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Danae THIVAIOU,
Mathias HARZHAUSER &
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Danae THIVAIOU
National and Kapodistrian University of Athens, University Campus 157 84 Zografou (Greece)
dthivaiou@geol.uoa.gr (corresponding author)

Mathias HARZHAUSER
Natural History Museum Vienna, Burgring 7 1010 Vienna (Austria)
mathias.harzhauser@nhm-wien.ac.at

Efterpi KOSKERIDOU
National and Kapodistrian University of Athens, University Campus 157 84 Zografou (Greece)
ekosker@geol.uoa.gr

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ABSTRACT
The early Miocene mollusc faunas from the Proto-Mediterranean Sea are still poorly-known. Herein, Aquitanian gastropod assemblages from the Felli section in NW Greece are described. Two assemblages were recovered, a low-diversity coastal mudflat assemblage dominated by *Granulolabium plicatum* (Bruguière, 1792) and *Mesohalina margaritacea* (Brocchi, 1814), and a high-diversity marine assemblage dominated by *Bittium larrieyense* (Vignal, 1911). The marine assemblage yielded 44 species, of which three species are described as new and 23 are left in open nomenclature. A new combination is proposed for *Finella perpusilla* (Grateloup, 1827). The family Pyramidellidae is exceptionally represented by 15 species. 17 new occurences are reported for the Proto-Mediterranean Sea. *Alvania amphitrite* n. sp., *Homalopoma acaste* n. sp. and *Pyramistomia aliakmoni* n. sp. are introduced as new species.

KEY WORDS
Gastropoda,
Greece,
Miocene,
Neogene,
new combination,
new species.

RÉSUMÉ
Gastéropodes du Miocène inférieur de proto-Méditerrannée (NO de la Grèce).
Les mollusques du Miocène inférieur de Proto-Méditerannée sont peu connus. Une faune de gastéropodes de l'Aquitanien d'une section du NO de la Grèce y est décrite. Deux assemblages ont été déterminés, le premier présentant une faible diversité dans un environnement de vasière lagunaire et dominé par *Granulolabium plicatum* (Bruguière, 1792) et *Mesohalina margaritacea* (Brocchi, 1814), le second présentant une haute diversité d'environnement marin dominé par *Bittium larrieyense* (Vignal, 1911). L'assemblage marin est composé de 44 espèces, dont trois nouvelles et 23 laissées en nomenclature ouverte. Une nouvelle combinaison est proposée pour *Finella perpusilla* (Grateloup, 1827). La famille Pyramidellidae est exceptionnellement représentée par un total de 15 espèces. 17 nouvelles occurences sont signalées pour la Proto-Méditerrannée. *Alvania amphitrite* n. sp., *Homalopoma acaste* n. sp. et *Pyramistomia aliakmoni* n. sp. sont introduites comme nouvelles espèces.

MOTS CLÉS
Gastéropodes,
Miocène,
Grèce,
Néogène,
combinaison nouvelle,
espèces nouvelles.

INTRODUCTION

The early Miocene marine mollusc faunas of the Eastern Mediterranean are relatively poorly known compared to the coeval faunas of the north-eastern Atlantic (Cossmann & Peyrot 1909-1935; Lozouet *et al.* 2001; Lozouet 2014). This is partly due to the poor preservation of fossils in the Mediterranean region (Lozouet 2014) and the limited amount of available outcrops. The best documented early Miocene (Burdigalian) faunas from the proto-Mediterranean Sea were described in the late 19th century from the Turin Hills in northern Italy (Sacco 1888, 1892, 1895a, b, 1896, 1897; Zunino & Pavia 2009).

During the last decades, additional occurrences were reported from various basins in Turkey (İslamoğlu & Taner 2003; İslamoğlu 2004; Mandic *et al.* 2004; Büyükmeriç 2017) and some localities in north-western Greece, with brackish water and marine species, have been reported by Harzhauser *et al.* (2002), Harzhauser & Kowalke (2001) and Wielandt-Schuster *et al.* (2004).

