigmoidal axial ribs. The teleoconch is ornamented with regularly spaced, slender, prosocline axial ribs and two widely spaced primary spiral cords. Distinct roundish tubercles form at the intersections of axial and spiral ribs. A single secondary spiral cord developes between the two primary spiral ribs on later teleoconch whorls that becomes progressively more prominent. A short, wide siphonal canal is pointing left-backwards. *Triphora* s.l. sp. 1 resembles *T.* (*Inella*) *javana* (MARTIN, 1899) in external ornamentation. However, the latter is larger and has a straight overall appearance, whereas *Triphora* s.l. sp. 1 has a somewhat spindle shape.

***Triphora* s.l. sp. 2**

(Pl. 10, Fig. 2)

Material: RGM 784.880 (1); RGM 784.881 (4)

Remarks: The protoconch is lacking in the material. *Triphora* s.l. sp. 2 contains two spiral ribs, whereas *Triphora* s.l. sp. 1 contains three. Furthermore, *Triphora* s.l. sp. 2 has a deeper impressed suture.

Family Cerithiopsidae Adams & Adams, 1853

Genus *Cerithiopsis* Forbes & Hanley, 1851

***Cerithiopsis* s.l. sp. 1**

(Pl. 10, Fig. 3)

Material: RGM 784.882 (1); RGM 784.883 (3)

Remarks: The material contains high, slender shells with an almost straight whorl profile and an ornamentation of numerous slender, slightly opisthocline axial ribs and three spiral cords forming a regular quadrate pattern with tubercles at the intersections of axial and spiral ribs. The protoconch is lacking.

***Cerithiopsis* s.l. sp. 2**

(Pl. 10, Fig. 4)

Material: RGM 784.884 (1)

Remarks: The specimen can be easily distinguished from *Cerithiopsis* s.l. sp. 1 by more straight-sided whorls and the slightly prosocline position of the axial ribs.

Infraorder Neogastropoda Thiele, 1929

Superfamily Buccinoidea Rafinesque, 1815

Family Columbellidae Swainson, 1840

Genus *Atilia* Adams & Adams, 1853

***Atilia* cf. *njalindungensis* (Martin, 1921)**

(Pl. 10, Fig. 5)

cf. 1921 *Columbella* (*Atilia*) *njalindungensis* Martin: 464, pl. 59, figs 47–48.
For synonymy see Leloux & Wesselingh (2009: p. 48, under *Atilia njalindungensis* (Martin, 1921)).

Material: RGM 784.885 (1); RGM 784.886 (1); RGM 784.887 (23)

Remarks: The shell is conical with a weakly rounded whorl profile. It is widest right above the base of the body whorl. Ornamentation is restricted to the base of the body whorl where regularly spaced spiral grooves are present. The aperture is spindle-shaped. Denticulation is seen on the inner side of outer and inner lip. It remains unclear if the syntypes designed by Martin 1921 belong to a single species. The specimens from Banyunganti agree especially well with syntype RGM.9615b but remain smaller.

Columbellidae indet. sp.

(Pl. 10, Fig. 6)

Material: RGM 784.888 (1); RGM 784.889 (1)

Remarks: The material differs from *Atilia* cf. *njalindungensis* (MARTIN, 1921) from Banyunganti by its larger size, the more constricted body whorl resulting in a slightly concave outer lip, the higher number of grooves on the base of the body whorl, and the longer and narrower aperture. The shell of Columbellidae indet. sp. is widest just below the spire while the shell of *A*. cf. *njalindungensis* is widest right above the base of the body whorl.

Family Fasciolariidae GRAY, 1853

Subfamily Fusininae WRIGLEY, 1927

Genus *Fusinus* RAFINESQUE, 1815

***Fusinus* sp.**

(Pl. 10, Fig. 7)

Material: RGM 784.891 (1)

Remarks: The single spire present in the material precludes a further identification.

Genus *Fasciolaria* LAMARCK, 1799

***Fasciolaria* s.l. sp.**

(Pl. 10, Fig. 8)

Material: RGM 784.892 (1); RGM 784.893 (2)

Remarks: Incomplete, subadult specimens are present. The material could not be identified on species level nor equivocally attributed to a genus of fasciolariids. The paucispiral protoconch suggests a close relationship with *Fusinus* (VERMEIJ, pers. comm.).

Superfamily Muricoidea RAFINESQUE, 1815

Family Muricidae RAFINESQUE, 1815

Subfamily Coralliophilinae CHENU, 1858

Genus *Coralliophilia* ADAMS & ADAMS, 1853

***Coralliophila* sp.**

(Pl. 10, Fig. 9)

Material: RGM 784.895 (1)

Remarks: The genus assignment of the present material is based on the dense ornamentation of closely positioned spiral cords with a characteristic scaled appearance. The specimen resembles modern representatives of the genus as illustrated in POPPE 2008b (*e.g.*, *Coralliophila infantula* KOSUGE, 1985: pl. 416, figs 1–2) but does not fully confirm any of the illustrated species in that work. It might represent an undescribed species.

Subfamily Muricinae RAFINESQUE, 1815

Genus *Calotrophon* HERTLEIN & STRONG, 1951

Subgenus *Panamurex* WOODRING, 1959

***Calotrophon* (*Panamurex*) sp.**

(Pl. 10, Fig. 10)

Material: RGM 784.894 (1)

Remarks: The available specimen resembles well modern representatives of *Calotrophon* (*Panamurex*) [*e.g.*, *Calotrophon* (*Panamurex*) *lychnia* (GARDNER, 1947) in MERLE *et al.* 2011: pl. 147, fig. 4]. Fossil representatives of the subgenus are known from the western Atlantic, Europe, and the eastern Pacific with the oldest record from the early Oligocene. Modern species are known from the western Atlantic and Somalia (MERLE *et al.* 2011). The present specimen is the first fossil record for the subgenus in the Indo-Pacific and may represent an undescribed species.

Subfamily Typhinae COSSMAN, 1903

Genus *Typhina* JOUSSEAUME, 1880

***Typhina* cf. *macropterus* (MARTIN, 1884)**

(Pl. 10, Fig. 11)

cf. 1884 *Typhis macropterus* MARTIN: 98, pl. 6, fig. 100.
For synonymy see LELOUX & WESSELINGH (2009: p. 94, under *Talityphis macropterus* (MARTIN, 1884)).

Material: RGM 784.896 (1)

Remarks: Only one apical fragment is present. The material is insufficient for an accurate species identification. Nevertheless, the spire fragment resembles the type material quite well.

Typhinae indet. sp.

(Pl. 10, Fig. 12)

Material: RGM 784.897 (1 frag.)

Remarks: One fragment of a distinct wing-shaped outer lip is present. The shape is characteristic for species within the subfamily Typhinae.

Muricidae indet. sp.

(Pl. 10, Fig. 13)

Material: RGM 784.898 (1)

Remarks: The present poorly preserved apical fragment is not sufficient for a further classification.

Family Costellariidae MACDONALD, 1860

Genus *Vexillum* RÖDING, 1798

Remarks: The costellariids from Banyunganti have been assigned to eight different species and are for the moment attributed to *Vexillum*. The material almost certainly includes undescribed species, but confirmation would require an extensive revision of Indo-Pacific Costellariidae which is beyond scope of this study.

***Vexillum* sp. 1**

(Pl. 11, Fig. 1)

Material: RGM 784.899 (1); RGM 784.900 (20)

Remarks: The small shells have a smooth, bulbous protoconch of about 1.4 whorls. The teleonconch whorls are slightly convex to almost straight and ornamented with up to 11 strong, regularly spaced, gently curved axial ribs resulting in a wavy appearance of the suture and a slightly stepped periphery. Four oblique columellar folds are present of which the uppermost one is strongest and the lowest one is very weak. A moderately strong denticulation is seen in the interior of the outer lip.

***Vexillum* sp. 2**

(Pl. 11, Fig. 2)

Material: RGM 784.901 (1); RGM 784.902 (5)

Remarks: The material closely resembles *Vexillum* sp. 1 in size and shell shape but has a teleoconch ornamentation of more numerous axial ribs (approximately 17 on the body whorl) which are slightly more slender, and less elevated.

***Vexillum* sp. 3**

(Pl. 11, Fig. 3)

Material: RGM 784.903 (1)

Remarks: The small individual is more slender than *Vexillum* sp. 1 and *Vexillum* sp. 2. The ornamentation of the shell resembles *Vexillum* sp. 1, but the material can be distinguished by the protoconch. The protoconch of *Vexillum* sp. 3 is higher, narrower, and comprises about 0.25 whorls more than the protoconch of *Vexillum* sp. 1.

***Vexillum* sp. 4**

(Pl. 11, Fig. 4)

Material: RGM 784.904 (1); RGM 784.905 (8)

Remarks: *Vexillum* sp. 4 can be easily distinguished from the previous *Vexillum* forms by its larger size. The shell is elongate-ovate with evenly convex whorls and a slightly stepped whorl profile. It is ornamented with up to 18 distinct, straight to slightly opisthocline, regularly spaced axial ribs. Four columellar folds with the upper one being strongest and less oblique than the lower three are present. The siphonal canal is short and straight. Numerous narrow ridges are seen in the interior of the inner lip.

***Vexillum* sp. 5**

(Pl. 11, Fig. 5)

Material: RGM 784.906 (1); RGM 784.907 (7)

The material resembles *Vexillum* sp. 4 but can be distinguished by its wider shell shape, the more strongly inflated later teleoconch whorls, and the wider and less numerous axial ribs (approximately 15 on the body whorl).

***Vexillum* sp. 6**

(Pl. 11, Fig. 6)

Material: RGM 784.908 (1)

Remarks: The apical fragment belongs to a relatively wide shell with a clearly stepped whorl profile. It most closely resembles *Vexillum* sp. 5 but can be distinguished by the lower number of axial ribs on early whorls (approximately 9 wheras *Vexillum* sp. 5 has 13) which are furthermore wider and slightly lower than in *Vexillum* sp. 5.

***Vexillum* sp. 7**

(Pl. 11, Fig. 7)

Material: RGM 784.909 (1)

Remarks: The single incomplete specimen is small with a wide, squat shell and up to eleven wide, roundish axial ribs. It can be easily distinguished from the other present *Vexillum* forms by the combination of small size and squat shape.

***Vexillum* sp. 8**

(Pl. 11, Fig. 8)

Material: RGM 784.910 (1); RGM 784.911 (1)

Remarks: Although only one spire (RGM 784.910) and one subadult specimen (RGM 784.911) are present, the material can be easily distinguished from the other *Vexillum* forms present in the assemblage by its conical shape, the straight whorl profile, and the character of the axial ribs which are opisthocline and thickened on the lower half of the whorl while having a slightly prosocyrt profile on the upper half.

Family Cystiscidae STIMPSON, 1865

Remarks: Cystiscidae from Banyunganti are described in open nomenclature but presumably include undescribed species. Confirmation would require a thorough revision of the family in the Indo-Pacific.

Subfamily Cystiscinae STIMPSON, 1865

Genus *Cystiscus* STIMPSON, 1865

***Cystiscus* sp.**

(Pl. 11, Fig. 9)

Material: RGM 784.912 (1); RGM 784.913 (5)

Remarks: The material is characterized by its widely ovate shape which is widest at the shoulder of the aperture, and a depressed spire. Three oblique columellar folds occupy less than half of the inner lip with the uppermost fold being the weakest. A distinctively thickened outer lip with a smooth interior is present. The anterior end of the shell is rounded. The placement in genus *Cystiscus* is based on the genus classification for *Euliginella* LASERON, 1957 which is a synonym of *Cystiscus* (COOVERT & COOVERT 1995). The material resembles the modern species *Cystiscus triangularis* COSSIGNANI, 2008 (POPPE 2008b: pl. 510, figs 5a, b), but the latter lacks a thickened outer lip.

Subfamily Persiculinae COOVERT & COOVERT, 1995

Genus *Gibberula* SWAINSON, 1840

***Gibberula* sp. 1**

(Pl. 11, Fig. 10)

Material: RGM 784.914 (1); RGM 784.915 (5)

Remarks: The specimens are ovate in shape and have slightly elevated, rounded spires. Three oblique columellar folds occupy about the lower third of the inner lip with the uppermost fold being the weakest. A moderately strong denticulation is seen on the inner side of the outer lip. A shallow anterior sinus is present.

***Gibberula* sp. 2**

(Pl. 11, Fig. 11)

Material: RGM 784.916 (1); RGM 784.917 (25)

Remarks: The material contains ovate shells with moderately elevated spires. Four oblique columellar folds occupy about the lower half of the inner lip with the uppermost fold being the weakest. A moderately strong denticulation is seen on the inner side of the outer lip. A deep anterior sinus is present. *Gibberula* sp. 2 resembles the modern Indo-West-Pacific *Gibberula poppei* Cossignani, 2001 (Poppe, 2008b: pl. 510, figs 10a–b) but has a stronger developed anterior sinus and a more strongly rounded shell outline.

Family Marginellidae Fleming, 1828

Remarks: All marginellids from Banyunganti that are described in open nomenclature represent potentially undescribed species. Confirmation requires an extensive revision of the family in the Indo-Pacific.

Subfamily Marginellinae Fleming, 1828

Genus *Dentimargo* Cossmann, 1899

***Dentimargo* sp. 1**

(Pl. 12, Fig. 1)

Material: RGM 784.918 (1); RGM 784.919 (41)

Remarks: The available specimens have biconical shells with an elevated, long conical spire which occupies more than one third of the shell height. The whorl profile is weakly convex. Four distinct columellar folds occupy more than the lower half of the inner lip, the upper pair being perpendicular to the shell's vertical axis and the lower pair being oblique. A distinctively thickened outer lip forms a rounded external varix, clearly demarcated by a groove. Roundish plications are present at the interior of the outer lip, the upper two to three being clearly the strongest. An anterior sinus is lacking.

***Dentimargo* sp. 2**

(Pl. 12, Fig. 2)

Material: RGM 784.920 (1); RGM 784.921 (18)

Remarks: The material is distinguished from *Dentimargo* sp. 1 by its biconical-ovate shape, the elevated rounded spire which occupies about one third of the shell height, and a smooth interior of the outer lip. The body whorl is almost straight-sided to slightly concave.

Genus *Mesoginella* Laseron, 1957

***Mesoginella nanggulanensis* (MARTIN, 1916) comb. nov.**

(Pl. 12, Fig. 3)

1916 *Marginella* (*Cryptospira*) *nanggulanensis* Martin: 232, pl. 1, fig. 18.
2009 *Cryptospira nanggulanensis* (Martin, 1916) – Leloux & Wesselingh: 96 [cum syn.].

Material: RGM 784.922 (1); RGM 784.923 (4+2 frag.)

Remarks: The material resembles the type material very well, although the columella is not preserved or very incomplete in the Banyunganti specimens. The species is placed in the genus *Cryptospira* HINDS, 1844 by LELOUX & WESSELINGH (2009), but the type material does not have the columellar folds occupying the lower half or more of the inner lip like it is characteristic for the genus (WAKEFIELD 2010). Therefore, the species is transferred to the genus *Mesoginella* LASERON, 1957, because of its shell shape; the discrete, somewhat rounded whorls; a terminal varix; and the distinct columellar folds occupying less than the lower half of the inner lip (MARSHALL 2004).

Genus *Volvarina* HINDS, 1844

***Volvarina* sp. 1**

(Pl. 12, Fig. 4)

Material: RGM 784.924 (1), RGM 784.925 (3)

Remarks: The shells are elongate cylindrical with a moderately elevated conical spire. Four oblique columellar folds occupy about the lower half of the inner lip with the upper fold being the weakest. Narrow ridges are present in the interior of the outer lip. An anterior sinus is lacking. *Volvarina* sp. 1 resembles the modern Indo-West-Pacific *Volvarina hirasei* BAVAY, 1917 (POPPE, 2008b: pl. 512, figs 6a–b) in shell shape but has more distinct columellar folds. Furthermore, *V. hirasei* has a sloping shoulder and seems to lack the denticles at the interior of the outer lip.

***Volvarina* sp. 2**

(Pl. 12, Fig. 5)

Material: RGM 784.926 (1); RGM 784.927 (9)

Remarks: Although *Volvarina* sp. 2 and *Volvarina* sp. 1 share features like four oblique columellar fold occupying about the lower half of the inner lip with the upper one being weakest, a denticulation of the interior of the outer lip, and a lacking anterior sinus, they can be easily distinguished by shell shape. *Volvarina* sp. 2 is elongate-ovate and has a short rounded spire while *Volvarina* sp. 1 is elongate cylindrical with a conical spire.

Family Mitridae SWAINSON, 1829

Subfamily Mitrinae SWAINSON, 1829

Genus *Mitra* LAMARCK, 1798

***Mitra* cf. *sokkohensis* MARTIN, 1916**

(Pl. 12, Fig. 6)

cf. 1916 *Mitra* (*Cancilla*) *sokkohensis* MARTIN: 237, pl. 1, figs 29–30.
For synonymy see LELOUX & WESSELINGH (2009: p. 96, under *Vexillum sokkohensis* MARTIN, 1916).

Material: RGM 784.928 (1)

Remarks: The species is represented by a spire only. It resembles *M. sokkohensis* MARTIN, 1916 but differs slightly from the type material in ornamentation. *Mitra sokkohensis* has narrower spaced growth lines which give the interspaces of the spiral cords a slightly more punctuated appearance rather than forming a quadrate pattern like in the studied specimen. The species has been assigned to *Vexillum* in LELOUX & WESSELINGH (2009). The original genus assignment is favoured, because the species is lacking distinct axial ribs.

Superfamily Olivoidea LATREILLE, 1825

Family Olividae LATREILLE, 1825

Subfamily Ancillariinae SWAINSON, 1840

Genus *Ancilla* LAMARCK, 1799

***Ancilla* cf. *cinnamomea* sensu BEETS, 1941 non LAMARCK, 1801**

(Pl. 12, Fig. 7)

cf. 1941 *Ancilla cinnamomea* LAMARCK, 1801 – BEETS: 105–106.
For synonymy see BEETS (1941: p. 105–106, under *Ancilla cinnamomea* LAMARCK, 1801).

Material: RGM 784.929 (1)

Remarks: BEETS (1941) identified four ancillarid specimens from Loc. 114, East Kalimantan as *A. cinnamomoea* LAMARCK, 1801. His classification is not correct, because the species has seven to eleven lirae on the columellar pillar (KILBURN 1981) while the material from Loc. 114 contains only five lirae. The columella of the Banyunganti specimen is incomplete and poorly preserved, but a low number of lirae appear to be present. Three of the specimens documented by BEETS (1941) can be distinguished from the present material by their higher, narrower, and more acuminate spire while the fourth specimen resembles the material quite well. However, important diagnostic characters like the columellar pillar and the labral denticle are incomplete or missing in the Banyunganti specimens as well as in the single specimen that resembles the material. It is possible that *A. cinnamomea* from Loc. 114 actually comprises two species one of which resembles the species from Banyunganti.

***Ancilla* sp.**

(Pl. 12, Fig. 8)

Material: RGM 784.930 (1)

Remarks: The material is not sufficiently well preserved for a further classification. It is distinguished from *A.* cf. *cinnamomea* BEETS, 1941 non LAMARCK, 1801 from Banyunganti by its much wider apical angle.

Genus *Oliva* BRUGUIÈRE, 1789

***Oliva* s.l. sp.**
(Pl. 12, Fig. 9)

Material: RGM 784.931 (1)

Remarks: The material contains one juvenile specimen that could not be identified beyond genus level. It has convex whorls well separated by a deeply channeled suture.

Family Olivellidae TROSCHEL, 1869

Genus *Olivella* SWAINSON, 1831

***Olivella* sp.**
(Pl. 12, Fig. 10)

Material: RGM 784.932 (1); RGM 784.933 (68)

Remarks: Diagnostic characters of the available specimens are their elongate-ovate shape, a deeply channeled suture, four oblique columellar folds, the ribbed interior of the outer lip, and the lack of an anterior sinus. It is quite possible that it concerns an undescribed species.

Superfamily Conoidea FLEMING, 1822

Remarks: The large superfamily Conoidea includes several families currently under revision that yield multiple unresolved issues regarding their taxonomy (*e.g.*, BOUCHET *et al.* 2011). Conoidea present in the Banyunganti material are often represented by fragments or single juveniles precluding an accurate classification. The material is therefore largely described in open nomenclature.

Family Conidae FLEMMING, 1822

Genus *Fusiconus* DA MOTTA, 1991

?*Fusiconus arntzenii* (MARTIN, 1916)
(Pl. 13, Fig. 1)

1916 *Conus arntzenii* MARTIN: 228, pl. 1, figs 9–10.
2009 *Lautoconus*? *arntzenii* (MARTIN, 1916) – LELOUX & WESSELINGH: 71 [cum syn.].

Material: RGM 784.937 (1); RGM 784.938 (50)

Remarks: The species is placed in genus *Fusiconus* by Tucker & Tenorio (2009). The shell contains a single spiral groove dissecting the whorls before the body whorl which is characteristic for that genus (Tucker & Tenorio 2009). *Fusiconus arntzenii* is lacking a distinct scalariform outline of the spire that also appears characetristic for the genus. We are uncertain about the base for the assignment by Tucker & Tenorio (2009) of *F. arntzenii* as another conid species described by Martin does confirm the generic characteristics of *Fusiconus* (Tucker & Tenorio 2009: p. 85–86). We can not rule out that the authors mixed up the two species.

***Fusiconus spolongensis* (Martin, 1916)**

(Pl. 13, Fig. 2)

1916 *Conus* (*Leptoconus*) *spolongensis* Martin: 228, pl. 1, fig. 8.
2009 *Leptoconus spolongensis* (Martin, 1816) – Leloux & Wesselingh: 71 [cum syn.].

Material: RGM 784.939 (1); RGM 784.940 (5)

Remarks: The most characteristic feature of the species is its highly elevated spire with a distinct scalariform outline. The species is placed in genus *Austroconus* by Tucker & Tenorio (2009) while ?*F. arntzenii* is placed in genus *Fusiconus*, although it lacks the scalariform outline typifying the genus (see also remarks under ?*F. arntzenii* above). We suspect that the two species might have been accidentally mixed up by Tucker & Tenorio (2009). Because of the distinct scalariform spire of *F. spolongensis* an assignment to the genus *Fusiconus* is favoured.