The geographic position of the Greek part of the Proto-Mediterranean Sea offers the possibility to trace species known from the north-eastern Atlantic Ocean and the Paratethys, as well as to assess their diversity and palaeogeographic dispersal (Harzhauser *et al.* 2002). Indeed, gastropod diversity plummets at the Paleogene/Neogene boundary as shown by well preserved faunas of the Aquitaine Basin of France (Lozouet 2014). This transition has yet to be assessed for the Proto-Mediterranean Sea, where few fossiliferous localities of Aquitanian age are known. In order to determine the effect of these climatic changes on the molluscan fauna, we investigated the Proto-Mediterranean deposits of the Mesohellenic Basin in north-western Greece. The aim of the present study is to report and describe gastropods of this age from north-western Greece in order to contribute to the knowledge of the taxonomic composition and environmental conditions of the region.

GEOLOGICAL SETTING

This study deals with the Aquitanian gastropod fauna of the Pentalofos Formation of the Mesohellenic Basin (MHB, NW Greece). The MHB is a molasse basin active from the late Eocene to the middle Miocene (Ferrière *et al.* 2004; Zelilidis *et al.* 2002)narrow and elongated basin containing up to *c.* 5 km of Cenozoic sediments, which partially covers the tectonic boundary between the external, western zones (Pindos). It is composed of five main formations often rich in fossils (Wielandt-Schuster *et al.* 2004). The present material originates from the Pentalofos Formation, which consists of sandstone sediments of late Oligocene (Chattian) to the early Miocene (late Aquitanian-Burdigalian) age (Mavridis *et al.* 1985; Ferrière *et al.* 2004; Kilias *et al.* 2015; Wielandt-Schuster *et al.* 2004).

The section is mainly composed of sandy beds, fine conglomerates, and the top of the section is richer in finer particles (marls to clays). A change in sediment colour occurs between samples F9 and F10, going from darker to lighter colour and resulting in greenish clay for the topmost bed (sample F12).

The gastropods described here come from sandy marl (samples F1-F3 and F7-F8) to marly and clayey beds (samples F10-F12). Samples F4 to F6 contained scarce and fragmented shells whereas sample F9 was barren. No bivalves are preserved at the lower part of the section; samples F10-F12 contain fragmented bivalves of which few can be identified below family-level.

MATERIAL AND METHODS

Sampling was carried out at one small section, east of the village of Felli (Fig. 1), SE of Grevena City, by the river Aliakmon, where 12 bulk samples were taken (samples F1-F12). Two specimens of *Melongena lainei* were picked by hand at the lower part of the section. About 1 kg of the bulk samples were sieved using a 250 µm size mesh in order to retrieve small-sized molluscs.

Taxonomy follows Bouchet *et al.* (2017).

Hierarchical cluster analysis (Fig. 2) was performed using RStudio version 1.1.453 with the Vegan package version 2.4-4. For this analysis, all gastropods and bivalves from the sieved samples that were identifiable up to the family-level were used.

RESULTS AND DISCUSSION

The best preserved specimens are described, including a new species of the family Pyramidellidae, a new species of the genus *Alvania* Risso, 1826 and three are left in open nomenclature, probably representing new species. The most abundant species is *Bittium larrieyense* Vignal, 1911, whereas the most diverse family is Pyramidellidae, which is represented by 15 species. In total, 17 species are reported for the first time in this part of the Proto-Mediterranean.

Two assemblages are recovered: 1) characterising a coastal mudflat environment; and 2) characterising a shallow marine environment. The differences between the two assemblages are clearly illustrated in a hierarchical cluster analysis (Fig. 2). The coastal mudflat assemblage is clustered together (samples F2-F8), with richer samples F2 and F7 being more similar. The marine assemblage is composed of three samples with little variability. Sample F10 has a lower diversity, and samples F11 and F12 have more species in common.

Seven species from the brackish assemblage are in common with those reported by Harzhauser *et al.* (2002) in the Burdigalian of the Mesohellenic Basin, whereas most of the marine gastropods mentioned therein have not been found in the present assemblages (perhaps due to different preservation conditions in the particular study section or due to a different paleoenvironmental setting).

Coastal mudflat

For the coastal mudflat assemblage, *Granulolabium plicatum* is the most abundant species followed by *Mesohalina marga-*

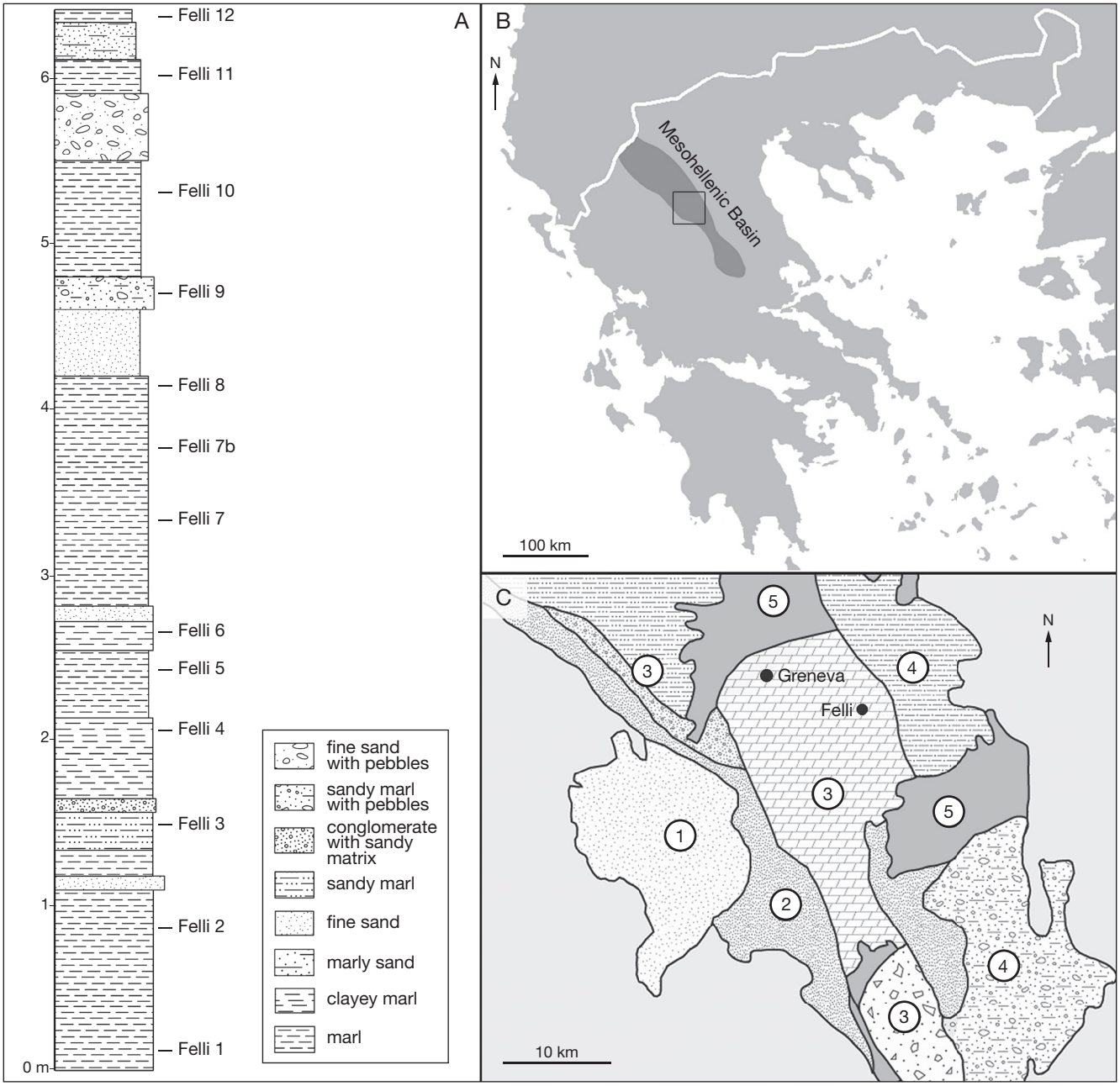

FIG. 1. — **A**, Lithostratigraphic column of the section of Felli; **B**, Geographical map of Greece and the Mesohellenic Basin; square indicates sampling area; **C**, Geological map of the studied area. Numbers: **1**, Krania formation (Eocene); **2**, Eptachori formation (lower-upper Oligocene); **3**, Pentalofos formation (upper Oligocene-lower Miocene); **4**, Tsotyli Formation (middle Miocene); **5**, Quaternary. (Modified after Zelilidis *et al.* 2002).

ritacea and *Vitta picta*. Recent species of Potamididae inhabit coastal environments usually associated with mangrove environments (Reid *et al.* 2008).