Genus *Phasmoconus* Mörch, 1852

***Phasmoconus* aff. *hulshofi* (Martin, 1906)**

(Pl. 13, Fig. 3)

1906 *Conus hulshofi* Martin: 290, pl. 42, figs 695–697.
2009 *Conus hulshofi* Martin, 1906 – Leloux & Wesselingh: 68 [sum syn.].

Material: RGM 784.941 (1)

Remarks: The species is represented by a spire only which resembles the type material very well. However, *P. hulshofi* (Martin, 1906) shows only three spiral grooves on the upper part of the base of the body whorl while the spiral ornamentation of at least ten grooves continues on the Banyunganti specimen. The genus assignment follows Tucker & Tenorio (2009).

Conidae indet. sp. 1

(Pl. 13, Fig. 4)

Material: RGM 784.934 (1); RGM 784.935 (9)

Remarks: The material only contains juvenile and subadult specimens mainly represented by apical fragments. The main diagnostic characteristics are a low spire and a lack of ornamentation apart from well visible, crescent shaped growthlines.

Conidae indet. sp. 2

(Pl. 13, Fig. 5)

Material: RGM 784.936 (1)

Remarks: A single juvenile specimen is present that is not sufficient for a further identification. It resembles Conidae indet. sp. 1 in shape but is distinguished by a suprasutural bulge and spiral grooves on the upper half of the whorls.

Family Clathurellidae ADAMS & ADAMS, 1858

Genus *Lienardia* JOUSSEAUME, 1884

Lienardia sp.

(Pl. 13, Fig. 6)

Material: RGM 784.942 (1); RGM 784.943 (4)

Remarks: The specimens show all characteristics for the genus after POWELL (1966): a small, solid shell with a strong ornamentation of rounded axial ribs and sharp spirals; a smooth paucispiral protoconch; a narrow aperture; a short deeply notched siphonal canal; a terminal varix; a very deep u-shaped subsutural sinus; and denticles on the inside of outer and inner lip. In the present material the uppermost denticle on the inner side of the outer lip is clearly the strongest.

Family Mangeliidae FISCHER, 1883

Genus *Eucithara* FISCHER, 1883

Eucithara sp. 1

(Pl. 13, Fig. 7)

Material: RGM 784.944 (1); RGM 784.945 (6)

Remarks: The present material shows resemblance to *Eucithara sawitrae* (BEETS, 1941) (Loc. 114, East Kalimantan). *Eucithara* sp. 1 can be distinguished from that species by its smaller size and the lower number of axial ribs on later whorls. Furthermore, *Eucithara* sp. 1 is more slender than the holotype of *E. sawitrae* (RGM 312.527).

Eucithara sp. 2

(Pl. 13, Fig. 8)

Material: RGM 784.946 (1); RGM 784.947 (11)

Remarks: *Eucithara* sp. 2 clearly differs from *Eucithara* sp. 1 in a larger, spindle-shaped shell and in ornamentation. It has a conical spire and an almost straight whorl profile.The axial ribs are wider and prosocline while they are very narrow and opisthocline in *Eucithara* sp. 1.

***Eucithara* sp. 3**

(Pl. 13, Fig. 9)

Material: RGM 784.948 (1)

Remarks: The specimen is lacking the body whorl. It shows more resemblance to *Eucithara* sp. 2 than to *Eucithara* sp. 1 concerning the shape of the spire. But it can be easily distinguished from the former by its more convex whorls and the opisthocline axial ribs. The specimen contains clearly wider, less sharp, and narrower spaced spiral ribs than *Eucithara* sp. 1 and *Eucithara* sp. 2.

***Eucithara* sp. 4**

(Pl. 13, Fig. 10)

Material: RGM 784.949 (1)

Remarks: One incomplete spire is present in the material. It has been assigned to the genus according to its resemblance with *Eucithara* sp. 1. The specimens share a convex whorl profile; narrow, widely spaced opisthocline axial ribs; and fine spiral ornamentation. The present fragment is larger and the axial ribs remain strongly opisthocline to prosocyrt in *Eucithara* sp. 4 while they become straighter on later whorls in *Eucithara* sp. 1.

Family Raphitomidae BELLARDI, 1875

Genus *Pseudodaphnella* BOETTGER, 1895

***Pseudodaphnella* sp. 1**

(Pl. 14, Fig. 1)

Material: RGM 784.950 (1); RGM 784.951 (3)

Remarks: The shells have subrounded whorls with a subsutural angulation. The material most closely resembles species of the genus *Pseudodaphnella* regarding the teleoconch ornament of sharp, slender axial ribs crossed by sharp spiral cords resulting in a distinct reticulate pattern with acuminate beads at the intersections of axial and spiral ribs. The protoconch ornamentation of fine spirals and thin axial riblets forming a lattice is consistent with POWELL's (1966) definition of the genus. The only disagreement between the Banyunganti specimens and the genus definition by POWELL (1966) concerns the number of protoconch whorls which is 2–3 in the latter and less than 2 in the the present specimens.

***Pseudodaphnella* sp. 2**

(Pl. 14, Fig. 2)

Material: RGM 784.952 (1)

Remarks: The genus assignment is based on the protoconch and teleoconch ornamentation as described by POWELL (1966). The specimen is distinguished from *Pseudodaphnella* sp. 1 by its evenly convex whorls lacking an angulation and its lower number of axial ribs which are furthermore clearly opisthocline while they are slightly prosocline in *Pseudodaphnella* sp. 1.

***Pseudodaphnella* sp. 3**

(Pl. 13, Fig. 3)

Material: RGM 784.953 (1); RGM 784.954 (2)

Remarks: The material resembles *Pseudodaphnella* sp. 2 in teleoconch as well as in protoconch ornamentation. It can be distinguished from the former by its shouldered whorl profile and a subsutural ramp lacking spiral ornamentation.

Raphitomidae indet. sp. 1

(Pl. 14, Fig. 4)

Material: RGM 784.955 (1)

Remarks: The material contains an incomplete spire which is insufficient for a genus assignment. Characteristics of the teleoconch are the convex, slightly angulated whorls and the strong reticulate ornamentation of evenly spaced, narrow, rounded axial ribs and elevated, narrow, sharp spiral lirae. The ultimate protoconch whorl is preserved. It shows a diagonally cancellate ornament.

Raphitomidae indet. sp. 2

(Pl. 14, Fig. 5)

Material: RGM 784.956 (1)

Remarks: An incomplete spire including the last protoconch whorl is present. The material is insufficient for a further classification. The specimen resembles Raphitomidae indet. 1 in protoconch as well as in teleoconch ornamentation, but it has a clearly defined shoulder, a concave subsutural ramp, wider spaced axial ribs, and stronger tubercles at the intersections of axial and spiral ribs. Raphitomidae indet. sp. 1 and Raphitomidae indet. sp. 2 likely belong to the same genus.

Family Drilliidae OLSSON, 1964

Genus *Splendrillia* HEDLEY, 1922

?*Splendrillia* sp.

(Pl. 14, Fig. 6)

Material: RGM 784.957 (1)

Remarks: Only a spire lacking the protoconch is present in the material which makes a genus assignment difficult. The specimen is tentatively placed in *Splendrillia* because of the glossy appearance of the shell and the presence of a distinct subsutural bulge followed by a deep shoulder sulcus and prominent axial ribs. A fine spiral liration like in our material might be present in the genus (POWELL 1966).

Genus *Tylotiella* HABE, 1958

***Tylotiella* sp.**

(Pl. 14, Fig. 7)

Material: RGM 784.958 (1); RGM 784.959 (1)

Remarks: The two specimens, although relatively poorly preserved, are consistent with POWELL's (1966) definition of the genus. Characters for the genus are moderate size; solid, claviform shell with a tall spire and a truncated body whorl; smooth, paucispiral protoconch; teleoconch ornamentation of "fold-like, slightly oblique axials, extending from suture to suture and partly over the base, weaker over the shoulder sulcus, and nowhere developed into peripheral nodes or tubercles" (POWELL 1966).

?Drilliidae indet.

(Pl. 14, Fig. 8)

Material: RGM 784.960 (1)

Remarks: A single incomplete body whorl which does not match any of the other specimens from Banyunganti is present. The material is considered to be insufficient for a further classification. The species is for now placed in Drillidae because of the dominant axial ribs and the weak, very low spiral ornamentation (see BOUCHET *et al.* 2011).

Family Pseudomelatomidae MORRISON, 1965

Genus *Crassispira* SWAINSON, 1840

***Crassispira molengraafi* (MARTIN, 1916)**

(Pl. 14, Fig. 9)

1916 *Drillia* (s. str.) *molengraaffi* MARTIN: 230, pl. 1, fig. 14.
2009 *Crassispira molengraafi* (MARTIN, 1916) – LELOUX & WESSELINGH: 64 [cum syn.].

Material: RGM 784.961 (1); RGM 784.962 (17)

Remarks: The shell is slender with a conical spire and an ornamentation of rounded axial ribs and spiral cords and threads. A distinct subsutural bulge divided by a spiral groove is present. The shoulder sulcus is deep and ornamented with spiral threads only. The deep u-shaped anal sinus is located at the shoulder sulcus.

Genus *Inquisitor* HEDLEY, 1918

***Inquisitor* sp. 1**

(Pl. 14, Figs 10–11)

Material: RGM 784.963 (1); RGM 784.964 (1); RGM 784.965 (3)

Remarks: POWELL (1966: p. 79) noted a “strong subsutural fold composed of two linear spaced cords, followed by a rather deep and narrow spirally lirate shoulder sulcus” as typical for the genus. The Banyunganti material agrees with these characters. The material is also in agreement with the genus definition in shell shape and teleoconch ornamentation. The only disagreement between the present specimens and the genus definition by POWELL (1966) concerns the small size of the specimens from Banyunganti and the number of protoconch whorls which is 2.5 whorls for smooth, rounded protoconchs in the genus definition and less than 2 whorls in the present material.

?*Inquisitor* sp. 2

(Pl. 14, Figs 12–13)

Material: RGM 784.966 (1); RGM 784.967 (1); RGM 784.968 (2)

Remarks: The genus assignment of the material is problematic, because only early teleoconch whorls are known. The specimens have a very characteristic conical protoconch of about four whorls which are smooth apart from a fine supersutural ridge. The protoconch is delimited from the teleoconch by a strongly developed, highly elevated axial riblet. The teleoconch ornamentation of axial ribs and spiral cords suggests a placement in the Pseudomelatomidae. According to the multispiral, conical protoconch the species likely belongs to *Inquisitor*.

Pseudomelatomidae indet. 1

(Pl. 15, Fig. 1)

Material: RGM 784.969 (1)

Remarks: A single body whorl is present. The material is considered to be insufficient for a further classification. The Banyunganti specimen resembles the genus *Austrotoma* FINLAY, 1924 as illustrated in POWELL (1966: text-figure A3, 18) in shape and position of the sinus.

Pseudomelatomidae indet. 2
(Pl. 15, Fig. 2)

Material: RGM 784.970 (1)

Remarks: A single body whorl is present which is considered to be insufficient for a further classification.

?Pseudomelatomidae indet. 3
(Pl. 15, Fig. 3)

Material: RGM 784.971 (1)

Remarks: The material contains an incomplete spire lacking the protoconch and is therefore insufficient for a further classification. The ornamentation of the fragment resembles the ornament of *Crassispira molengraafi* (MARTIN, 1916). The fragment can be distinguished from that species by its steeper and wider shoulder sulcus and the presence of only two distinct primary spiral cords. The species is assigned to Pseudomelatomidae because of the presence of well developed spiral elements overrunning the axial ribs.

Family Clavatulidae GRAY, 1853

Genus *Clavatula* LAMARCK, 1801

***Clavatula* s.l. sp.**
(Pl. 15, Fig. 4)

Material: RGM 784.974 (1); RGM 784.975 (4)

Remarks: The shell has an almost biconical shape. The protoconch is paucispiral and smooth. The teleoconch shows a reticulate ornamentation with slightly more dominant axial ribs. A distinct, somewhat angulated subsutural bulge is present. Below it a shoulder sulcus and a clearly angulated shoulder are developed. The siphonal canal is relatively short and straight. Ridges are seen on the inner side of the outer lip. Because the anal sinus is not located at the whorl periphery, an assignment to Clavatulidae rather than Turridae is favoured (ROBBA pers. comm.).

Genus *Turricula* SCHUHMACHER, 1817

?***Turricula kelirensis*** **(MARTIN, 1916)**
(Pl. 15, Fig. 5)

1916 *Surcula kelirensis* MARTIN: 228, pl. 1, figs 11–12.
2009 *Turricula kelirensis* (MARTIN, 1916) – LELOUX & WESSELINGH: 80 [cum syn.].

Material: RGM 784.972 (1); RGM 784.973 (19)

Remarks: The turreted shell is ornamented with very regular thin but distinct axial ribs and three primary spiral cords on the lower half of the whorl. Axial and spiral ribs form a reticulate pattern. A distinct shoulder at the middle of the whorl and a deep shoulder sulcus with well visible concave growthlines develop on later teleoconch whorls. Thin spiral ridges are present on the inner side of the outer lip. It is questionable if the assignment to *Turricula* (SKWARKO & SUFIATI 1994; VAN DEN HOEK OSTENDE *et al.* 2002; LELOUX & WESSELINGH 2009) is correct, because the distinct reticulate ornament is untypical for the genus.

Family Strictispiridae MCLEAN, 1971

Genus *Strictispira* MCLEAN, 1971

***Strictispira* sp.**

(Pl. 15, Fig. 6)

Material: RGM 784.976 (1); RGM 784.977 (3)

Remarks: The specimens have been assigned to genus *Strictispira* according to their resemblance with modern *Strictispira* species such as *Strictispira solida* (C.B. ADAMS, 1850) (BOUCHET *et al.* 2011: fig. 11 E). However, *S. solida* shows a clearly higher number of axial ribs. If confirmed, this would be the first Indo-Pacific record of a likely undescribed *Strictispira* species. The genus is so far known from the tropical Atlantic only.

Family Terebridae MÖRCH, 1852

Subfamily Terebrinae MÖRCH, 1852

Genus *Terebra* BRUGUIÈRE, 1789

***Terebra* s.l. sp.**

(Pl. 15, Fig. 7)

Material: RGM 784.978 (1); RGM 784.978 (1)

Remarks: The material is incomplete and quite poorly preserved and remains unclassified.

Superfamily Cancellarioidea FORBES & HANLEY, 1851

Family Cancellariidae FORBES & HANLEY, 1851

Cancellariidae indet. sp.

(Pl. 15, Fig. 8)

Material: RGM 784.980 (1)

Remarks: A large multispiral protoconch of 3.1 whorls rapidly increasing in size is present. It is ornamented with two thin but distinct spiral ridges on the upper half of the whorl which is characteristic for cancellariids.

Clade Heterobranchia Gray, 1840

Informal group "Lower Heterobranchia"(= Allogastropoda)

Superfamily Acteonoidea d'Orbigny, 1843

Family Acteonoidae d'Orbigny, 1843

Genus *Acteon* Montfort, 1810

***Acteon* s.l. sp.**

(Pl. 15, Fig. 9)

Material: RGM 785.008 (1); RGM 785.009 (1+1 frag.)

Remarks: The material contains subadult specimens with an ornamentation of low, narrowly spaced spiral cords. Growthlines are well visible in the interspaces of the spiral ribs resulting in a pattern of punctuated grooves which is characteristic for the genus. It remains unclear if one additional fragment of the body whorl of a larger individual (RGM 785.009) belongs to same species.

?Acteonidae indet. sp.

(Pl. 15, Fig. 10)

Material: RGM 785.010 (1)

Remarks: A fragment of the lower columella is present in the material. It is characterized by the presence of deep spiral grooves which become shallower and more widely spaced towards the abapical end of the shell. The material does not allow a further classification.

Superfamily Architectonicoidea Gray, 1850

Family Architectonicidae Gray, 1850

Remarks: Bieler (1993) used an eloborate system to name the various spiral ribs of architectonicids that we follow here.

Genus *Adelphotectonica* Bieler, 1987

***Adelphotectonica* sp.**

(Pl. 16, Fig. 1)

Material: RGM 784.981 (1); RGM 784.982 (10)

Remarks: The shell of this potentially undescribed species is widely conical with an almost straight whorl-profile. The upper point of whorl attachment is located at the peripheral keel. The teleoconch ornamentation shows a low subsutural and upper peripheral rib while the middle part of the teleoconch whorls lack spiral ribs or grooves. Strong growth marks are present. The wide, low, strongly ribbed proxumbilical cord is unusual for the genus (Bieler 1993).

Genus *Discotectonica* Marwick, 1931

?*Discotectonica* sp.

(Pl. 16, Fig. 2)

Material: RGM 784.983 (1); RGM 784.984 (5)

Remarks: Only the first one to two teleoconch whorls are present in the Banyunganti material precluding a further taxonomic assignment. The specimens have depressed shells with bulging whorls and a very prominent peripheral keel. A nodulose subsutural rib and two nodulose midribs of equal strength are present. A narrow upper peripheral rib consists of narrower spaced nodules than those on the subsutural and the median ribs. The area between the peripheral keel and the upper peripheral rib is sligthly concave and lacks spiral ornamentation. A narrow, distinct, infraperipheral rib and a weak spiral ridge at the concave area between the peripheral keel and the infraperipheral rib are developed. The umbilical cord is low and strongly ribbed. Four nodulose proxumbilical cords which increase in width towards the umbilicus are present. The material could not be equivocally assigned to a genus. It most closely agrees with the description of *Discotectonica* Marwick, 1931 (in Bieler 1993), although the number of spiral cords on the apical as well as on the adapical side is lower in our material than it is described for the genus.

Genus *Heliacus* d'Orbigny in Sagra, 1842

Subgenus *Heliacu*s (*Torinista*) Iredale, 1936

***Heliacus* (*Torinista*) *implexus* (Mighels, 1845)**

(Pl. 16, Fig. 3)

1845 *Solarium implexum* Mighels: 22.
1993 *Heliacus (Torinista) implexus* (Mighels, 1845) – Bieler: 205–207 [cum syn.].

Material: RGM 784.985 (1)

Remarks: The available specimen has a depressed cone-shaped shell and two prominent peripheral keels with the upper one being stronger. The apical side of the shell is ornamented with four nodolar spiral ribs. A strong umbilical cord and five nodular spiral ribs which regularly decrease in width with distance from the umbilicus are present on the base of the shell. The Banyunganti material agrees with BIELER's (1993) description of the species. The species has a continous range in the Indo-Pacific (BIELER 1993). The present material represents the first fossil record of *H.* (*T.*) *implexus*.

Genus *Psilaxis* WOODRING, 1928

***Psilaxis* cf. *radiatus* (RÖDING, 1798)**

(Pl. 16, Fig. 4)

cf. 1798 *Architectonica radiata* RÖDING: 79.
1993 *Psilaxis radiatus* (RÖDING, 1798) – BIELER: 117–120 [cum syn.].

Material: RGM 784.986 (1)

Remarks: The present specimen shows moderately inflated whorls which appear smooth and glossy. A prominent peripheral keel is present which is accompanied by two weaker but distinct spiral ribs of which one is located above and one below the median keel. *Psilaxis radiatus* (RÖDING, 1798) can be distinguished from the very similar *Psilaxis oxytropis* (A. ADAMS, 1855) by its smaller protoconch. Nevertheless, the protoconch diameter of the available specimen is slightly smaller than the smallest recorded protoconch of 105 specimens of *P. radiatus* (BIELER 1993). At the same time the anal keel is distinctively longer. Our specimen has a 0.47 mm long anal keel while the mean length for the species is 0.27 mm for 217 measured specimens (BIELER 1993). For that reasons the species assignment remains somewhat uncertain.

Superfamily Pyramidelloidea GRAY, 1840

Remarks: Paleogene to Quarternary Pyramidelloidea from Indonesia were recently revised by Robba (2013). None of the taxa from Banyunganti fully confirms the species recognized in that work. Therefore, it is likely that the majority of the Banyunganti material, here described in open nomenclature, could be attributed to new species. However, the low abundance and often incomplete preservation of the available specimens precludes a full taxonomic revision for the moment.

Family Odostomiidae PELSENEER, 1928

Subfamily Odostomiinae PELSENEER, 1928

Genus *Odostomia* FLEMING, 1813

***Odostomia* sp.**

(Pl. 16, Fig. 5)

Material: RGM 784.994 (1)

Remarks: The available specimen lacks its protoconch. It has a narrowly conical shell, a moderately convex whorl profile with a subtle suprasutural angulation, well impressed sutures, a smooth shell apart from growthlines, a single very distinct columellar ridge, and a smooth interior of the outer lip. The fossil Indonesian *Odostomia* species illustrated in ROBBA (2013; pl. 3, figs 3–5) can be distinguished from the studied material by their evenly convex whorl profile lacking an angulation.

Genus *Parodostomia* LASERON, 1959

***Parodostomia* sp.**
(Pl. 16, Fig. 6)

Material: RGM 784.995 (1); RGM 784.996 (35)

Remarks: The present specimens resemble *Odostomia* sp. in shape but have a slightly convex to almost straight whorl profile, a narrow umbilicus and distinct, elevated ridges at the interior of the outer lip. The genus assignment is based on the latter character and on the intorted protoconch. According to ROBBA (2013) both are diagnostic characters for the genus in the Paleogene to Quarternary of Indonesia. A grooved suture which is considered an additional character for the genus (ROBBA 2013) is lacking in the present material by which it can be distinguished from the fossil Indonesian species illustrated in ROBBA (2013: pl. 4, figs 1–5, pl. 5, fig. 1).

Subfamily Chrysallidinae SAURIN, 1958

Genus *Babella* DALL & BARTSCH, 1906

***Babella* sp.**
(Pl. 16, Fig. 7)

Material: RGM 784.987 (1)

Remarks: The specimen is characterized by a stout shell with a conical spire and a straight whorl profile. The teleoconch ornamentation consists of regular, prosocline, slender axial ribs. The body whorl is angular, one distinct spiral cord is present at its base. A single moderately strong columellar fold is developed.

Genus *Pyrgulina* ADAMS, 1863

***Pyrgulina* sp. 1**
(Pl. 16, Fig. 8)

Material: RGM 784.988 (1); RGM 784.989 (6)

Remarks: Characteristic features of the specimens are an elongate-conical shape, an intorted protoconch, a weak columellar ridge, an ornamentation of strong prosocline axial ribs extending on the base, and regular spiral threads best visible in the interspaces of the axial elements. The species most closely resembles *Pirgulina wesselinghi* ROBBA (2013: pl. 11, figs 6–7) but can be distinguished from that species by its elongate-conical shape while *P. wesselinghi* is more cylindrical.