The extant species *Granulolabium diemenensis* is able to withstand higher salinities associated with tidal flats with permanent water flow (Lozouet *et al.* 2001). On the other hand, recent podamidids (*Tympanotonos*, *Telescopium* and *Terebralia*) inhabit similar microhabitats within mangroves (Reid *et al.* 2008). The family Neritidae, represented here by *Vitta picta*, has free-swimming larvae developing in marine environments, and adults that inhabit lower reaches of streams as well as estuaries (Strong *et al.* 2008). Another relatively abundant species in this assemblage is *Neritilia neritinoides* (Cossmann & Peyrot, 1918). This genus comprises recent species with very particular ecological needs, with adults living in freshwater environments with a proximity to the sea (Lozouet 2004), submarine caves, brackish estuaries and anchialine lakes (Kano *et al.* 2003), or freshwater streams (Kano & Kase 2004) and larvae developing in saline environments (Symonds & Tracey 2014).

In Felli, the specimens of *Neritilia neritinoides* (Cossmann & Peyrot, 1917) are all fragmented, therefore transportation

is inferred. This could also be the case for the freshwater gastropod *Melanopsis* sp., all specimens of which are always found, incomplete.

The gastropods of this assemblage point to a mudflat environment with patches of mangrove or at the fringe of the mangrove, with freshwater input.

Shallow Marine

The shallow marine assemblage is largely dominated by *Bittium larrieyense*, followed by *Finella perpusilla* and *Ringicula minor*.

Modern representatives of *Bittium* feed on microalgae commonly occurring on seegrasses (Houbrick 1993), whereas Recent species of *Ringicula* are carnivores and have been recorded to feed on different species of benthic foraminifera (Chaban *et al.* 2017). The type species *Finella pupoides* A. Adams, 1860 lives on muds and muddy sands and more rarely on seagrasses (Janssen *et al.* 2011). Turritellidae are suspension feeders partially borrowed in sand (Allmon 2011). Extant Mediterranean species of *Gibborissoia* have been recorded to live on hard substrates (Öztürk *et al.* 2014), whereas *G. varicosa* seems to have been associated with seagrass environments (Lozouet *et al.* 2001).

The Rissoidae, represented here by two species, is a family whose members are usually found in shallow water depths with the majority of the species living on algae and sheltered environments (e.g. beneath stones or coral slabs); only a few species are found on the continental slopes and abyssal depths (Ponder 1984). In the Mediterranean Sea they are also reported from sands, muds and coralligenous algae (Bitlis & Öztürk 2017). Species of the genus *Alvania* are known to be deposit feeders but also feed on benthic foraminifera (Ponder 1984).

The taxonomically most diverse family with moderate abundances is the parasitic family Pyramidellidae. Another moderately diverse group of gastropods of the assemblage is the Cephalaspidea represented by the families Retusidae, Rhizoridae and Cylichnidae. All three families are predators of diatoms and foraminifers, living in the top few centimetres of the sediment from mudflats to depths greater than 5500 m (Burn & Thompson 1998). The family Columbellidae, represented in this fauna by *Costoanachis* cf. *terebralis*, live in shallow water environments, preferentially in rock or coral crevices, under stones, at the base of algae beds or associated with plant rhizomes (Oliverio 1995).

The most abundant species in this assemblage indicate a vegetated sandy environment. Accompanying fauna consists of species that live on hard bottoms such as *Mathilda* sp., *Nodiscala* cf. *rugatina* or *Zebinella* sp. This suggests the presence of elements that provide shelter, including vegetation elements (including seagrass rhizomes), rocks and corals. Coral remains were found in sample F11, thus confirming the information provided by the gastropod fauna.

Lastly, the presence of *Smaragdia merignacensis* is indicative of seagrasses as its modern representatives (*Smaragdia viridis* for example) are restricted to such environments (Rueda & Salas 2007).

The species found in these Greek deposits are common in assemblages of the European Oligocene and Miocene, and the dominating species, *Granulolabium plicatum* and *Mesohalina margaritacea*, composing the mudflat assemblage are found from the NE Atlantic to the Paratethys and the Proto-Mediterranean (Lozouet *et al.* 2001; Harzhauser 2004; İslamoğlu 2004; Reid *et al.* 2008). In the fossil record, these species are believed to have inhabited shallow lagoons or saline inland lakes (Lozouet *et al.* 2001; Esu & Girotti 2010); furthermore, *M. margaritacea* can be considered as an indicator of mangroves (Esu & Girotti 2010) although usually it is known from brackish-lagoonal environments (Lozouet 2004). When associated with *Granulolabium plicatum* it implies a coastal mud flat (Harzhauser 2004).

Vitta picta has been reported in the Aquitanian of France as a species inhabiting the intertidal zone with low salinities or a freshwater influx (Cahuzac *et al.* 2012). In the brackish-lagoonal assemblages of the stratotype region of the Aquitanian, the most abundant species is *Vitta picta*, with *Granulolabium plicatum* and *Mesohalina margaritacea* being less abundant (Lozouet *et al.* 2001).

The association of *Granulolabium plicatum*, *Mesohalina margaritacea*, *Vitta picta* and *Melanopsis* sp. is known from multiple locations of the Western Tethys and the Paratethys as early as the Oligocene (Báldi 1973; İslamoğlu 2008). This association persists in the Western Tethys-Proto-Mediterranean until the Aquitanian for the same types of environments with fluviatile influence (İslamoğlu 2008). In Felli, this association also includes *Neritilia neritinoides*, which is a rarely reported species from the European Oligocene and Miocene, yet has been found with *Melanopsis* sp. in the Aquitaine Basin accompanied solely by freshwater species as *Gyraulus balizacencis* (Peyrot, 1931) and *Hydrobia* spp. (Lozouet 2004).

Comparable marine assemblages are found in the Aquitaine Basin, where the most abundant gastropod is *Gibborissoia varicosa* closely followed by *Bittium larrieyense*. The present assemblage has a similar composition and differs in abundances. *Finella perpusilla* is mostly known from the Paratethys where it can contribute up to 65% of shells in recovered tempestite beds (Zuschin *et al.* 2004). *Ringicula* species have been found in the Aquitaine Basin in muddy detrital assemblages (Lozouet 2004); in the Burdigalian Kerala Basin in India, *Ringicula* occur in seagrass samples (Harzhauser 2014). Associations of burrowing gastropods such as *Pyrunculus* sp. with *Retusa truncatula*, have been described in the Badenian of the Vienna Basin (Švagrovský 1984).

Concluding remarks

Herein, we present a new assemblage of mainly small-sized gastropod species from the Aquitanian of the Mesohellenic Basin in NW Greece. Only very limited information on the Aquitanian mollusc fauna of the Proto-Mediterranean Sea was available so far and the preservation of the shells is usually very poor. Thus, the new material provides a rare opportunity to describe the taxonomic composition if this early Miocene fauna and to evaluate its paleoecological requirements and its paleobiogeographic significance.

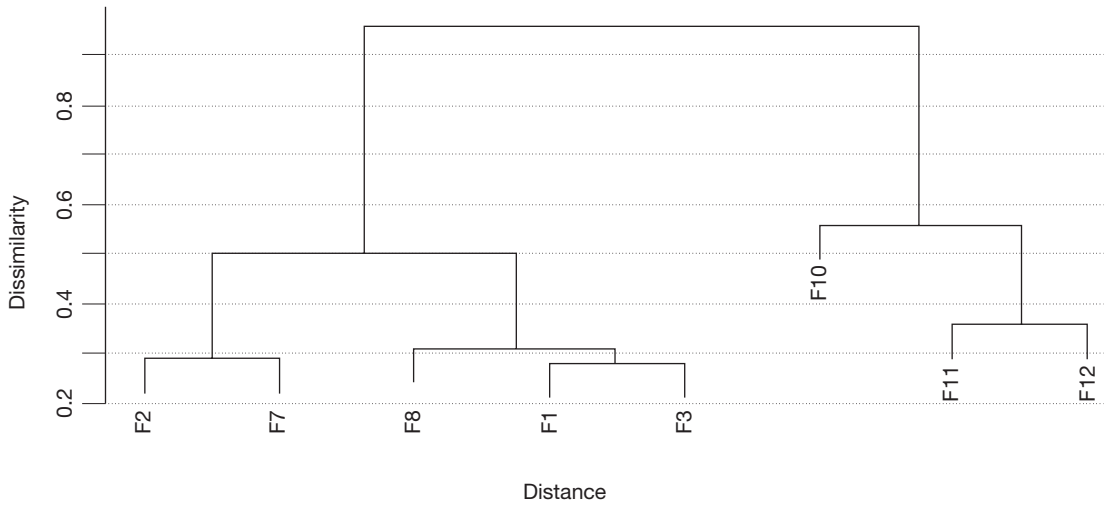

FIG. 2. — Hierarchal cluster analysis of the fossil-bearing samples of the section Felli. Distances were calculated using Bray-Curtis distances and single linkage.