***Pyrgulina* sp. 2**

(Pl. 16, Fig. 9)

Material: RGM 784.990 (1); RGM 784.991 (1)

Remarks: The available material can be distinguished from *Pyrgulina* sp. 1 by its more slender shape and the straight axial ribs which are prosocline in *Pyrgulina* sp. 1. The columellar fold is strong for the genus.

Family Pyramidellidae GRAY, 1840

Subfamily Pyramidellinae GRAY, 1840

Genus *Longchaeus* MÖRCH, 1875

***Longchaeus* sp.**

(Pl. 16, Fig. 10)

Material: RGM 784.997 (1); RGM 784.998 (1)

Remarks: The available specimens have a partially immersed but not fully intorted, protoconch, a conical spire with a straight outline, a grooved suture resulting in a peripheral furrow, a smooth shell, three distinct columellar ridges of which the uppermost one is strongest and least oblique, and teeth of different strength in the interior of the outer lip. The characters agree with ROBBA's (2013) description of the genus. The five fossil Indonesian species illustrated in ROBBA (2013: pl. 13, figs 3–5, 7–12, pl. 14, figs 1–4) differ from the present material in shell shape, convexity of the whorls and/or in the presence of a slight crenulation just below the suture.

Genus *Pyramidella* LAMARCK, 1799

***Pyramidella* sp.**

(Pl. 17, Fig. 1)

Material: RGM 784.999 (1)

Remarks: The protoconch is lacking in the studied specimen. It resembles *Longchaeus* sp. in shell shape, in being smooth, and in the characters of the interior of the outer lip and the columellar folds. It can be distinguished by lack of a grooved suture and the associated peripheral furrow which is regarded as the distinctive character between the genera *Pyramidella* and *Longchaeus* according to Robba (2013).

Family Turbonillidae Bronn, 1849

Subfamily Turbonillinae Bronn, 1849

Genus *Asmunda* Dall & Bartsch, 1904

***Asmunda* sp.**

(Pl. 17, Fig. 2)

Material: RGM 785.000 (1); RGM 785.001 (1)

Remarks: The genus assignment is based on the following characters (after Robba 2013): the protoconch is situated perpendicular with respect to the first teleoconch whorl, being slightly immersed in it, a peripheral spiral cord at which the axial ribs end abruptly is present. The material can be easily distinguished from *Asmunda rebjongensis* Robba, 2013 (pl. 17, fig. 7) by its cylindro-conical shape with an almost straight whorl profile while the latter is elongate-conical with more convex whorls. The Banyunganti specimens have a single spiral cord located right above the suture on early whorls, and moving upwards on later whorls.

Genus *Pyrgiscus* Philippi, 1841

?*Pyrgiscus* sp.

(Pl. 17, Fig. 3)

Material: RGM 785.002 (1); RGM 785.003 (5)

Remarks: The specimens have slender elongate-conical shells. The protoconch is helicoid and does not protrude over the first teleoconch whorl. The teleoconch is ornamented with straight to slightly prosocline axial ribs that continue on the base of the body whorl and numerous spiral threads that are visible in the interspaces of the axial ribs. The columella is slightly twisted. A single prominent spiral cord is present at the upper part of the base of the body whorl.

Genus *Turbolidium* Robba, 2013

***Turbolidium* sp. 1**

(Pl. 17, Fig. 4)

Material: RGM 785.004 (1); 785.005 (4)

Remarks: The genus assignment is based on the following characters (after ROBBA 2013): the helicoid protoconch is almost at a right angle to the shell axis with the apex lying at the suture of the first teleoconch whorl. The aperture is ovate-quadrangular. The columella is very gently twisted. The axial ribs fade out over the upper part of the otherwise smooth base of the body whorl. Our material can be distinguished from the type species *Turbolidium schroederi* (WISSEMA, 1947) (ROBBA 2013: pl. 22, fig. 6) by its more slender shell and its whorl profile which is slightly intended at the upper half of the whorl while the whorls of *T. schroederi* are evenly convex. Spiral ornamentation is lacking in our material.

?*Turbolidium* sp. 2

(Pl. 17, Fig. 5)

Material: RGM 785.006 (1)

Remarks: The studied specimen is incomplete. The shell is cylindrical. The columella is slightly twisted but lacks a ridge. Classification of the species was somewhat problematic since the protoconch is lacking in the material. However, a lack of spiral ornamentation in combination with the axial ribs fading out over the upper part of the otherwise smooth base suggest a placement in genus *Turbolidium* (see ROBBA 2013). The specimen is distinguished from the other Turbonillinae from Banyunganti by its high number of slender, slightly sigmoidal axial ribs. The whorls are more convex than in *Turbolidium* sp. 1.

Genus *Turbonilla* RISSO, 1826

***Turbonilla* sp.**

(Pl. 17, Fig. 6)

Material: RGM 785.007 (1)

Remarks: The specimen has an elongate-conical shell with a moderately convex whorl profile, a protoconch with a short spire not projecting over the first teleoconch whorl, a teleoconch ornamentation of axial ribs stopping at the periphery of the last whorl without a peripheral spiral cord being present. Spiral ornamentation is lacking.

Subfamily Eulimellinae SAURIN, 1958

Genus *Eulimella* FORBES & MACANDREW, 1846

***Eulimella* sp.**

(Pl. 17, Fig. 7)

Material: RGM 784.992 (1); RGM 784.993 (1)

Remarks: The specimens have high, elongate-conical spires with a slightly convex to almost straight whorl profile, smooth, shiny shells, and a twisted columella bearing a single moderately strong fold. The protoconch is damaged or lacking in the material. The material is assigned to the genus *Eulimella* according to its shape, the smooth shell and the absence of a distinct collumellar ridge. It does not resemble any of the fossil Indonesian *Eulimella* species illustrated in Robba (2013: pl. 23, fig. 7; pl. 24, figs 1–6; pl. 25, figs 1, 2).

Superfamily Ringiculoidea Philippi, 1853

Family Ringiculidae Philippi, 1853

Remarks: The following taxa from Bayunganti assigned to genus *Ringicula* are potentially undescribed species. A revision of fossil and modern Indo-Pacific ringiculids is required for confirmation.

Genus *Ringicula* Deshayes, 1838

***Ringicula* sp. 1**

(Pl. 17, Fig. 8)

Material: RGM 785.011 (1); RGM 785.012 (122)

Remarks: The available specimens have small, narrowly ovate shells with a rounded whorl profile and a slight shoulder angulation. The height of the spire equals that of the body whorl. The teleoconch is ornamented with up to approximately 16 regular, closely spaced spiral cords. The aperture is ovate and strongly modified by two very pronounced columellar folds, of which the upper one is oblique, and a parietal tooth. The thickened outer lip forms a low, wide, well pronounced bulge with an elongated internal swelling at the middle part of the outer lip. Inner and outer lip are clearly differentiated from the body whorl and surround the aperture completely. The ornamentation with elevated spiral cords instead of grooves seems unusual for the family (see *e.g.* Poppe 2010a: pl. 741 for comparison). None of the *Ringicula* species described by Martin (1879, 1884) is ornamented with spiral cords.

***Ringicula* sp. 2**

(Pl. 17, Fig. 9)

Material: RGM 785.013 (1); RGM 785.014 (91)

Remarks: The material resembles *Ringicula* sp. 1 in shell shape, but it is provided with spiral grooves with interspaces varying in width instead of elevated cords. In most specimens the interspace between the second and the third or between the third and the fourth spiral groove below the suture on the body whorl are widest. Between the ringiculid species described by Martin (1879, 1884) *Ringicula pygmaea* Martin, 1884 resembles the Banyunganti material most closely but has a narrower spire and lacks the slight shoulder angulation. The first subsutural groove on the body whorl appears to be strongest in that species, a feature lacking in *Ringicula* sp. 2. The other ringiculids described by Martin (1879, 1884) can easily be distinguished from the Banyunganti material by their larger size and wider, more convex whorls.

***Ringicula* sp. 3**

(Pl. 17, Fig. 10)

Material: RGM 785.015 (1); RGM 785.016 (1)

Remarks: The specimens are distinguished from the other ringiculids from Banyunganti by being more widely ovate and having a spiral ornamentation of approximately up to 20, narrowly spaced spiral grooves. The interspaces between the grooves do not show a variation in width as in *Ringicula* sp. 2. Although the specimens are more ovate than *Ringicula* sp. 2, they remain smaller and less inflated than the *Ringicula* species described by Martin (1879, 1884).

Order Opisthobranchia Milne-Edwards, 1848

Suborder Cephalaspidea Fischer, 1883

Superfamily Philinoidea Gray, 1850 (1815)

Family Cylichnidae Adams & Adams, 1854

Genus *Cylichna* Lovén, 1846

***Cylichna triplicata* (Martin, 1916)**

(Pl. 17, Fig. 11)

1916 *Bullinella triplicata* Martin: 224, pl. 1, fig. 3.
1941 *Cylichna triplicata* – Beets: 144–145, pl. 7, fig. 294.
2009 *Cylichna triplicata* – Leloux & Wesselingh: 40 [cum syn.].

Material: RGM 785.017 (1); RGM 785.018 (49)

Remarks: This *Cylichna* species is characterized by the presence of three columellar folds. Furthermore, spiral grooves are present at the abapical and adapical side of the body whorl but are lacking on the middle segment.

***Cylichna* s.l. sp.**

(Pl. 17, Fig. 12)

Material: RGM 785.019 (1); RGM 785.020 (2)

Remarks: The only more or less complete specimen (RGM 785.019) is slightly compressed and abraded precluding a further taxonomic assignment. The shell is elongate-cylindrical and contains regularly spaced spiral grooves all over the shell's surface.

Family Retusidae THIELE, 1925

Retusidae indet. sp.

(Pl. 17, Fig. 13)

Material: RGM 785.021 (1); RGM 785.022 (2)

Remarks: The studied material contains fragments that preclude a further classification. The shells are solid and show a distinct ornamentation of low, imbricated spiral ridges separated by narrow grooves.

Class Bivalvia LINNAEUS, 1758

Subclass Autobranchia GROBBEN, 1894

Superorder Pteriomorphia BEURLEN, 1944

Order Arcida GRAY, 1854

Superfamily Arcoidea LAMARCK, 1809

Family Glycymerididae DALL, 1908 (1847)

Subfamily Glycimeridinae DALL, 1908 (1847)

Genus *Tucetona* IREDALE, 1931

?*Tucetona* sp.

(Pl. 18, Fig.1)

Material: RGM 785.031 (1/2); RGM 785.032 (2 frag.)

Remarks: Only three fragments are present in the studied material. They are ornamented with radial ribs with irregularly shaped roundish tubercles varying in size. The material is tentatively assigned to the genus *Tucetona* due to the presence of axial ribs (NICOL 1956).

Order Pectinida GRAY, 1854

Superfamily Pectinoidea RAFINESQUE, 1815

Family Pectinidae RAFINESQUE, 1815

Subfamily Chlamydinae TEPPNER, 1922

Tribe Mimachlamydini WALLER, 1993

Genus *Mimachlamys* IREDALE, 1929

***Mimachlamys* sp.**

(Pl. 18, Fig. 2)

Material: RGM 785.033 (1 frag.); RGM 785.034 (5 frag.)

Remarks: Only fragments are present in the studied material. They have evenly spaced, low radial ribs which bear regularly spaced tubercles and are flanked with secondary costallae. The ornamentation is characteristic for the genus (DIJKSTRA 2013).

Family Spondylidae GRAY, 1826

Genus *Spondylus* LINNAEUS, 1758

***Spondylus* sp.**

(Pl. 18, Fig. 3)

Material: RGM 785.035 (1/2); RGM 785.036 (1 frag.)

Diagnosis: The available material is insufficient for a taxonomic classification. The genus assignment is based on the spinose radial ribs and a partly preserved hinge (RGM 785.035) with very weak primary teeth and well developed secondary teeth and sockets.

Clade Heterodonta NEUMAYR, 1884

Order Lucinida GRAY, 1854

Superfamily Lucinoidea FLEMING, 1828

Family Lucinidae FLEMING, 1828

Subfamily Lucininae FLEMING, 1828

Genus *Cardiolucina* SACCO, 1901

***Cardiolucina civica* (YOKOYAMA, 1927)**

(Pl. 18, Figs 4–6)

1927 *Cardium civica* YOKOYAMA, 1927: 179, pl. 48, figs 3–4.
1997 *Cardiolucina civica* (YOKOYAMA, 1927) – TAYLOR & GLOVER: 99–102, figs 7–8 [cum syn.].

Material: RGM 785.041 (1); RGM 785.040 (1 rv); RGM 785.039 (1 lv); RGM 785.042 (3+60 rv, 44 lv)

Remarks: The present material agrees with the description and illustrated material of the modern Indo-Pacific *Cardiolucina civica* (YOKOYAMA, 1927) provided by

TAYLOR & GLOVER (1997: 99–102, figs 7–8). It is the first fossil record of the species. The material also shows resemblance with *Cardiolucina antjamensis* (BEETS, 1986) from Loc. B [published as *Linga* (*Bellucina*) *antjamensis* BEETS, 1986]. Although paratype RGM 312.173 of the latter contains more strongly elevated and more numerous commarginal ridges than our material, *C. antjamensis* (BEETS, 1986) might be a synonym of *C. civica*.

***Cardiolucina* sp.**

(Pl. 18, Figs 7–9)

Material: RGM 785.044 (1); RGM 785.043 (1 rv); RGM 785.045 (1 lv); RGM 785.046 (9 rv, 9 lv)

Remarks: *Cardiolucina* sp. resembles *Cardiolucina civica* (YOKOYAMA, 1927) in almost all shell characters. A clear difference is the lack of strong commarginal ridges. Regarding the latter character *Cardiolucina* sp. might represent an undescribed species.

Order Carditida DALL, 1889

Superfamily Carditoidea FÉRUSSAC, 1822

Family Carditidae FÉRUSSAC, 1822

Subfamily Carditinae FÉRUSSAC, 1822

Genus *Cardita* BRUGUIÈRE, 1792

***Cardita* s.l. sp.**

(Pl. 18, Fig. 10)

Material: RGM 785.037 (1); RGM 785.038 (3 + 107 rv, 100 lv)

Remarks: The present specimens have subquadrate shells with largest height near the posterior margin. The radial ornamentation consists of 18 well defined ribs. The commarginal ornament forms roundish nodules when crossing the anterior ribs. Those develop into scales on the posterior side. The hinge teeth show the fine transversal striation characteristic for carditids. The material appears to include juvenile and subadult specimens only, therefore an accurate identification is difficult.

Order Venerida GRAY, 1854

Superfamily Cardioidea LAMARCK, 1809

Family Cardiidae LAMARCK, 1809

Remarks: Cardiidae from Banyunganti are only represented by low numbers of damaged valves and fragments, therefore they are presented in open nomenclature.

Subfamily Fraginae STEWART, 1930

Genus *Fragum* RÖDING, 1798

***Fragum* sp.**

(Pl. 18, Fig. 11)

Material: RGM 785.048 (1 lv); RGM 785.049 (4 rv, 3 lv)

Remarks: The shells are strongly inequivalve. The anterior ventral shell margin is short and rounded. The anterior margin is narrow and gently curved ventrally to almost straight dorsally. The posterior part of the shell is extended showing a distinct wing like shape with a long, straight ventral margin, a slightly wavy dorsal margin, and a sharp almost 90° angulation between the two. The shell is ornamented with low radial ribs and a commarginal striation. The most prominent rib runs in a gentle curve from the umbo to the dorsal point where the narrow anterior margin meets with the wing-like posterior margin.

Subfamily Laevicardiinae KEEN, 1951

Genus *Nemocardium* MEEK, 1876

***Nemocardium* sp.**

(Pl. 19, Fig. 1)

Material: RGM 785.050 (1 rv); RGM 785.051 (1 rv); RGM 785.052 (1 rv)

Remarks: The material is damaged. The ornamentation consists of numerous, regularly spaced, low radial ribs. At some distance from the umbo the narrow interspaces of the ribs bear commarginal riblets. The anterior shell area is almost smooth apart from widely spaced commarginal threads which are only present close to the umbo and do not continue over the radial ribs. The genus assignment is based on the latter character.

Subfamily Trachycardiinae STEWART, 1930

Genus *Acrosterigma* DALL, 1900

?*Acrosterigma* sp.

(Pl. 19, Fig. 2)

Material: RGM 785.053 (1 frag.)

Remarks: A single fragment is present in the material. It has a strongly dentate shell margin, radial ornamentation of wide, low ribs which coincide with the interspaces of the marginal denticles, and strongly sinuouse growthlines. The distinct denticles at the shell margin show some resemblance with modern *Acrosterigma* species, but the material is insufficient for a certain assignment, because other cardiids show similar characters as well.

Cardiidae indet. sp. 1

(Pl. 19, Fig. 3)

Material: RGM 785.054 (1 rv)

Remarks: An incomplete right valve is available. It has a radial ornamentation of regularly spaced, wide, low ribs which bear distinct roundisch knobs. A narrow keel bearing very small spiny tubercles is running from the umbo ventro-posteriorly.

Cardiidae indet. sp. 2

(Pl. 19, Fig. 4)

Material: RGM 785.055 (1 lv); RGM 785.056 (1 lv)

Remarks: Two incomplete left valves witnh a radial ornamentation of regularly spaced, low, slender ribs are available from Banyunganti. A slightly more prominent keel is running from the umbo to the ventro-posterior margin. The material is distinguished from Cardiidae indet. sp. 1 by the lack of spines along the keel.

Cardiidae indet. sp. 3

(Pl. 19, Fig. 5)

Material: RGM 785.057 (1 frag.)

Remarks: A fragment with a clearly dentate shell margin is distinguished from ?*Acrosterigma* sp. (see above) by its more elevated radial ribs, and its blunter, more angular marginal denticles. Furthermore, the denticles coincide with the radial ribs in *Cardium* s.l. sp. 3 while they coincide with the interspaces of the ribs in ?*Acrosterigma* sp.

Superfamily Glossoidea Gray, 1847 (1840)

Family Kelliellidae Fischer, 1887

Genus *Kelliella* Sars, 1870

Kelliella sp.

(Pl. 19, Fig. 6)

Material: RGM 785.058 (1 rv)

Remarks: One right valve is present in the Banyunganti material. It resembles *Kelliella japonica* Hayami & Kase, 1993 (Okutani 2000: pl. 495, fig. 2), but an attribution to that species needs further confirmation. Today the genus is almost entirely restricted to abyssal depths, but late Eocene to Miocene records from shallow-water deposits also exist (STUDENCKA 1987).

Superfamily Tellinoidea BLAINVILLE, 1814

Family Tellinidae BLAINVILLE, 1814

Remarks: Only low numbers of damaged valves and fragments of tellinids are present in the Banyunganti material. This and the general difficulties occuring with identifications of tellinids preclude a further identification.

Genus *Arcopagia* LEACH, 1927

?***Arcopagia*** **sp.**

(Pl. 19, Fig. 7)

Material: RGM 785.059 (1 lv)

Remarks: The incomplete left valve is relatively thick and moderately inflated. The shell surface is worn, but an ornament of fine widely spaced commarginal striae is still visible. The small, pointed umbo in combination with the appearance of the hinge, although incomplete, supports an assignment to the Tellinidae. According to the relatively thick shell and the semicircular outline the species might belong in the genus *Arcopagia*.

Genus *Tellina* LINNAEUS, 1758

Tellina **s.l. sp. 1**

(Pl. 19, Fig. 8)

Material: RGM 785.060 (1 lv); RGM 785.061 (1 lv); RGM 785.062 (1 lv); RGM 785.063 (2 lv)

Remarks: The material consists of very incomplete left valves only. The thin shells are flat and have a small, pointed umbo and a long, straight hinge line. The shell surface is smooth apart from a fine commarginal striation. The hinge consists of two cardinal teeth. The anterior tooth is clearly bifurcate.

Tellina **s.l. sp. 2**

(Pl. 19, Fig. 9)

Material: RGM 785.064 (1 lv)

Remarks: The incomplete valve is characterized by a well developed ornamentation of narrow but prominent commarginal ridges dominating a very fine cancellate pattern of numerous, narrowly spaced radial and commarginal striae. The distinct ornamentation is unusual for tellinids. Nevertheless, a typical tellinid hinge is present.

Superfamily Veneroidea Rafinesque, 1815

Remarks: The Banyunganti material in the family Veneroidea that is described in open nomenclature contains only damaged or juvenile specimens, mainly in low abundances, precluding more accurate classifications.

Family Veneridae Rafinesque, 1815

Subfamily Gouldinae Stewart, 1930

Genus *Circe* Schumacher, 1817

Circe junghuhni **Martin, 1917**

(Pl. 20, Fig. 1)

1917 *Circe* (s. str.) *junghuhni* Martin: 271, pl. 5, figs 128–129.
2009 *Circe* (*Circe*) *junghuhni* Martin, 1917 – Leloux & Wesselingh: 14 [cum syn.].

Material: RGM 785.065 (1 rv); RGM 785.064 (2+94 rv, 82 lv+frags)

Remarks: The valves from Banyunganti are all incomplete apart from one small left valve (included in RGM 785.064). The shell is ovate with a small pointed umbo and an ornament of distinct, regularly spaced commarginal ridges. At the posterior side of the ventral shell margin the ridges end in characteristic thickened nodules.

Circe **sp.**

(Pl. 20, Fig. 2)

Material: RGM 785.067 (1 rv); RGM 785.068 (1 rv)

Remarks: The two available juvenile valves are subcircular and moderately inflated. The anterior shell margin is slightly bulging. Ornamentation consists of numerous, narrowly spaced commarginal striae. The umbo is small and pointed. Traces of the original color pattern are preserved. The material resembles the modern species *Circe scripta* (Linnaeus, 1758) (Poppe 2010 b: pl. 1129, figs 1–5) in shell shape and ornamentation.

Veneridae indet. sp. 1

(Pl. 20, Figs 3–4)

Material: RGM 785.070 (1 rv); RGM 785.069 (1 lv); RGM 785.071 (12 rv, 13 lv)

Remarks: The material is incomplete. The valves are ornamented with equally spaced, thin and low but well defined commarginal ridges. A strongly prosogyrate umbo and a well-defined large lunula demarcated by a furrow are present.