SYSTEMATIC PALAEONTOLOGY

Subclass VETIGASTROPODA Salvini-Plawen, 1980
Order TROCHIDA Rafinesque, 1815
Superfamily TROCHOIDEA Rafinesque, 1815
Family TROCHIDAE Rafinesque, 1815

Genus *Paroxystele* Schultz, 1969

TYPE SPECIES. — *Trochus patulus* Brocchi, 1814, by original designation. Late Miocene-Pliocene, Mediterranean Sea.

Paroxystele orientale (Cossmann & Peyrot, 1917)
(Fig. 3A1-A4)

Oxystele orientalis Cossmann & Peyrot, 1917: 102.

Paroxystele orientale – Landau *et al.* 2013: 28, pl. 1, fig. 8 (cum syn.).

MATERIAL EXAMINED. — Sample F11: AMPG(IV) 1506-1508 (three specimens).

DIMENSIONS. — Maximum height: 3.2 mm (incomplete); maximum diameter: 4.2 mm.

DISTRIBUTION. — **Early Miocene**. Paratethys: Austria (Schaffer 1912); Proto-Mediterranean Sea: Greece (this paper).
Middle Miocene. Proto-Mediterranean Sea: Turkey (Landau *et al.* 2013); Paratethys: Austria (Hörnes 1855), Poland (Bałuk 1975), Hungary (Strausz 1966).

DESCRIPTION
Protonch of about 150-160 µm, corroded. First three teleoconch whorls high spired, later whorls much more flat-sided. Spiral sculpture of 10-11 spiral cords of alternating strength. Discrete axial sculpture present with inconspicuous growth lines giving a rough appearance in spaces between spiral cords; these growth lines become more prominent in later whorls, forming very fine lamellae. Umbilicus not preserved. Colour is preserved in all specimens, almost white apically, grading into darker orange-brown with some irregularly spaced white blotches in later whorls.

REMARKS
Although the specimens recovered are incomplete, the characters available are in agreement with the description of the species by Landau *et al.* (2013). Furthermore, a complete list of synonymy is provided by Landau *et al.* (2013), followed by a comparison with other Miocene species.

Species of Trochidae are commonly associated with hard substrata (Williams *et al.* 2010).

Family COLLONIIDAE Cossmann, 1917

Genus *Homalopoma* Carpenter, 1864

TYPE SPECIES. — *Turbo sanguineus* Linnaeus, 1758, by original designation. Recent, Mediterranean Sea.

Homalopoma acaste n. sp.
(Fig. 3B1-B3)

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TYPE MATERIAL. — Holotype: sample F11: AMPG(IV) 1512. — Paratype: sample F11: AMPG(IV) 1513.

OTHER MATERIAL EXAMINED. — Sample F10: AMPG(IV) 1509-1511 (three juveniles); sample F11: AMPG(IV) 1516, 1517 (two juveniles).

DIMENSIONS. — Maximum height: 4.80 mm; maximum diameter: 6 mm.

ETYMOLOGY. — Named after the Oceanid Acaste of Greek mythology, one of the companions of Persephone when abducted by Hades (as noun in apposition).

TYPE LOCALITY. — Felli village section, 40°01'4.55"N, 21°33'34.37"E. Mesohellenic Basin, Grevena area, Greece.

TYPE LEVEL. — Pentalofos Formation, Aquitanian, lower Miocene.

DIAGNOSIS. — A small *Homalopoma* species, with a granulated aspect of the spiral sculpture on top of whorls, prominent spiral sculpture and an umbilicus with strongly crenulated edge.

DISTRIBUTION. — **Early Miocene**. Proto-Mediterranean Sea: Greece (this paper).

DESCRIPTION

Shell small, solid, turbiniform. Teleoconch consisting of 3.5 slightly depressed convex whorls, suture impressed and linear. Spiral sculpture consists of four primary cords, adapical cord beaded to crenulated; four secondary spiral cords beneath the primary cords. Last whorl inflated, convex. Base with seven weakly granulose cords. Axial sculpture consists of very thin prosocline ribs. Aperture subcircular; umbilicus moderately wide, bordered by beaded edge.