Veneridae indet. sp. 2
(Pl. 20, Figs 5–6)

Material: RGM 785.072 (1 lv); RGM 785.073 (1 lv); RGM 785.074 (2 lv)

Remarks: Only incomplete left valves are available. The main characteristic feature of the shells is a dense ornamentation of thin, equally spaced commarginal striae instead of slightly elevated ridges like in *Venus* s.l. sp. 1.

Veneroidea indet. sp. 1
(Pl. 20, Fig. 7)

Material: RGM 785.075 (1 rv)

Remarks: An incomplete right valve is present in the material. It is solid, inflated and has a circular outline. The umbo is strongly prosogyrate. The hinge is incomplete. One large cardinal tooth parallel to the margin and a deep socket situated above the cardinal are preserved in the specimen. The shell surface appears to be partly covered with sand-grains. It remains unclear if this is a preservational or biological effect.

?Veneroidea indet. sp. 2
(Pl. 20, Fig. 8)

Material: RGM 785.076 (1)

Remarks: The available specimen was originally paired, but the valves got separated during investigation, damaging the hinge. The shell is small, subtriangular, and ornamented with fine commarginal striae.

Class Scaphopoda BRONN, 1862

Order Dentaliida STAROBOGATOV, 1974

Family Dentaliidae CHILDREN, 1834

Genus *Dentalium* LINNAEUS, 1758

Dentalium sp. 1
(Pl. 20, Fig. 9)

Material: RGM 783.220 (1); RGM 783.221 (4)

Remarks: The specimens are relatively robust and thick-shelled. Primary and secondary ribs are irregularly spaced, the finer secondary ribs dissapear during growth.

Dentalium sp. 2
(Pl. 20, Fig. 10)

Material: RGM 783.222 (1); RGM 783.223 (4)

Remarks: The specimens are smaller and thinner-shelled than those of *Dentalium* sp. 1. Ten well defined, regularly spaced primary ribs are present.

Class Polyplacophora BLAINVILLE, 1816

Subclass Neoloricata BERGENHAYN, 1955

Order Chitonida THIELE, 1909

Suborder Chitonina THIELE, 1909

Superfamily Schizochitonoidea DALL, 1889

Family Schizochitonidae DALL, 1889

Genus *Schizochiton* GRAY, 1847

***Schizochiton incisus* (SOWERBY II, 1841)**
(Pl. 20, Fig. 11)

Material: RGM 783.224 (1)

Remarks: A single damaged intermediate valve with closely-spaced well-defined longitudinal riblets is present in the material.

Results

Composition of the fauna

Gastropods (n = 4,086; 92 %) are dominant over bivalves (n = 333). The most abundant families are Rissoidae (n = 1507) and Cerithiidae (n = 747) followed by Ringiculidae (n = 221) and Veneridae (n = 120).

The three most abundant species in the Banyunganti fauna are *Rissoina banyungantiensis* spec. nov. (n = 1,423; 32 %), *Cerithidium* cf. *perparvulum* (n = 543; 12 %) and *Bothropoma mediocarinata* spec. nov. (n = 365; 8 %). Other common species are *Plesiotrochus hasibuani* spec. nov. (4 %), *Diala semistriata* s.l., *Cerithium* s.s. sp. 1 and *Ringicula* sp. 1 (3 % each). The remaining 35 % of the fauna comprise 177 species.

In terms of species numbers the gastropods are the most diverse mollusc group in the Banyunganti fauna with 158 species. Bivalves are represented by 22 species, scaphopods by two species, and polyplacophorans by one species.

The most species-rich families are Cerithiidae (15 species), Pyramidellidae (13 species), and Costellariidae (8 species). Almost 50 % of the molluscan families are represented by one or two species only.

Feeding guilds

The Banyunganti mollusc fauna has been assigned to five feeding guilds: herbivores and deposit feeders (HD), predatory carnivores (CP), specialized carnivores and parasites (CSP), suspension feeders (S), and chemosymbiotic deposit feeders (CD) (TODD 2001).

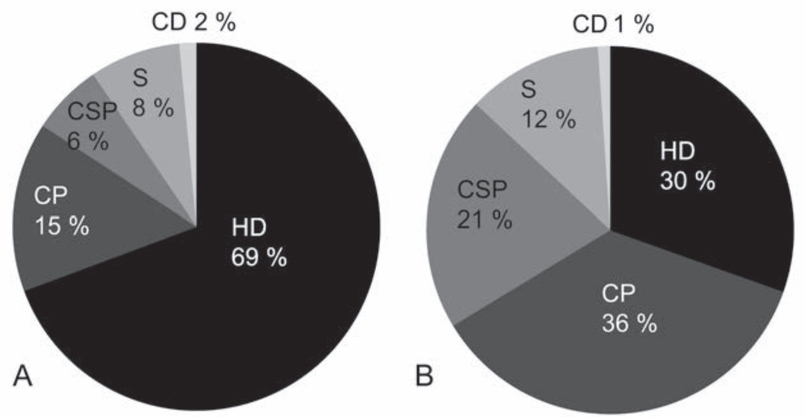

Fig. 2. The ecological composition of the Banyunganti fauna in terms of feeding guilds. A: Abundances of feeding guilds in the Banyunganti fauna with $n_{specimens} = 4,428$. B: Species numbers of feeding guilds with $n_{species} = 184$.

Herbivores (*e.g.*, grazers on microalgae) and non-selective deposit-feeders where merged to one feeding guild, because an assignment to one of these groups might vary by genus or even species level (*e.g.*, in Cerithiidae, Rissoidae; BEESLEY *et al.* 1998).

Gastropods assigned to the CP-group prey on vagile and whole sedentary organisms. Scavengers were included in the group since most of them also prey on living organisms and shift facultative to carrion (BRITTON & MORTON 1994). Assignment to a guild was problematic for the Columbellidae, because the family combines several feeding modes. The food of the majority of columbellids includes some sort of animal material, thus they are here considered as predatory carnivores. Feeders on foraminifers such as cylichnids, most retusid species, and scaphopods are included in the CP-guild as well.

The guild CSP includes highly specialized feeders on predominantly sedentary animals and ectoparasites on a variety of organisms (see "browsing carnivores" in BOUCHET *et al.* 2002; TODD 2001; JOHNSON *et al.* 2007). The assignment of the Marginellidae and Cystiscidae to the group was somewhat problematic, because the feeding habits of both families are not well known. Marginellidae feed on a wide range of animal material, are often highly specialized (*e.g.*, FRETTER 1976), and parasitism is known within the family, hence it is assigned to the CSP-group. Cystiscidae were included in the Marginellidae until the division of the two families by COOVERT & COOVERT (1995). No information on the feeding ecology of cystiscid species has been found in the literature. The family is assigned to the same feeding guild as the Marginellidae.

The suspension feeders includes most of the bivalves and the Turritellidae, Capulidae, and Vermetidae.

The chemosymbiont guild contains two lucinid species (WILLIAMS *et al.* 2004).

In terms of numbers of specimens the fauna is clearly dominated by herbivores and deposit-feeders (Fig. 2 A). In terms of species numbers the fauna is dominated by carnivorous species (Fig. 2 B).

Preservation

For much of the material fine surface ornamentation details and sometimes color patterns are retained. Wear is very rare. Although fragmentation is high the non-abraded edges of fragments and the predominantly excellent preservation of the ornamentation of shells suggest shell breakage due to biogenic interactions rather than due to postmortal transportation (*e.g.*, Stanton 1980). Shell breakage due to sediment compaction, collecting and post-collecting effects likely plays a role as well. Preservation of color patterns occurs in the neritids, *Bothropoma mediocarinata* nov. spec., *Diala semistriata* s.l., *Cerithium deningeri,* and *Circe* sp. Two specimens of *B. mediocarinata* were found with their opercula still in place. Bivalves are predominantly disarticulated, but left and right valves of common species (> 50 specimens) occur in similar numbers indicating little post-mortem transport (*e.g.*, Lever 1958).

Palaeoenvironment

The overall excellent preservation of shells including color pattern preservation and in-situ opercula suggests deposition in a low energetic environment and very little to no post-mortem transport of the material. The lack of very fine-grained sediments suggests that the preservation cannot be attributed to rapid “sealing” by mud.

The mollusc fauna is considered to represent a seagrass associated assemblage. This assumption is based on a number of arguments.

Herbivores and deposit feeders, particularly small grazers on microalgae, are the most abundant feeding guild in the Banyunganti fauna (Fig. 2 A). The numerous occurrence of small herbivores has been used before to infer seagrass vegetation (Moulinier & Picard 1952; Davies 1970; see also Brasier 1975; Ivany *et al.* 1990). Within the small herbivores the Bittiinae are very abundant (*Cerithidium* cf. *perparvulum*, n = 543). All living, observed members of *Bittium* graze on epiphytic microalgae which commonly occur on seagrasses (Houbrick 1993). Another indicator might be *Bothropoma mediocarinata* (n = 365). *Bothropoma* is predominantly associated with seagrasses in the northern Red Sea although it occurs less abundantly in other habitats as well (Zuschin & Hohenegger 1998; Zuschin *et al.* 2009). Reuter *et al.* (2010) used the numerous occurrence of *Bothropoma* sp. among others as an indicator for an ancient seagrass habitat in the Miocene of India.

The high abundance of small herbivorous species might also be relatively higher as a result of the different life spans of herbivorous and carnivorous gastropod species. Shorter life spans of herbivores compared to carnivores might result in the accumulation of herbivore’s shells in a fossil assemblage (Cadée 1968; Albano & Sabelli 2011).

In general, the ecological composition of the Banyunganti mollusc assemblage in terms of feeding guilds appears typical for seagrass associated mollusc communities (see *e.g.*, RUEDA *et al.* 2009a for comparison), but further research is needed to confirm this assumption. Characteristical elements of the ecological composition of the Banyunganti fauna and likely of other seagrass associated mollusc assemblages are, besides the high abundance of herbivores and detritivores, the high diversity in the CP- and CSP-guilds and the presence of lucinids (VAN DER HEIDE *et al.* 2012; RUEDA, pers. comm.).

Modern representatives of *Smaragdia*, present in the Banyunganti assemblage as well, are closely associated with seagrasses as observed for several species in different parts of the world (TAYLOR & LEWIS 1970; HIGO *et al.* 1999; KAY 1979; RUEDA *et al.* 2009a; ZUSCHIN *et al.* 2009). The modern species *Smaragdia viridis* and *Smaragdia bryanae* feed selectively on seagrass tissue (RUEDA & SALAS 2007; RUEDA *et al.* 2009a, b; UNABIA 2011). The radula of the genus differs from those of other neritids and might have evolved for breaking the cell walls of seagrasses which would indicate a general relation of the genus to marine angiosperms (RUEDA & SALAS 2007; UNABIA 2011). The occurrence of *Smaragdia* within a fossil assemblage has therefore been used as an indicator for seagrass vegetation before (REUTER *et al.* 2010) and is generally regarded as the best available indicator for seagrass vegetation within a fossil mollusc assemblage.

The assemblage of associated benthic foraminifers hints to seagrass vegetation as well. Members of the permanently attached morpho-group (sensu LANGER 1993) such as *Sorites* sp., *Planogypsina* sp. and *Planorbulina* sp. occur in the fauna. Especially higher concentrations of *Sorites* species are associated with seagrass environments (RENEMA 2006, 2008a; HOHENEGGER *et al.* 1999). Also *Pseudotaberina* sp. and *Flosculinella* sp., both present in Banyunganti, have been associated with seagrass vegetation (RENEMA 2008b, REUTER *et al.* 2010). *Pseudotaberina vandervlerki* (DE NEVE, 1947) is the most common foraminifer species in the assemblage.

An assessment of the palaeo water depth for the Banyunganti assemblage remains somewhat speculative. Considering the terrestrial influence in the environment the associated foraminifers and the scleractinian coral assemblage point to a shallow depositional depth in the upper photic zone in not more than 20 m waterdepth (TOMASCIK *et al.* 2007). Modern Indonesian seagrasses occur in waterdepths of up to at least 20 m in clear waters, but are most abundant in the intertidal zone often growing on reef flats (HOEKSEMA 2007; NIENHUIS *et al.* 1989; D. KNEER, pers. comm.). The excellent preservation of the Banyunganti material suggests a deposition in a slightly deeper environment than the latter, because modern seagrass associated shells from intertidal reef flats show much higher rates of wear (own observation). Therefore a palaeodepth of ~5–20 m is assumed.

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Plate captions

Plate 1

***Scutus* sp.**
Fig. 1 dorsal view RGM 783.219

***Emarginula* sp.**
Fig. 2a dorsal view RGM 784.739
Fig. 2b lateral view

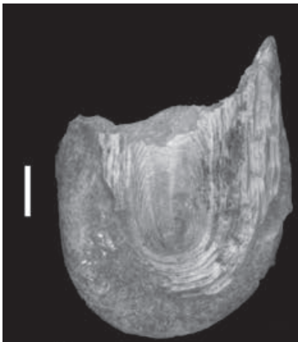
***Puncturella* sp.**
Fig. 3a dorsal view RGM 784.741
Fig. 3b lateral view

***Jujubinus* cf. *polychromus* (A. ADAMS, 1853a)**
Fig. 4a rear view RGM 784.743
Fig. 4b frontal view

***Calliostoma* sp.**
Fig. 5a rear view RGM 784.745
Fig. 5b frontal view

Trochoidea indet. sp.
Fig. 6a rear view RGM 784.753
Fig. 6b dorsal view

Scale bars equal 1 mm.



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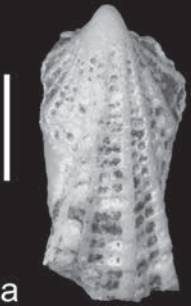

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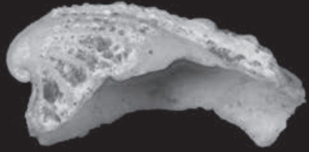

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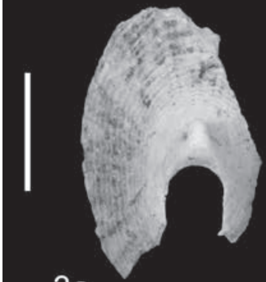

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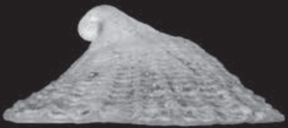

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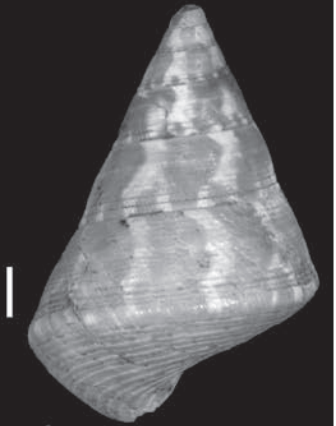

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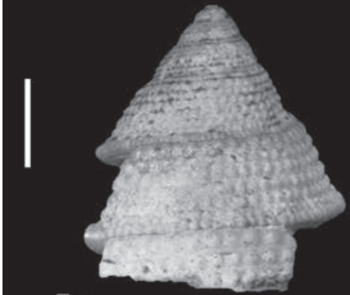

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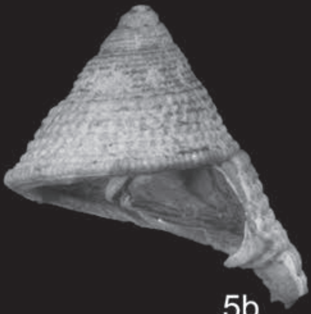

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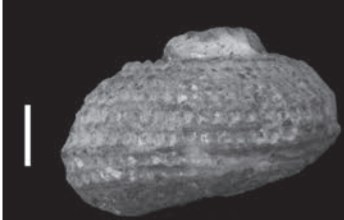

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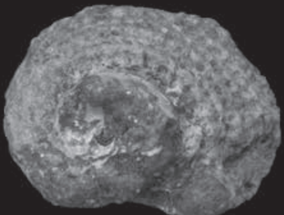

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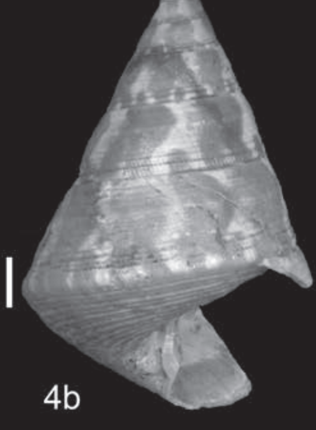

4b

Plate 2

***Bothropoma mediocarinata* nov. spec.**
Fig. 1a rear view holotype RGM 784.746
Fig. 1b lateral view
Fig. 1c frontal view
Fig. 1d dorsal view
Fig. 1e ventral view
Fig. 2 frontal view paratype 1 RGM 784.747
Fig. 3 frontal view paratype 2 RGM 784.748
Fig. 4 frontal view paratype 3 RGM 784.749
Fig. 5 frontal view paratype 5 RGM 784.750
Fig. 6a rear view operculum RGM 784.751
Fig. 6b frontal view
Fig. 7 SEM dorsal view, enlargement protoconch RGM 608.186

***Smaragdia jogjacartensis* (MARTIN, 1916)**
Fig. 8a rear view RGM 784.754
Fig. 8b frontal view
Fig. 8c dorsal view

***Smaragdia* sp.**
Fig. 9a rear view RGM 784.756
Fig. 9b frontal view
Fig. 9c dorsal view

Scale bars equal 1 mm.

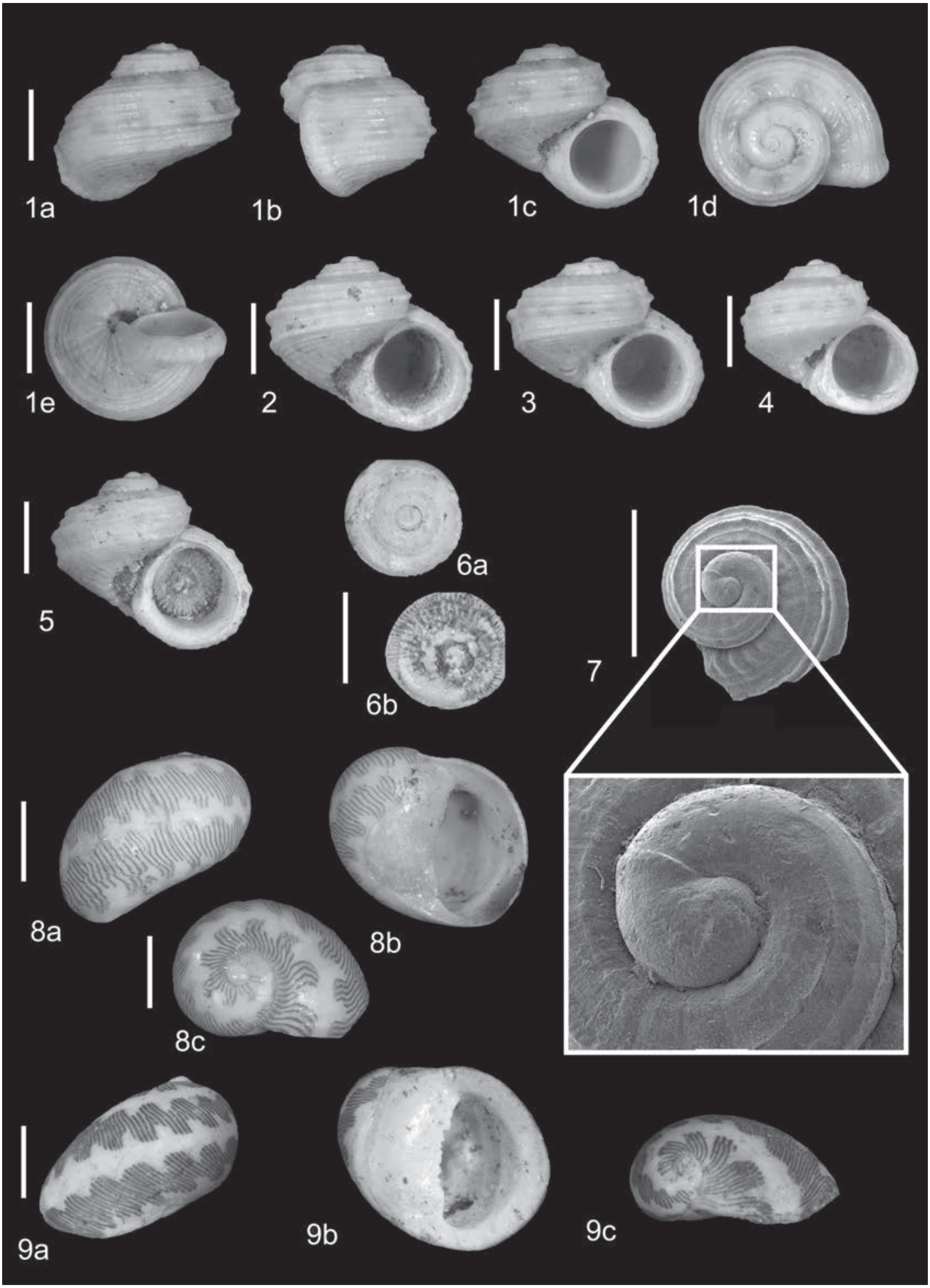
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Plate 3

***Bittium* sp.**
Fig. 1a rear view RGM 784.761
Fig. 1b frontal view

***Cerithidium* cf. *perparvulum* (Watson, 1886)**
Fig. 2a rear view RGM 784.758
Fig. 2b frontal view
Fig. 3a rear view RGM 784.890
Fig. 3b frontal view

***Cerithidium* sp.**
Fig. 4 spire RGM 784.760

***Cerithium* aff. *balteatum* Philippi, 1848**
Fig. 5 spire RGM 784.764

***Cerithium deningeri* (Martin, 1916)**
Fig. 6a rear view RGM 784.766
Fig. 6b frontal view

***Cerithium dolfusi* (Martin, 1916)**
Fig. 7a lateral view RGM 784.768
Fig. 7b frontal view

?*Cerithium* “*ickei*” (Martin, 1916)
Fig. 8a rear view RGM 784.778
Fig. 8b frontal view

***Cerithium progoense* (Martin, 1916)**
Fig. 9a rear view RGM 784.769
Fig. 9b lateral view
Fig. 9c frontal view

Scale bars equal 1 mm.

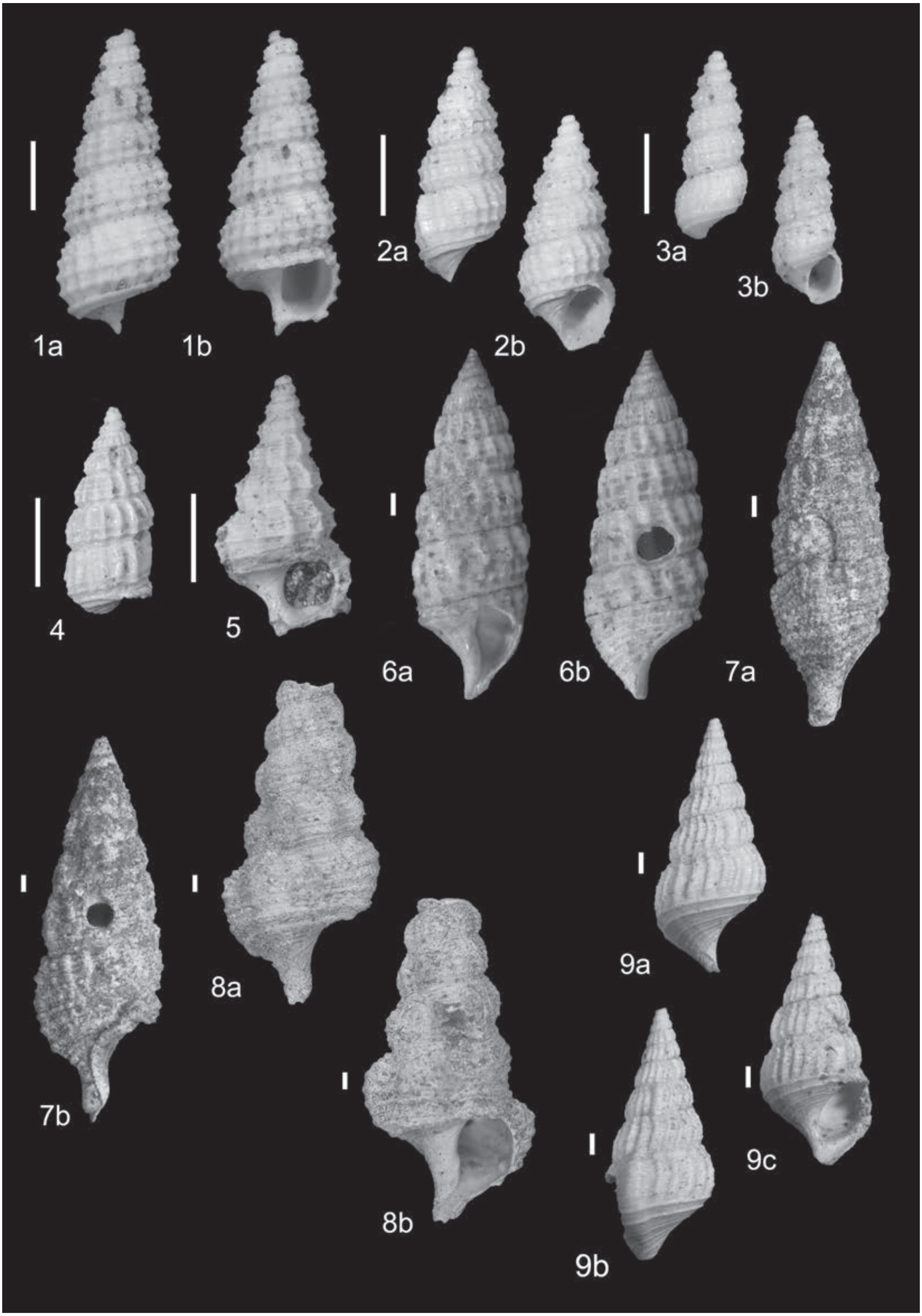
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Plate 4

***Cerithium teschi* (Martin, 1916)**
Fig. 1 spire RGM 784.772

***Cerithium* s.s. sp. 1**
Fig. 2a rear view RGM 784.774
Fig. 2b frontal view

***Cerithium* s.s. sp. 2**
Fig. 3a rear view RGM 784.776
Fig. 3b frontal view

***Cerithium* s.l. sp. 1**
Fig. 4a rear view RGM 784.779
Fig. 4b frontal view

***Cerithium* s.l. sp. 2**
Fig. 5 rear view RGM 784.780

***Clypeomorus* sp. 1**
Fig. 6a rear view RGM 784.781
Fig. 6b frontal view

?*Clypeomorus* sp. 2
Fig. 7a rear view RGM 784.783
Fig. 7b frontal view

***Diala semistriata* s.l. (Philippi, 1849)**
Fig. 8a rear view RGM 784.785
Fig. 8b frontal view
Fig. 9a rear view RGM 784.786
Fig. 9b frontal view

***Diala* sp.**
Fig. 10a rear view RGM 784.788
Fig. 10b frontal view

***Modulus* sp. 1**
Fig. 11a rear view RGM 784.794
Fig. 11b frontal view

***Modulus* sp. 2**
Fig. 12 spire RGM 784.796

Scale bars equal 1 mm.

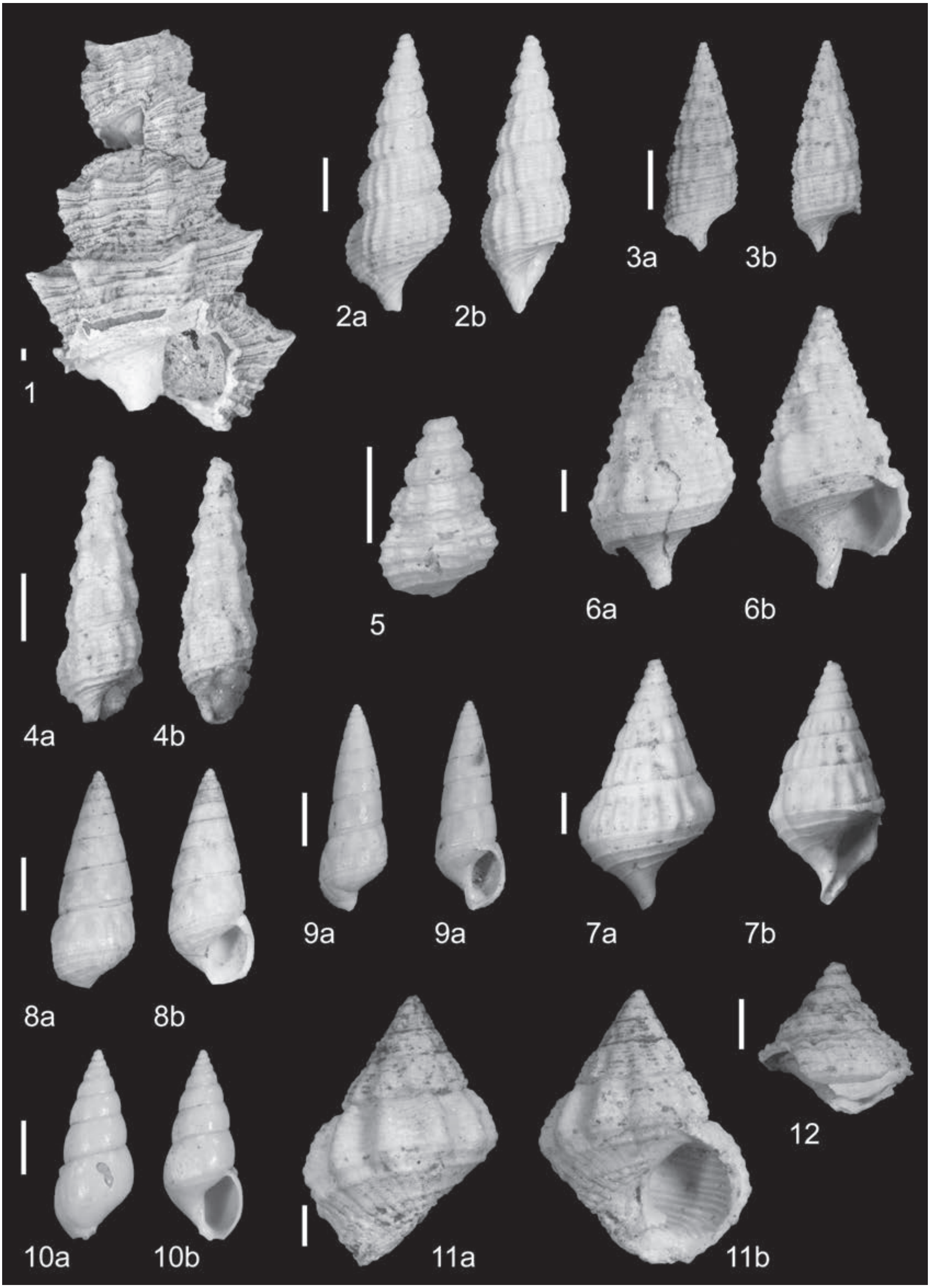
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Plate 5

***Planaxis* s.l. sp.**
Fig. 1 spire RGM 784.797

?*Cerithideopsilla* sp.
Fig. 2 incomplete teleoconch RGM 784.798
Fig. 3 incomplete teleoconch RGM 784.800

***Finella* cf. *pupoides* A. ADAMS, 1860**
Fig. 4a rear view RGM 784.802
Fig. 4b frontal view
Fig. 5a rear view RGM 784.803
Fig. 5b frontal view

***Finella* sp. 1**
Fig. 6a rear view RGM 784.805
Fig. 6b frontal view

***Finella* sp. 2**
Fig. 7a rear view RGM 784.807
Fig. 7b frontal view

***Archimediella spolongensis* (MARTIN, 1916)**
Fig. 8 spire RGM 784.808

***Haustator* sp.**
Fig. 9 spire RGM 784.811

Cerithioidea indet. 1
Fig. 10a rear view RGM 784.813
Fig. 10b frontal view

Cerithioidea indet. sp. 2
Fig. 11 spire RGM 784.815

Cerithioidea indet. sp. 3
Fig. 12 spire RGM 784.816

Scale bars equal 1 mm.

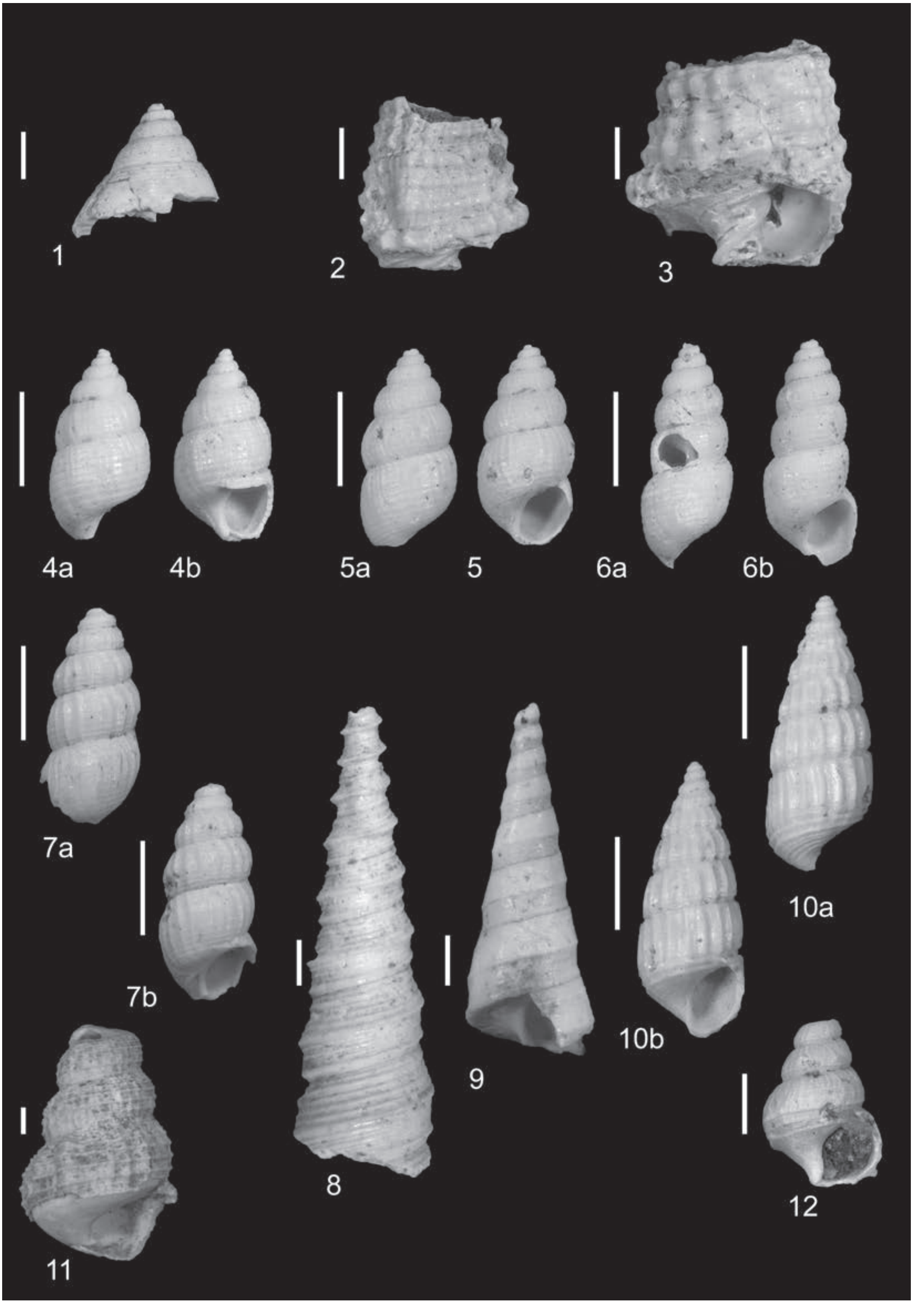
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Plate 6

?Cerithioidea indet. sp. 4
Fig. 1 spire 784.790

?Cerithioidea indet. sp. 5
Fig. 2 spire 784.792

***Ampullina* s.l. sp.**
Fig. 3a lateral view RGM 784.817
Fig. 3b dorsal view

?*Cernina* sp.
Fig. 4a lateral view RGM 784.819
Fig. 4b dorsal view

***Plesiotrochus hasibuani* nov. spec.**
Fig. 5 rear view holotype RGM 784.820
Fig. 5b lateral view
Fig. 5c frontal view
Fig. 6 frontal view paratype 1 RGM 784.821
Fig. 7 frontal view paratype 2 RGM 784.822
Fig. 8 frontal view paratype 3 RGM 784.823
Fig. 9 frontal view paratype 4 RGM 784.824
Fig. 10a SEM spire RGM 608.189
Fig. 10b SEM protoconch

***Plesiotrochus* sp. 1**
Fig. 11 spire RGM 784.826

***Plesiotrochus* sp. 2**
Fig. 12a rear view RGM 784.828
Fig. 12b frontal view

?*Plesiotrochus* sp. 3
Fig. 13 frontal view RGM 784.829

Scale bars equal 1 mm.

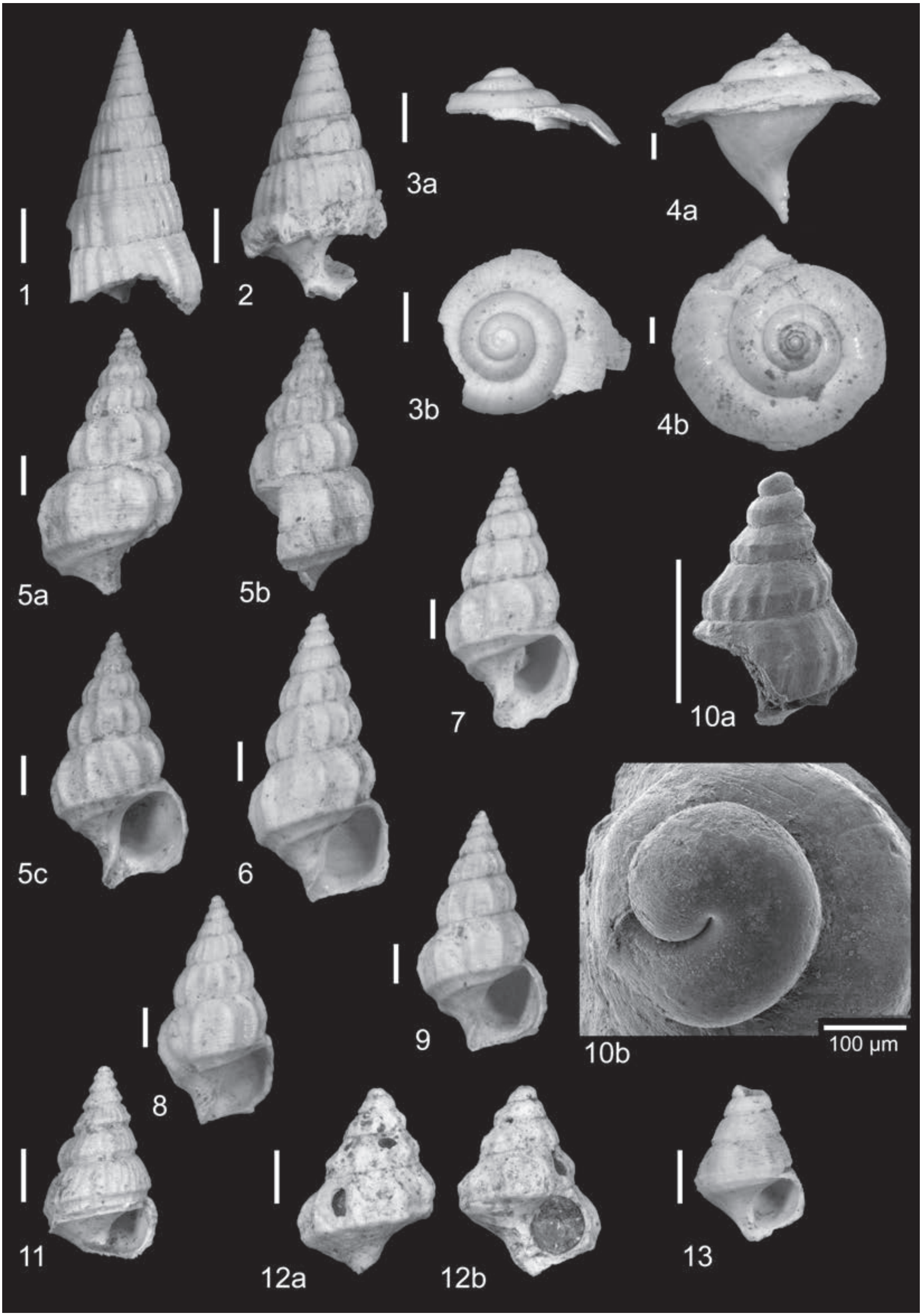
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Plate 7

***Capulus* sp.**
Fig. 1a dorsal view RGM 784.830
Fig. 1b lateral view

***Eatoniella* s.l. sp. 1**
Fig. 2a rear view RGM 784.831
Fig. 2b frontal view

***Eatoniella* s.l. sp. 2**
Fig. 3a rear view RGM 784.833
Fig. 3b frontal view

Cypraeidae indet. sp.
Fig. 4 dorsal view RGM 784.835
Fig. 5 ventral view RGM 784.836

***Natica* s.l. sp. 1**
Fig. 6a frontal view RGM 784.839
Fig. 6b dorsal view

***Natica* s.l. sp. 2**
Fig. 7a frontal view RGM 784.840
Fig. 7b dorsal view

***Naticarius* sp.**
Fig. 8a frontal view RGM 784.838
Fig. 8b dorsal view

Naticidae indet.
Fig. 9a frontal view RGM 784.842
Fig. 9b rear view

***Rissoina* (*Rissoina*) *banjunantensis* nov. spec.**
Fig. 10a rear view holotype RGM 784.843
Fig. 10b lateral view
Fig. 10c frontal view

Scale bars equal 1 mm.

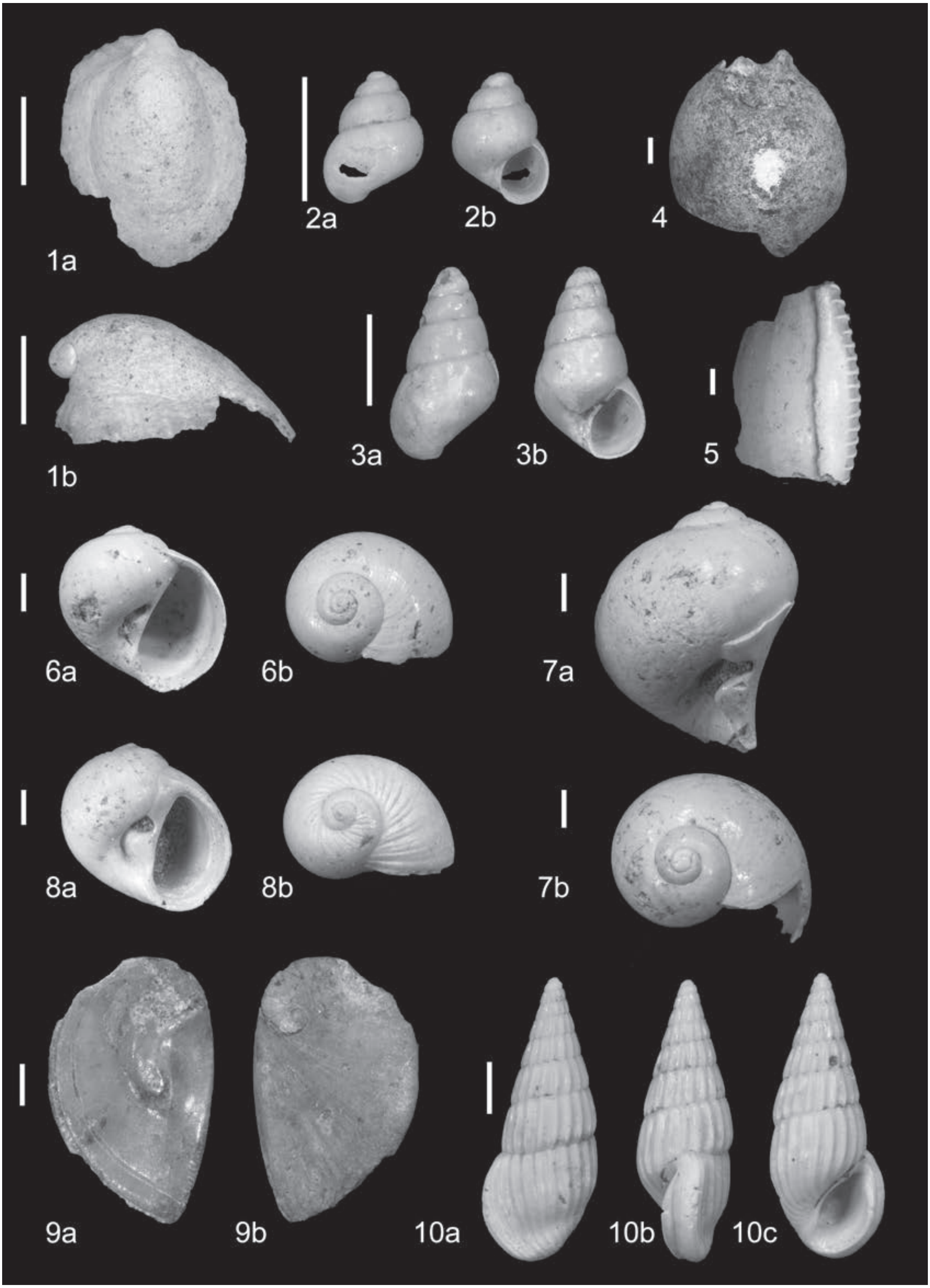
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Plate 8

***Rissoina* (*Rissoina*) *banjunantensis* nov. spec.**
Fig. 1 frontal view paratype 1 RGM 784.844
Fig. 2 frontal view paratype 2 RGM 784.845
Fig. 3 frontal view paratype 3 RGM 784.846
Fig. 4a SEM protoconch RGM 608.193
Fig. 4b SEM spire

***Rissoina* (*Rissoina*) sp.**
Fig. 5a rear view RGM 784.856
Fig. 5b frontal view

?*Rissoina* s.l. sp.
Fig. 6a rear view RGM 784.855
Fig. 6b frontal view

***Rissolina reticuspiralis* nov. spec.**
Fig. 7a rear view holotype RGM 784.849
Fig. 7b lateral view
Fig. 7c frontal view
Fig. 8 frontal view paratype 1 RGM 784.850
Fig. 9 frontal view paratype 2 RGM 784.851
Fig. 10 frontal view paratype 3 RGM 784.852
Fig. 11a SEM spire RGM 608.196
Fig. 11b SEM protoconch
Fig. 11c SEM detail teleoconch microstriation

***Stosicia* (*Iseliella*) sp.**
Fig. 12 frontal view RGM 784.857

Scale bars equal 1 mm (unless otherwise indicated).

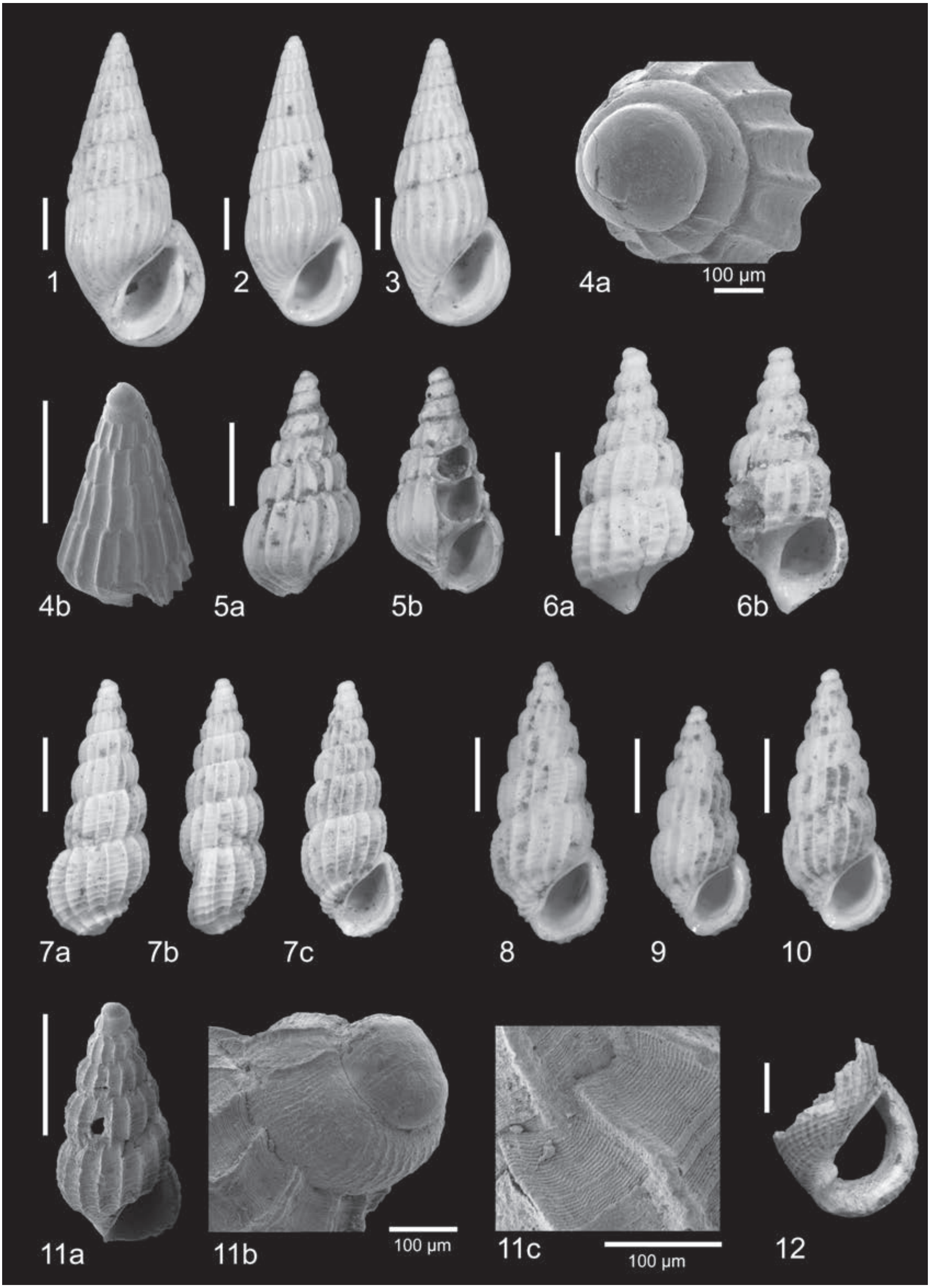
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Plate 9

***Strombus* s.l. sp.**
Fig. 1a rear view fragment RGM 784.858
Fig. 1b lateral view

***Varicospira sokkohensis* (Martin, 1916)**
Fig. 2a rear view RGM 784.859
Fig. 2b lateral view
Fig. 2c frontal view

***Terebellum* sp. 1**
Fig. 3 spire RGM 784.861

***Terebellum* sp. 2**
Fig. 4 spire RGM 784.862

***Sassia* (*Cymatiella*) *fennemai* (Martin, 1899)**
Fig. 5a rear view RGM 784.863
Fig. 5b lateral view
Fig. 5c frontal view
Fig. 6a rear view juvenile RGM 784.863
Fig. 6b frontal view

Ranellidae indet. sp.
Fig. 7a spire RGM 784.865
Fig. 7b inclined dorsal

***Vermetus* s.l. sp.**
Fig. 8 fragment RGM 784.867

***Amaea* sp.**
Fig. 9 spire RGM 784.868

***Epitonium* sp.**
Fig. 10 teleoconch whorl RGM 784.870

***Melanella* sp.**
Fig. 11 frontal view RGM 784.871

Eulimidae indet. sp.
Fig. 12a rear view RGM 784.873
Fig. 12b frontal view

***Metaxia* sp. 1**
Fig. 13 incomplete teleoconch RGM 784.875

***Metaxia* sp. 2**
Fig. 14 incomplete teleoconch RGM 784.877

Scale bars equal 1 mm.

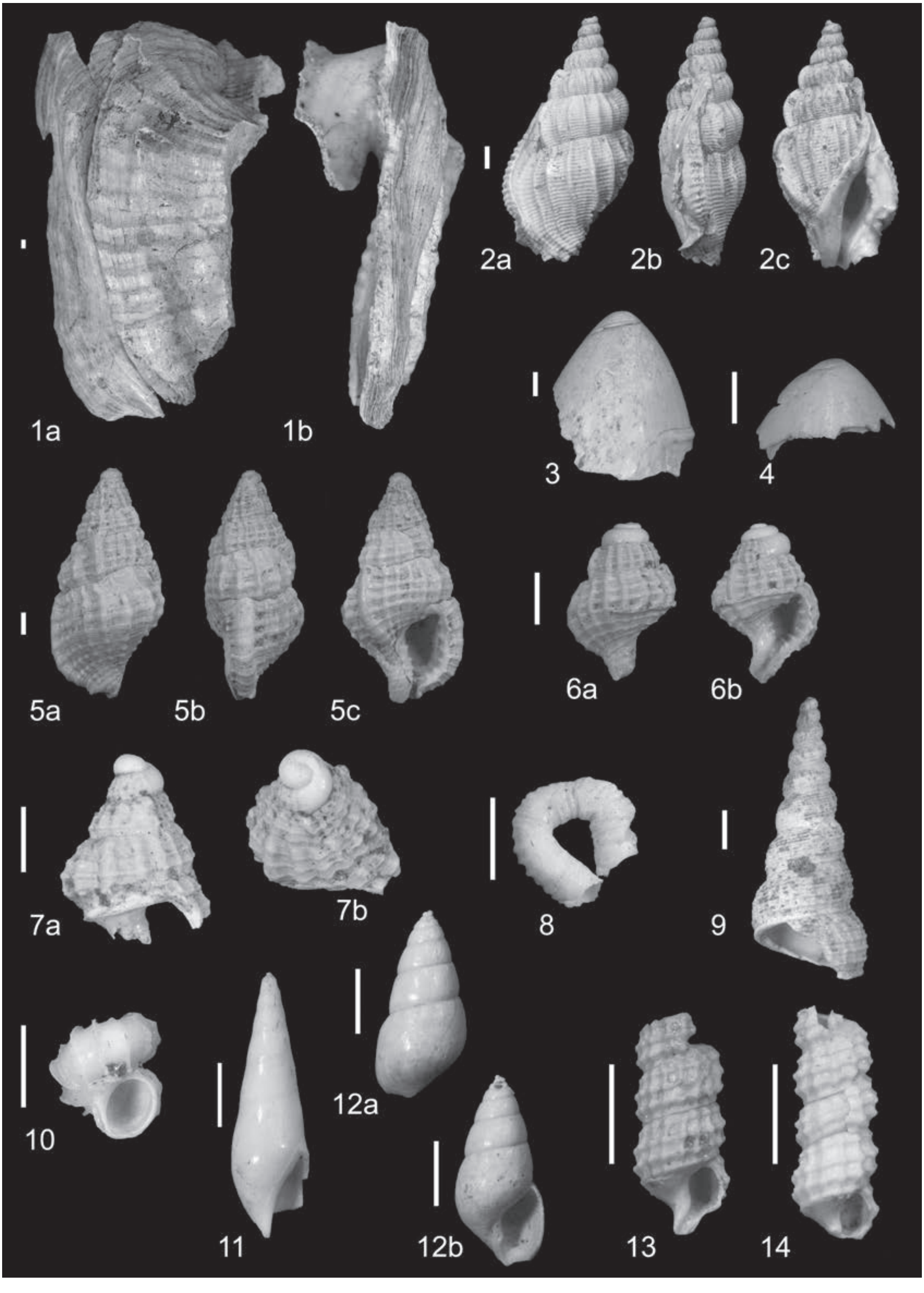
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Plate 10

***Triphora* s.l. sp. 1**
Fig. 1a frontal view RGM 784.878
Fig. 1b lateral view
Fig. 1c rear view

***Triphora* s.l. sp. 2**
Fig 2a frontal view RGM 784.880
Fig 2b rear view

***Cerithiopsis* s.l. sp. 1**
Fig. 3 frontal view RGM 784.882

***Cerithiopsis* s.l. sp. 2**
Fig. 4 frontal view RGM 784.884

***Atilia* cf. *njalindungensis* MARTIN, 1921**
Fig. 5a rear view RGM 784.885
Fig. 5b lateral view
Fig 5c frontal view

Columbellidae indet. sp.
Fig. 6a rear view RGM 784.888
Fig. 6b lateral view
Fig. 6c frontal view

***Fusinus* sp.**
Fig. 7 spire RGM 784.891

***Fasciolaria* s.l. sp.**
Fig. 8a rear view RGM 784.892
Fig 8b frontal view

***Coralliophila* sp.**
Fig. 9a side view RGM 784.895
Fig. 9b frontal view

***Calotrophon* (*Panamurex*) sp.**
Fig. 10a rear view RGM 784.894
Fig. 10b frontal view

***Typhina* cf. *macropterus* (MARTIN, 1884)**
Fig. 11 spire RGM 784.896

Typhinae indet. sp.
Fig. 12a frontal view fragment RGM 784.897
Fig. 12b rear view fragment

Muricidae indet. sp.
Fig. 13 spire RGM 784.898

Scale bars equal 1 mm.

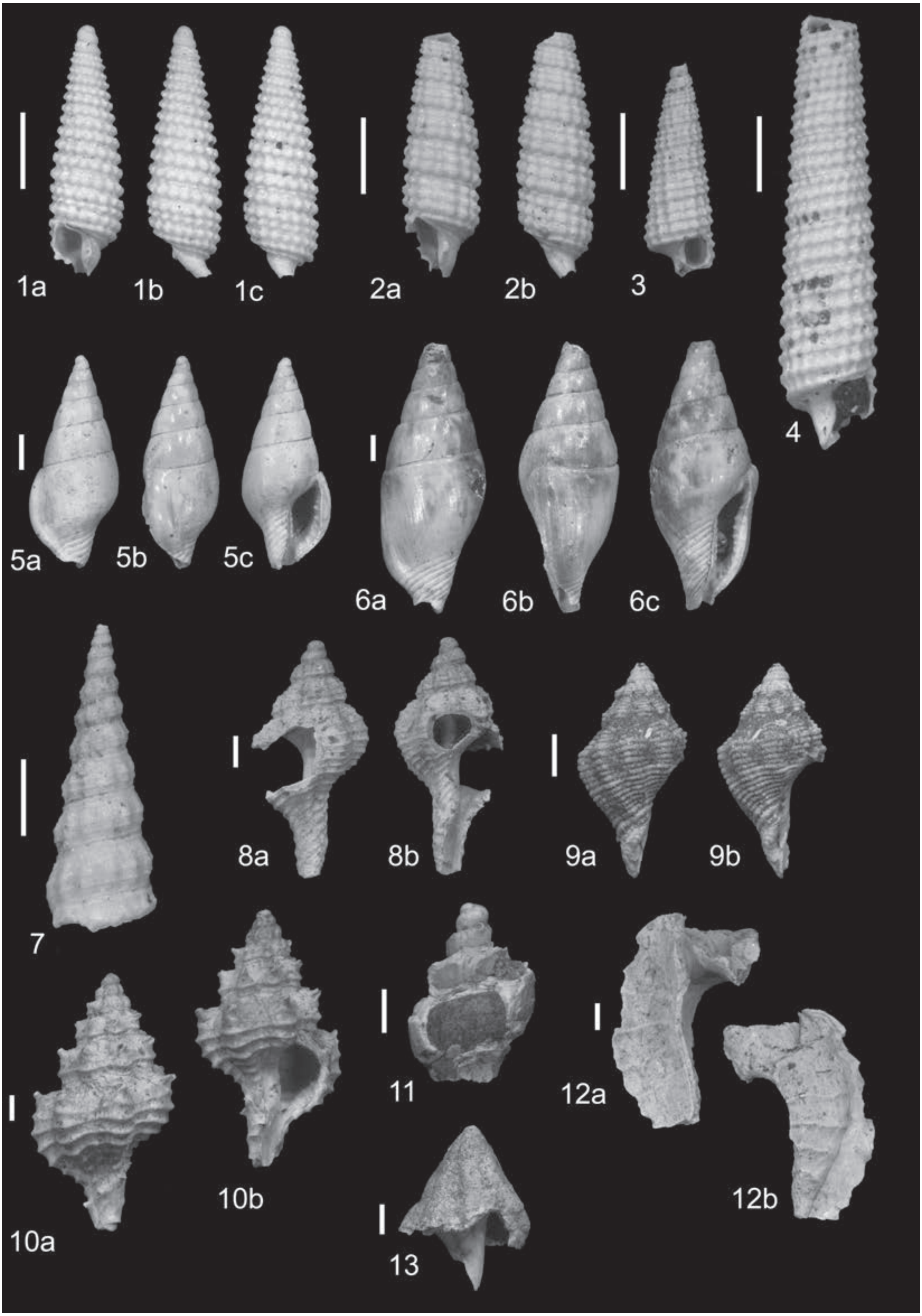
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Plate 11

***Vexillum* sp. 1**
Fig. 1a rear view RGM 784.899
Fig. 1b frontal view

***Vexillum* sp. 2**
Fig. 2a rear view RGM 784.901
Fig. 2b frontal view

***Vexillum* sp. 3**
Fig. 3a rear view RGM 784.903
Fig. 3b frontal view

***Vexillum* sp. 4**
Fig. 4a rear view RGM 784.904
Fig. 4b frontal view

***Vexillum* sp. 5**
Fig. 5a rear view RGM 784.906
Fig. 5b frontal view

***Vexillum* sp. 6**
Fig. 6 spire RGM 784.908

***Vexillum* sp. 7**
Fig. 7a rear view RGM 784.909
Fig. 7b frontal view

***Vexillum* sp. 8**
Fig. 8 spire RGM 784.910

***Cystiscus* sp.**
Fig. 9a rear view RGM 784.91
Fig. 9b lateral view
Fig. 9c frontal view

***Gibberula* sp. 1**
Fig. 10a rear view RGM 784.914
Fig. 10b lateral view
Fig. 10c frontal view

***Gibberula* sp. 2**
Fig. 11a rear view RGM 784.916
Fig. 11b lateral view
Fig. 11c frontal view

Scale bars equal 1 mm.

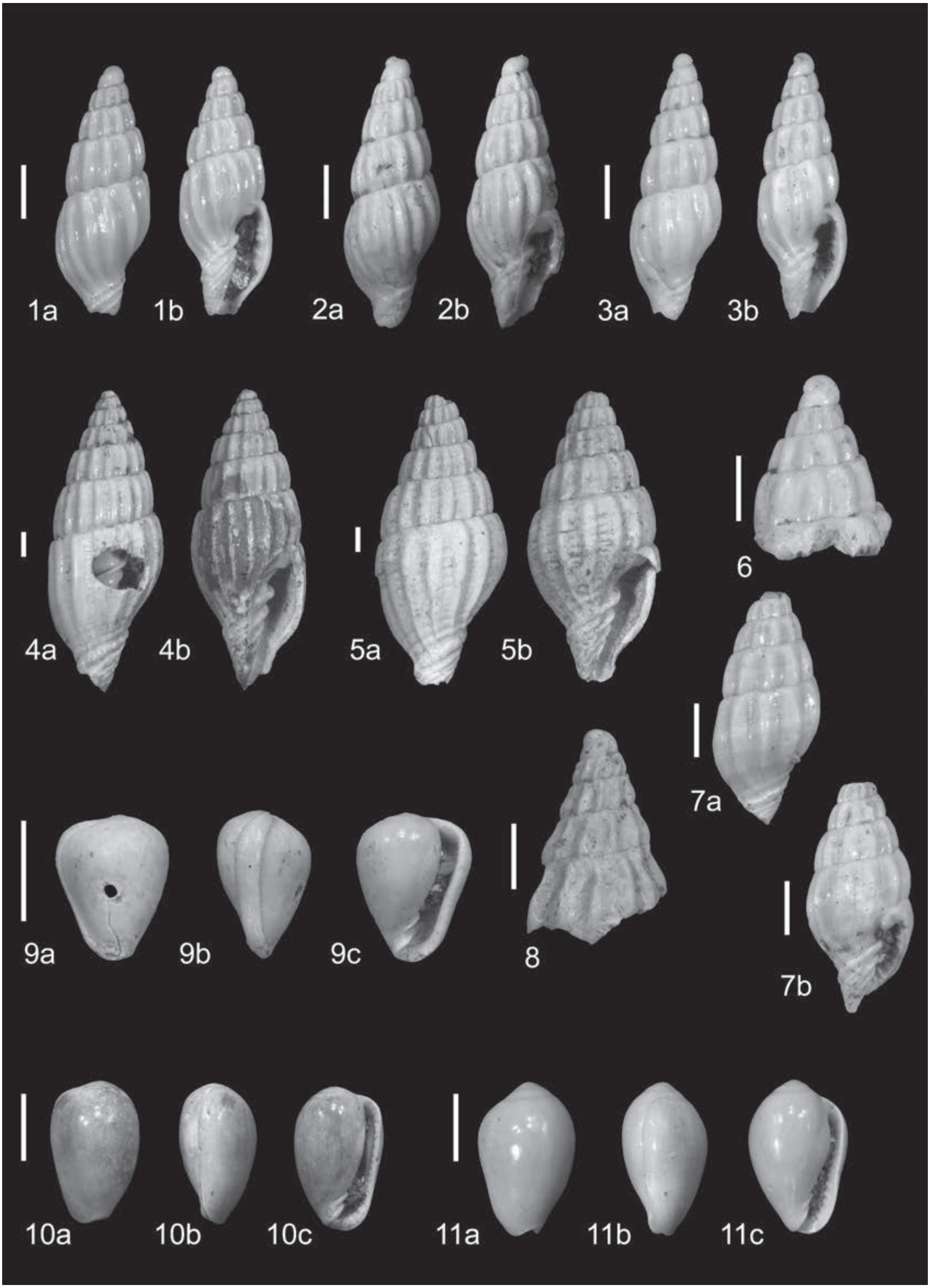
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Plate 12

***Dentimargo* sp. 1**
Fig. 1a rear view RGM 784.918
Fig. 1b lateral view
Fig. 1c frontal view

***Dentimargo* sp. 2**
Fig. 2a rear view RGM 784.920
Fig. 2b frontal view

***Mesoginella nanggulanensis* (MARTIN, 1916)**
Fig. 3a rear view RGM 784.922
Fig. 3b lateral view
Fig. 3c frontal view

***Volvarina* sp. 1**
Fig. 4a rear view RGM 784.924
Fig. 4b frontal view

***Volvarina* sp. 2**
Fig. 5a rear view RGM 784.926
Fig. 5b frontal view

***Mitra* cf. *sokkohensis* MARTIN, 1916**
Fig. 6a rear view spire RGM 784.928
Fig. 6b frontal view spire

***Ancilla* cf. *cinnamomea* sensu BEETS, 1941 non LAMARCK, 1801**
Fig. 7a rear view RGM 784.929
Fig. 7b frontal view

***Ancilla* sp.**
Fig. 8a rear view RGM 784.930
Fig. 8b frontal view

***Oliva* s.l. sp.**
Fig. 9a rear view RGM 784.931
Fig. 9b frontal view

***Olivella* sp.**
Fig. 10a rear view RGM 784.932
Fig. 10b frontal view

Scale bars equal 1 mm.

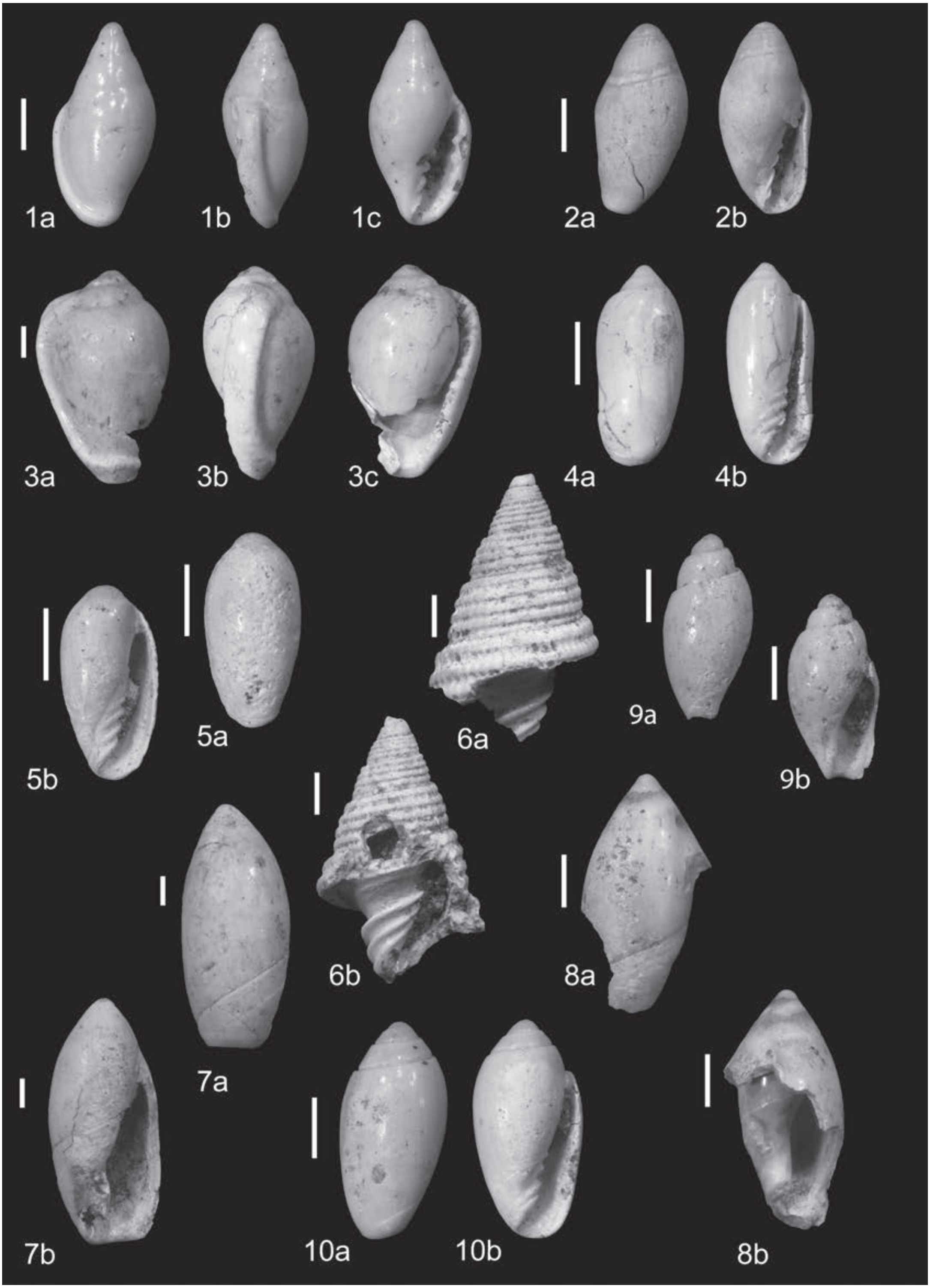
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Plate 13

?*Fusiconus arntzenii* (Martin, 1916)
Fig. 1a rear view RGM 784.937
Fig. 1b frontal view

***Fusiconus spolongensis* Martin, 1916**
Fig. 2a rear view RGM 784.939
Fig. 2b frontal view

***Phasmoconus* aff. *hulshofi* (Martin, 1906)**
Fig. 3 spire RGM 784.941

Conidae indet. sp. 1
Fig. 4a rear view RGM 784.934
Fig. 4b frontal view

Conidae indet. sp. 2
Fig. 5a rear view RGM 784.936
Fig. 5b frontal view

***Lienardia* sp.**
Fig. 6a rear view RGM 784.942
Fig. 6b lateral view
Fig. 6c frontal view

***Eucithara* sp. 1**
Fig. 7a rear view RGM 784.944
Fig. 7b lateral view
Fig. 7c frontal view

***Eucithara* sp. 2**
Fig. 8a rear view RGM 784.946
Fig. 8b lateral view
Fig. 8c frontal view

***Eucithara* sp. 3**
Fig. 9 spire RGM 784.948

***Eucithara* sp. 4**
Fig. 10 spire RGM 784.949

Scale bars equal 1 mm.

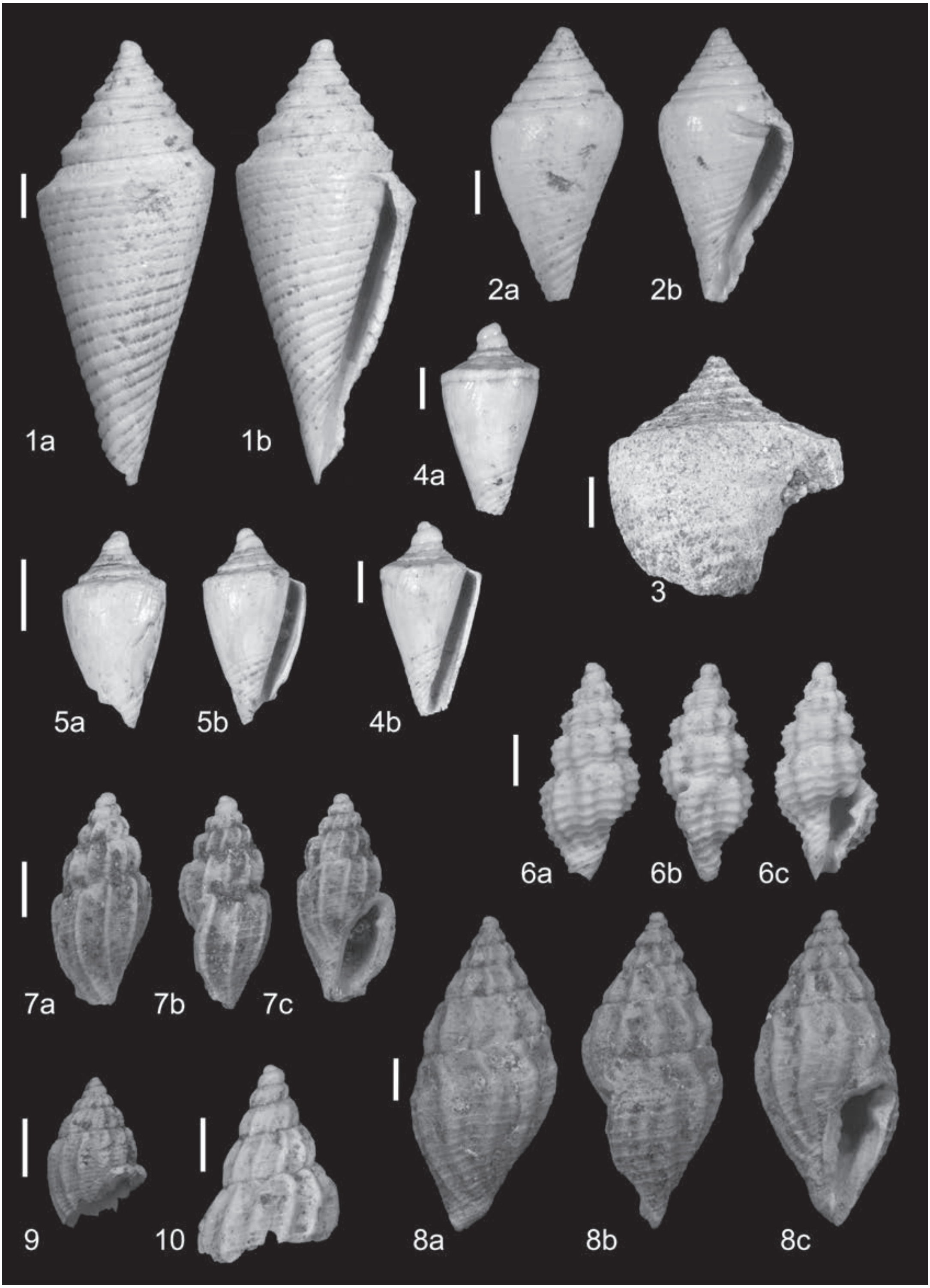
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Plate 14

***Pseudodaphnella* sp. 1**
Fig. 1a rear view RGM 784.950
Fig. 1b frontal view

***Pseudodaphnella* sp. 2**
Fig. 2 spire RGM 784.952

***Pseudodaphnella* sp. 3**
Fig. 3 spire RGM 784.953

Raphitomidae indet. sp. 1
Fig. 4 spire RGM 784.955

Raphitomidae indet. sp. 2
Fig. 5 spire RGM 784.956

?*Splendrillia* sp.
Fig. 6 spire RGM 784.957

***Tylotiella* sp.**
Fig. 7a rear view RGM 784.958
Fig. 7b frontal view

?Drilliidae indet.
Fig. 8 frontal view body whorl RGM 784.960

***Crassispira molengraafi* (Martin, 1916)**
Fig. 9a rear view RGM 784.961
Fig. 9b lateral view
Fig. 9c frontal view

***Inquisitor* sp. 1**
Fig. 10a rear view RGM 784.963
Fig. 10b frontal view
Fig. 11 rear view juvenile RGM 784.964

?*Inquisitor* sp. 2
Fig. 12a rear view RGM 784.966
Fig. 12b frontal view
Fig. 13 rear view juvenile RGM 784.967

Scale bars equal 1 mm.

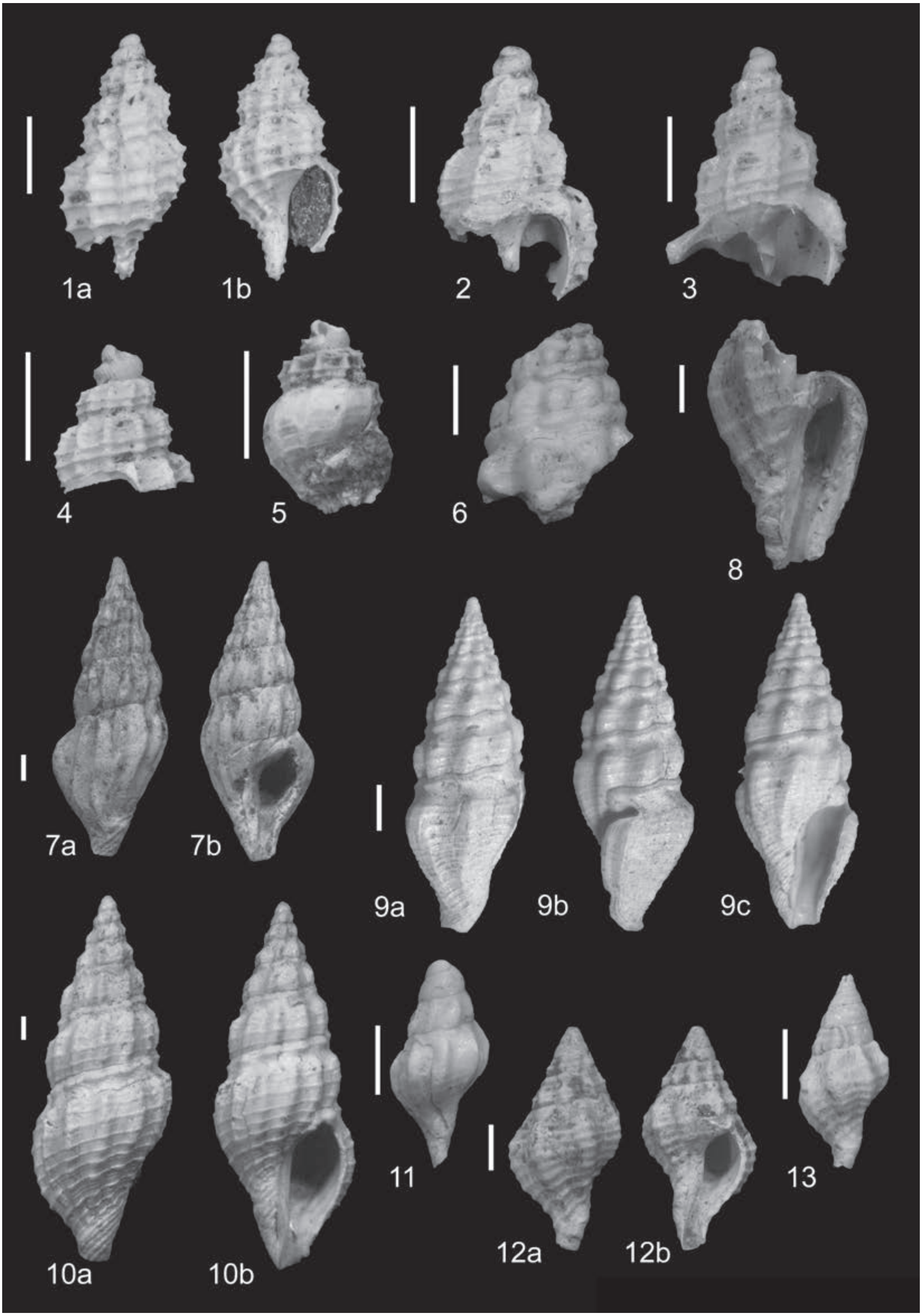
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Plate 15

Pseudomelatomidae indet. 1
Fig. 1a rear view body whorl RGM 784.969
Fig. 1b lateral view
Fig. 1c frontal view

Pseudomelatomidae indet. 2
Fig. 2a rear view body whorl RGM 784.970
Fig. 2b frontal view

Pseudomelatomidae indet. 3
Fig. 3 spire RGM 784.971

***Clavatula* s.l. sp.**
Fig. 4a rear view RGM 784.974
Fig. 4b frontal view

?*Turricula kelirensis* (Martin, 1916)
Fig. 5a rear view RGM 784.972
Fig. 5b frontal view

***Strictispira* sp.**
Fig. 6a rear view RGM 784.976
Fig. 6b lateral view
Fig. 6c frontal view

***Terebra* sp.**
Fig. 7a rear view RGM 784.978
Fig. 7b frontal view

Cancellariidae indet. sp.
Fig. 8a lateral view protoconch RGM 784.980
Fig. 8b dorsal view

***Acteon* sp.**
Fig. 9a rear view RGM 785.008
Fig. 9b frontal view

?Acteonidae indet. sp.
Fig. 10 frontal view fragment RGM 785.010

Scale bars equal 1 mm.

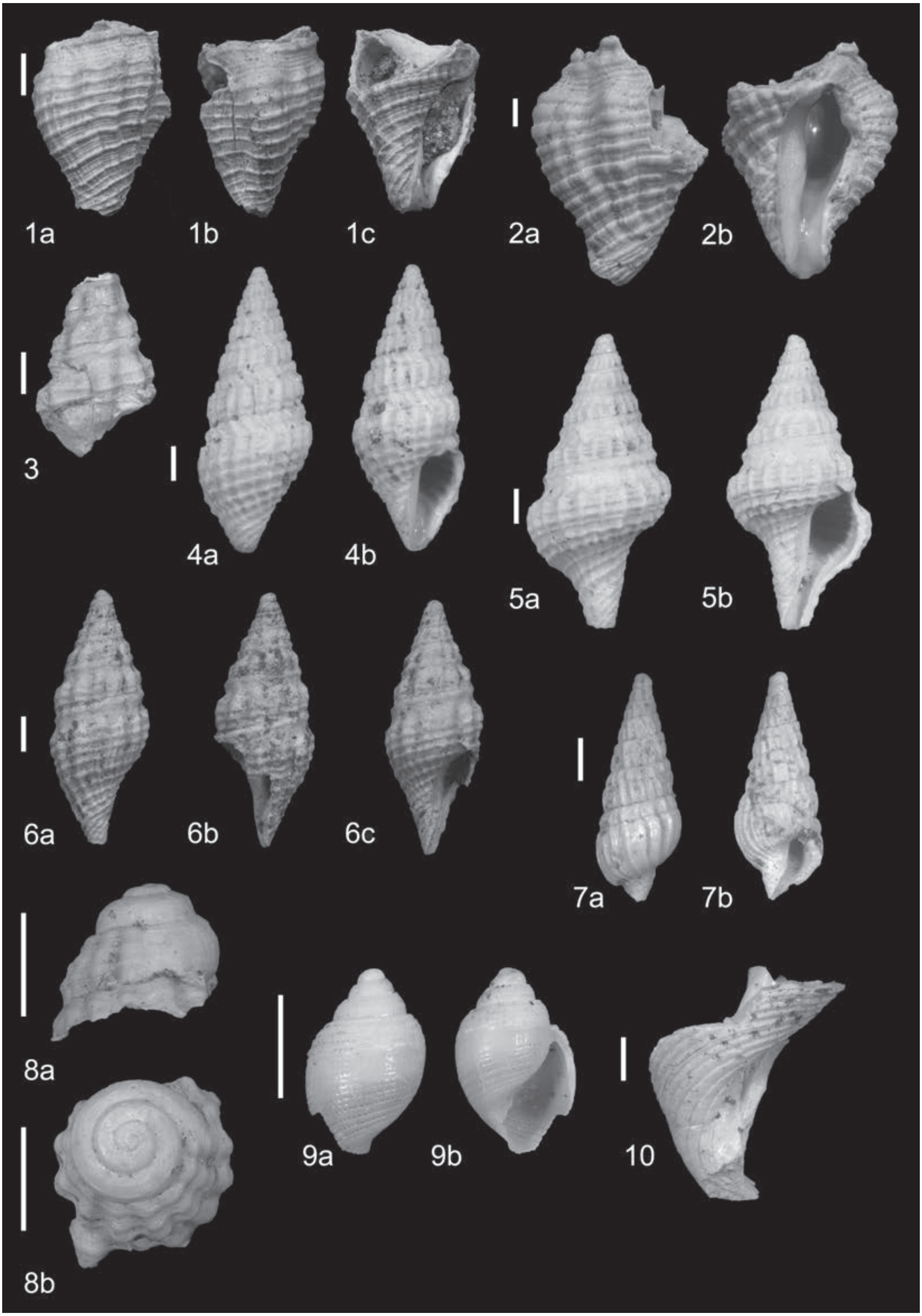
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Plate 16

***Adelphotectonica* sp.**
Fig. 1a dorsal view RGM 784.981
Fig. 1b ventral view
Fig. 1c lateral view

?*Discotectonica* sp.
Fig. 2a lateral view RGM 784.983
Fig. 2b dorsal view
Fig. 2c ventral view

***Heliacus* (*Torinista*) *implexus* (MIGHELS, 1845)**
Fig. 3a dorsal view RGM 784.985
Fig. 3b ventral view
Fig. 3c lateral view

***Psilaxis radiatus* (RÖDING, 1798)**
Fig. 4a dorsal view RGM 784.986
Fig. 4b ventral view
Fig. 4c lateral view

***Odostomia* sp.**
Fig. 5a rear view
Fig. 5b frontal view

***Parodostomia* sp.**
Fig. 6a rear view
Fig. 6b frontal view

***Babella* sp.**
Fig. 7a rear view RGM 784.987
Fig. 7b frontal view

***Pyrgulina* sp. 1**
Fig. 8a rear view RGM 784.988
Fig. 8b frontal view

***Pyrgulina* sp. 2**
Fig. 9a rear view RGM 784.990
Fig. 9b frontal view

***Longchaeus* sp.**
Fig. 10a rear view RGM 784.997
Fig. 10b frontal view

Scale bars equal 1 mm.

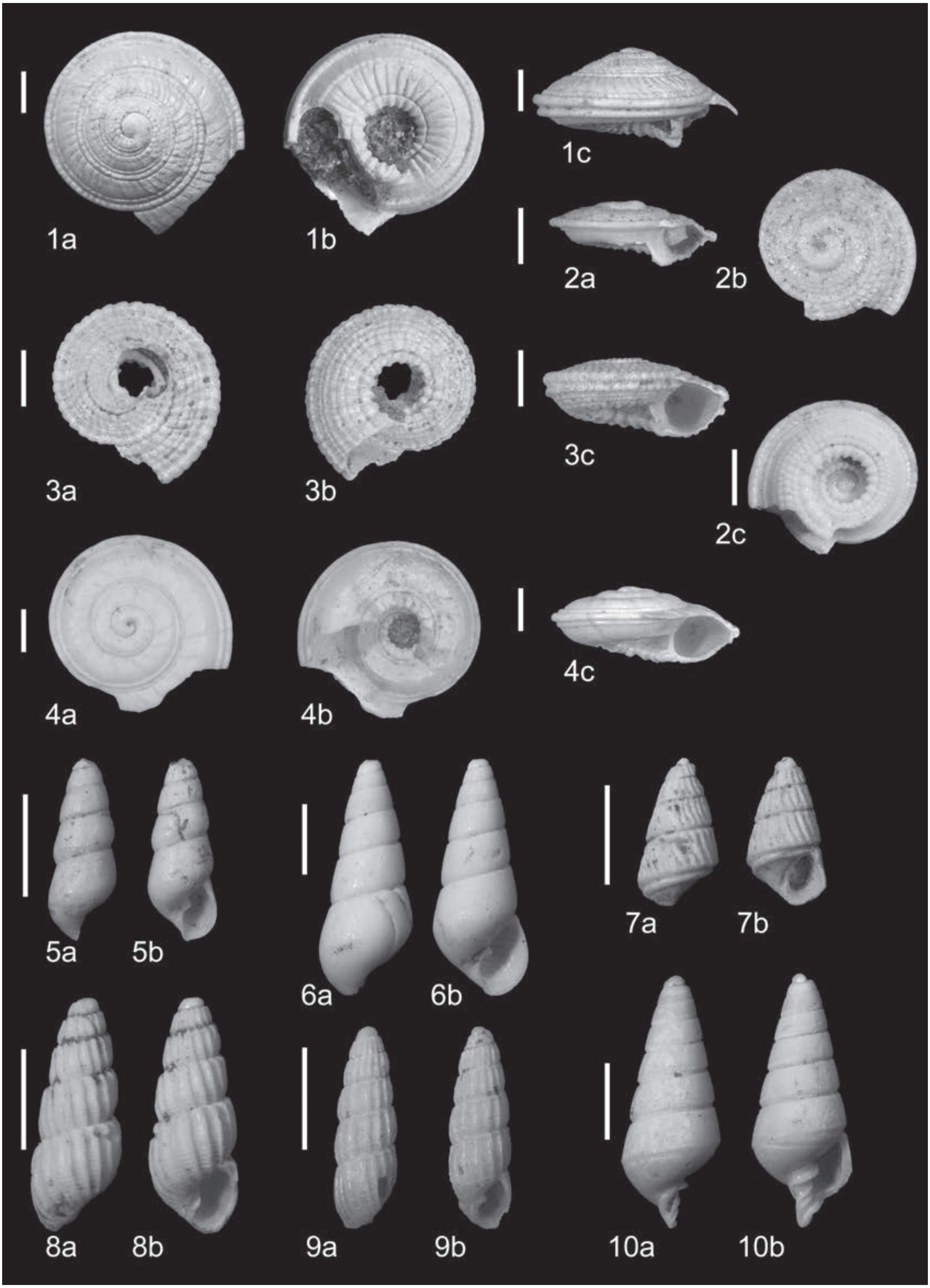
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Plate 17

***Pyramidella* sp.**
Fig. 1a rear view RGM 784.999
Fig. 1b frontal view

***Asmunda* sp.**
Fig. 2a rear view RGM 785.000
Fig. 2b frontal view

?*Pyrgiscus* sp.
Fig. 3a rear view RGM 785.002
Fig. 3b frontal view

***Turbolidium* sp. 1**
Fig. 4a rear view RGM 785.004
Fig. 4b frontal view

?*Turbolidium* sp. 2
Fig. 5a rear view RGM 785.004
Fig. 5b frontal view

***Turbonilla* sp.**
Fig. 6a rear view RGM 785.007
Fig. 6b frontal view

***Eulimella* sp.**
Fig. 7a rear view RGM 784.992
Fig. 7b frontal view

***Ringicula* sp. 1**
Fig. 8a rear view RGM 785.011
Fig. 8b lateral view
Fig. 8c frontal view

***Ringicula* sp. 2**
Fig. 9a rear view RGM 785.013
Fig. 9b lateral view
Fig. 9c frontal view

***Ringicula* sp. 3**
Fig. 10a rear view RGM 785.015
Fig. 10b lateral view
Fig. 10c frontal view

***Cylichna triplicata* (MARTIN, 1916)**
Fig. 11a rear view RGM 785.017
Fig. 11b frontal view

***Cylichna* s.l. sp.**
Fig. 12a rear view RGM 785.019
Fig. 12b frontal view

Retusidae indet. sp.
Fig. 13 dorsal view fragment RGM 785.021

Scale bars equal 1 mm.

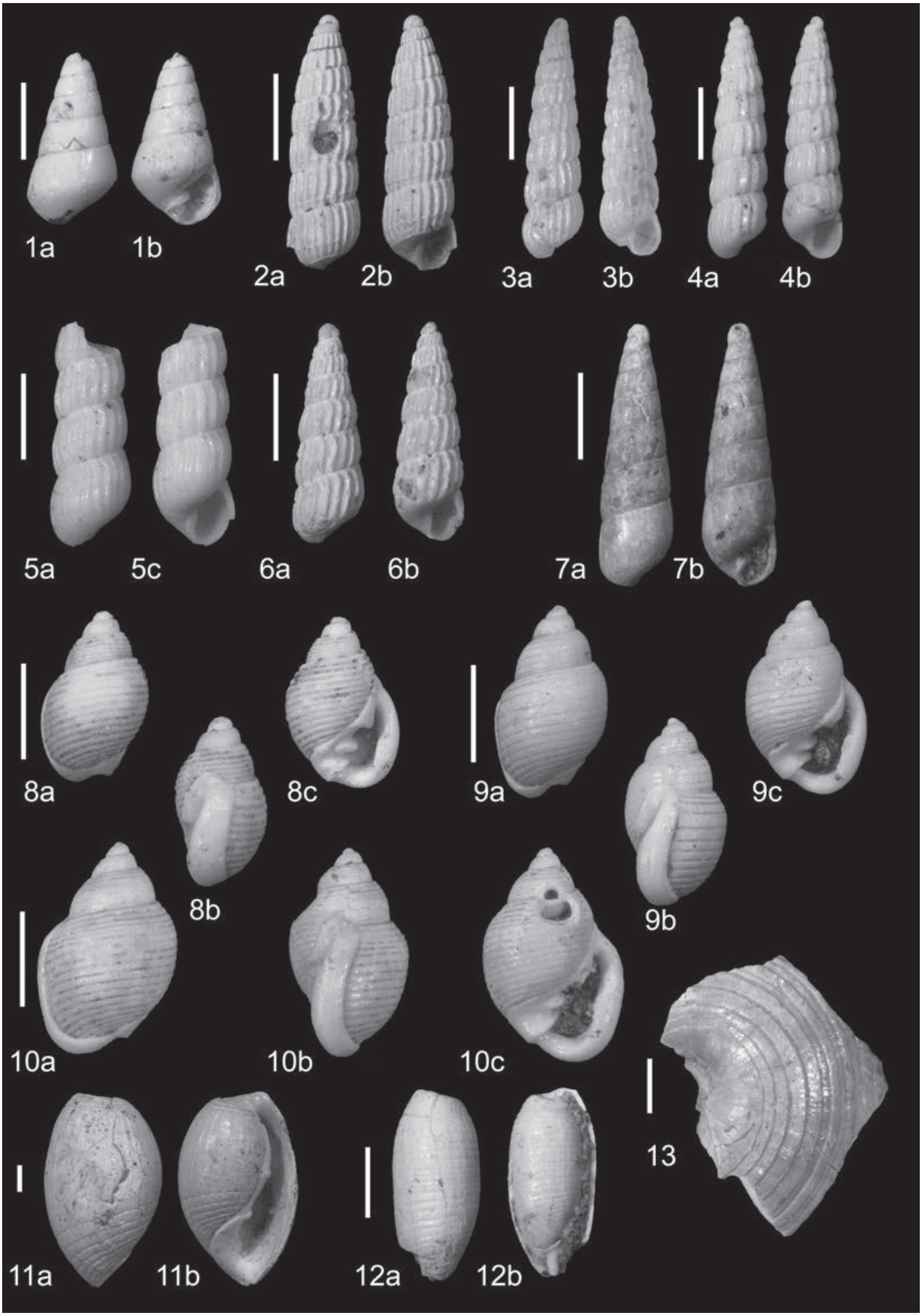
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Plate 18

?*Tucetona* sp.
Fig. 1a external view RGM 785.031
Fig. 1a internal view

***Mimachlamys* sp.**
Fig. 2 external view fragment RGM 785.033

***Spondylus* sp.**
Fig. 3 external view RGM 785.035

***Cardiolucina civica* (Yokoyama, 1927)**
Fig. 4a external view left valve RGM 785.039
Fig. 4b internal view
Fig. 5a internal view right valve RGM 785.040
Fig. 5b external view
Fig. 6 dorsal view RGM 785.041

***Cardiolucina* sp.**
Fig. 7 external view right valve RGM 785.043
Fig. 8 internal view left valve RGM 785.045
Fig. 9 dorsal view RGM 785.044

***Cardita* s.l. sp.**
Fig. 10a internal view left valve RGM 785.037
Fig. 10b external view
Fig. 10c external view right valve
Fig. 10d internal view

***Fragum* sp.**
Fig. 11 external view RGM 785.048

Scale bars equal 1 mm.

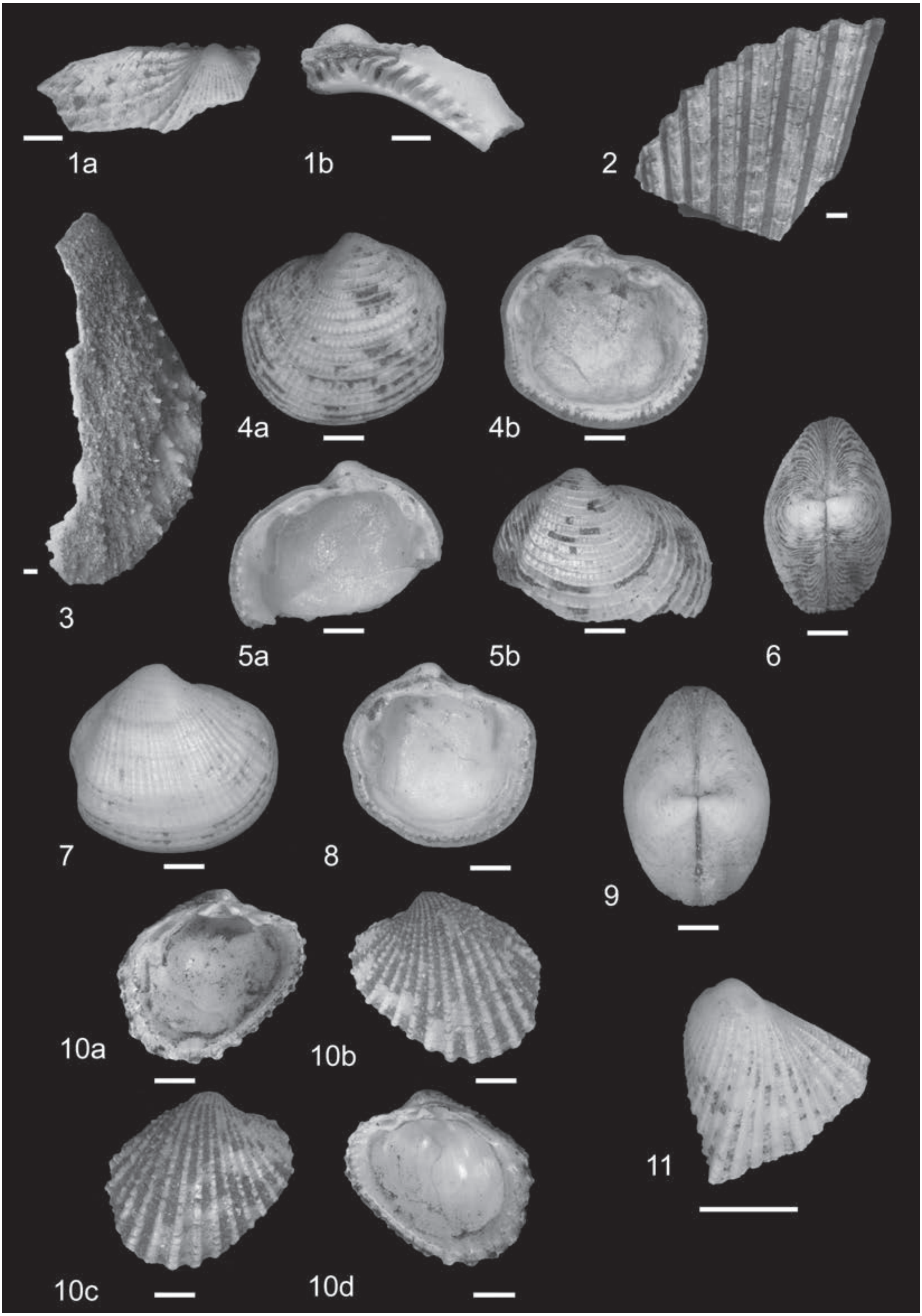
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Plate 19

***Nemocardium* sp.**
Fig. 1 external view RGM 785.050

?*Acrosterigma* sp.
Fig. 2 external view fragment RGM 785.053

Cardiidae indet. sp. 1
Fig. 3 external view RGM 785.054

Cardiidae indet. sp. 2
Fig. 4 internal view RGM 785.055
Fig. 4b external view

Cardiidae indet. sp. 3
Fig 5a external view fragment RGM 785.057

***Kelliella* sp.**
Fig. 6a external view RGM 785.058
Fig. 6b internal view

?*Arcopagia* sp.
Fig 7a internal view RGM 785.059
Fig. 7b external view

***Tellina* s.l. sp. 1**
Fig. 8a external view RGM 785.060
Fig. 8b hinge

***Tellina* s.l. sp. 2**
Fig. 9a external view
Fig. 9b hinge

Scale bars equal 1 mm.

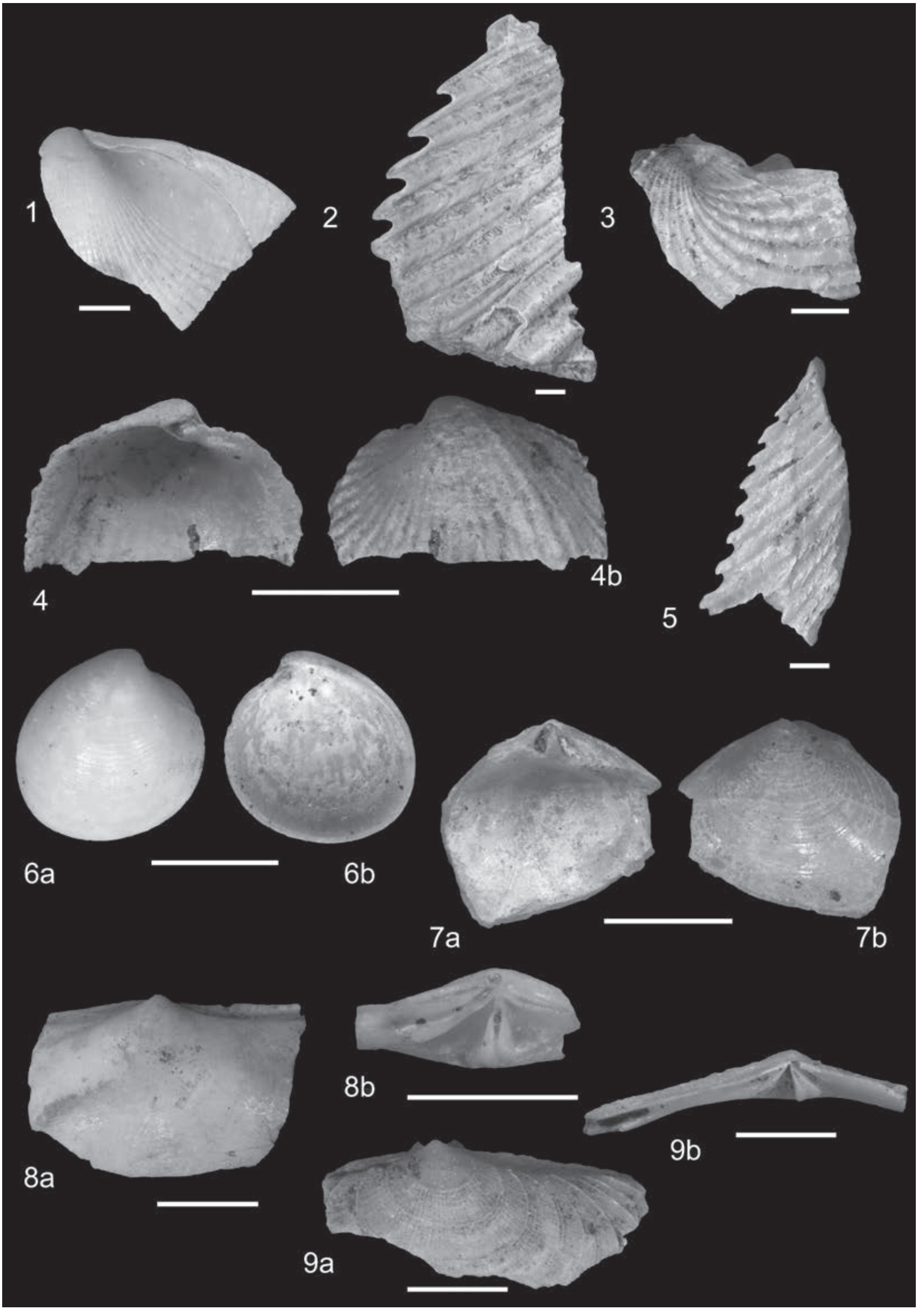
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Plate 20

***Circe junghuhni* Martin, 1917**
Fig. 1 external view RGM 785.065

***Circe* sp.**
Fig. 2a external view RGM 785.067
Fig. 2b internal view

Veneridae indet. sp. 1
Fig. 3 external view right valve RGM 785.070
Fig. 4a internal view left valve RGM 785.069
Fig. 4b external view

Veneridae indet. sp. 2
Fig. 5a internal view subadult RGM 785.072
Fig. 5b external view
Fig 6 external view RGM 785.073

Veneroidea indet. sp. 1
Fig. 7a external view RGM 785.075
Fig. 7b hinge

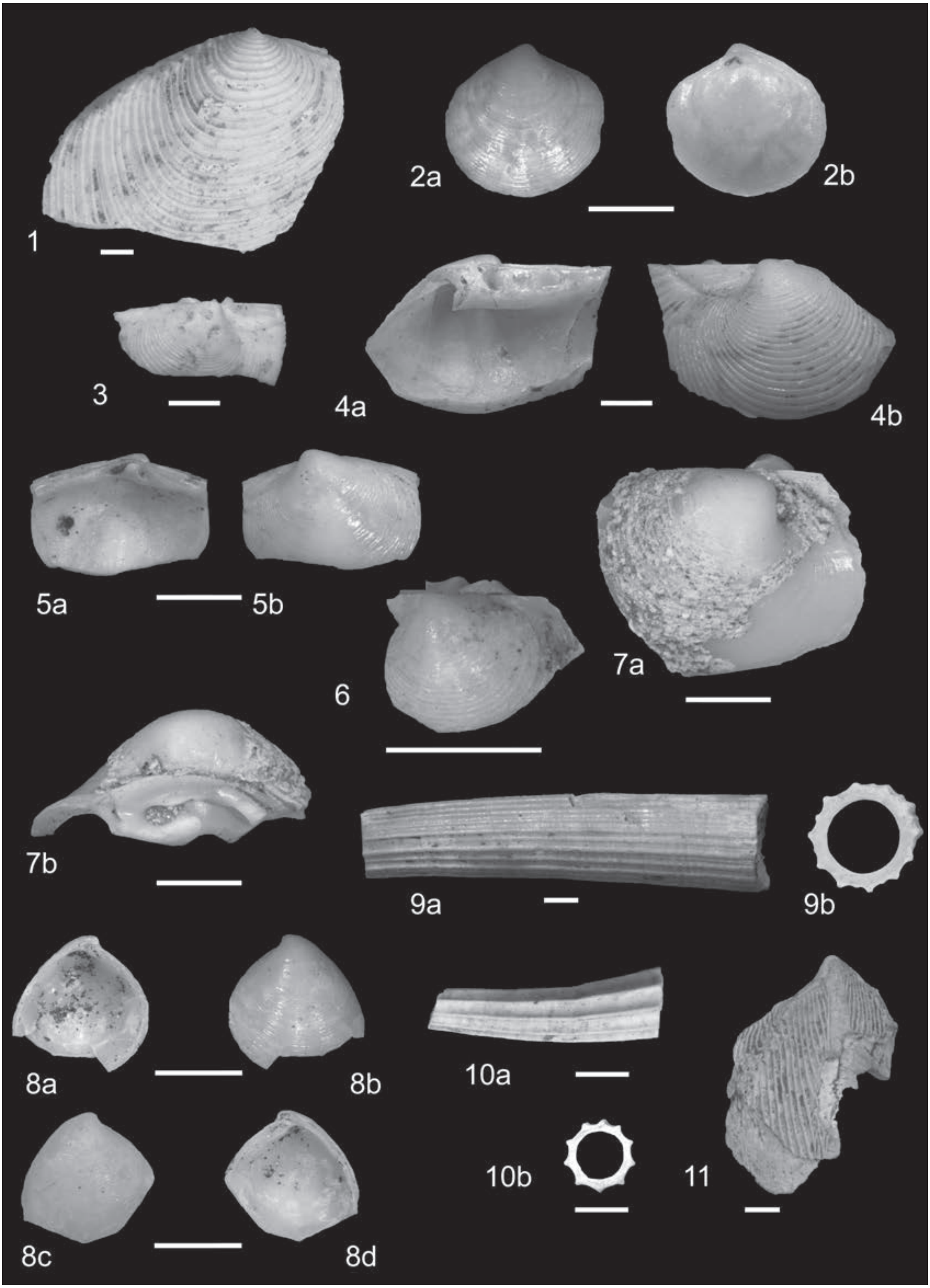
?Veneroidea indet. sp. 2
Fig. 8a internal view left valve RGM 785.076
Fig. 8b external view
Fig. 8c external view right valve
Fig. 8d internal view

***Dentalium* sp. 1**
Fig. 9a lateral view RGM 783.220
Fig. 9b cross section

***Dentalium* sp. 2**
Fig. 10a lateral view RGM 783.222
Fig. 10b cross section

***Schizochiton incisus* (Sowerby, 1841)**
Fig. 11 dorsal view RGM 783.224

Scale bars equal 1 mm.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