REMARKS

In the present material the protoconch measures about 105 µm in all specimens. The colour patterns are still preserved as is often the case with other members of the genus in the Aquitaine Basin (Cossmann & Peyrot 1917). The granulose appearance of the primary cords is irregular with weak beads of different sizes cords on the base of the shell having a more granulose aspect, whereas the cords adjacent to the umbilicus have larger but weaker beads. Two morphotypes were found in similar sandy sediments; they have the same spiral sculpture (number of primary and secondary cords) with one morphotype having more prominent, finer spiral cords, and more prominent axial sculpture.

The present *Homalopoma* differs from *H. granulosa*, a species from the Oligocene and Miocene of France (Lozouet *et al.* 2001), in having a granulose aspect in its spiral sculpture, a wider umbilicus, as well as wider spirals. Another species from the early Miocene (Burdigalian) of the Aquitaine region of France is *H. degrangei* (Cossmann & Peyrot, 1917). It differs with the present species in having weak spiral sculpture and more convex whorls. *Homalopoma laleensis* Landau, Harzhauser, from the middle Miocene (Serravalian) of Turkey is smaller in size, has weak spiral sculpture and weaker umbilical crenulations.

Homalopoma includes hard-bottom dwellers and species that are adapted to cryptic environments (Lozouet 2004), including the type species *H. sanguineum*, which is frequent in Mediterranean submarine caves (Di Geronimo *et al.* 1997).

Subclass NERITIMORPHA Golikov & Starobogatov, 1975
Order CYCLONERITIDA Frýda, 1998
Superfamily HELICINOIDEA Férussac, 1822
Family NERITILIIDAE Schepman, 1908

Genus *Neritilia* Martens, 1879

TYPE SPECIES. — *Neritina rubida* Pease, 1865, by monotypy. Recent, Indo-Pacific.

Neritilia neritinoides (Cossmann & Peyrot, 1917) (Fig. 3D1-D4)

Tinostoma (*Megatyloma*) *neritinoides* Cossmann & Peyrot, 1917: 14, no. 126, pl. 7, figs 11-13.

Agapilia picta – Harzhauser & Kowalke 2001: 356, fig. 2/5-8 (*non* Férussac, 1823).

Neritilia neritinoides – Lozouet 2004: 450, fig. 3.

MATERIAL EXAMINED. — Sample F2: AMPG(IV) 1517-1533 (16 specimens); sample F3: AMPG(IV) 1534-1540 (seven specimens); sample F7: AMPG(IV) 1541-1542 (two specimens).

DIMENSIONS. — Maximum height: 1.21 mm (incomplete), maximum diameter: 1.23 mm.

DISTRIBUTION. — Oligocene. NE Atlantic: France (Lozouet 2004). **Early Miocene**. NE Atlantic: France (Cossmann & Peyrot 1917); Proto-Mediterranean Sea: Greece (this paper).

REMARKS

A complete description was provided by Lozouet (2004) in his review of the European Tertiary Neritiliidae, with remarks on this poorly known family of small gastropods. The most characteristic feature of the family is the structure of the protoconch, with a characteristic embryonic shell that has a different orientation to that of the rest of the protoconch; furthermore, it bears a semi-circular to circular scar and spiral ridges (Kano *et al.* 2003; Lozouet 2004). In *N. neritinoides* the protoconch has regularly-spaced minute pits, observable in the Greek specimens despite their poorer preservation compared to the well-preserved French specimens. Almost all of the specimens have a hyaline shell and a broken outer lip; the protoconch measures about 270 µm; the largest specimen measures approximately 1.20 mm in height.

N. neritinoides seems to be the most common species of the family during the early Miocene, being found in France as well as Greece. In recent species, the planktotrophic larval phase occurs in saline environments before returning to estuaries for settling and migrating upstream as juveniles after metamorphosis (Kano *et al.* 2003). This supports the dispersal of species through the saline-water barrier, thus explaining the dispersal of a single Miocene species throughout Europe.

Superfamily NERITOIDEA Rafinesque, 1815
Family NERITIDAE Rafinesque, 1815

Genus *Vitta* Mörch, 1852

TYPE SPECIES. — *Nerita virginea* Linnaeus, 1758; subsequent designation by Baker (1923). Recent, Western Atlantic.

Vitta picta (Férussac, 1823) (Fig. 3C1-C4)

Neritina picta Férussac *in* Férussac & Deshayes, 1823: pl. 2, figs 4-7.

Agapilia picta – Landau *et al.* 2013: 36, pl. 2, figs 11-14; pl. 54, fig. 7 (cum syn.).

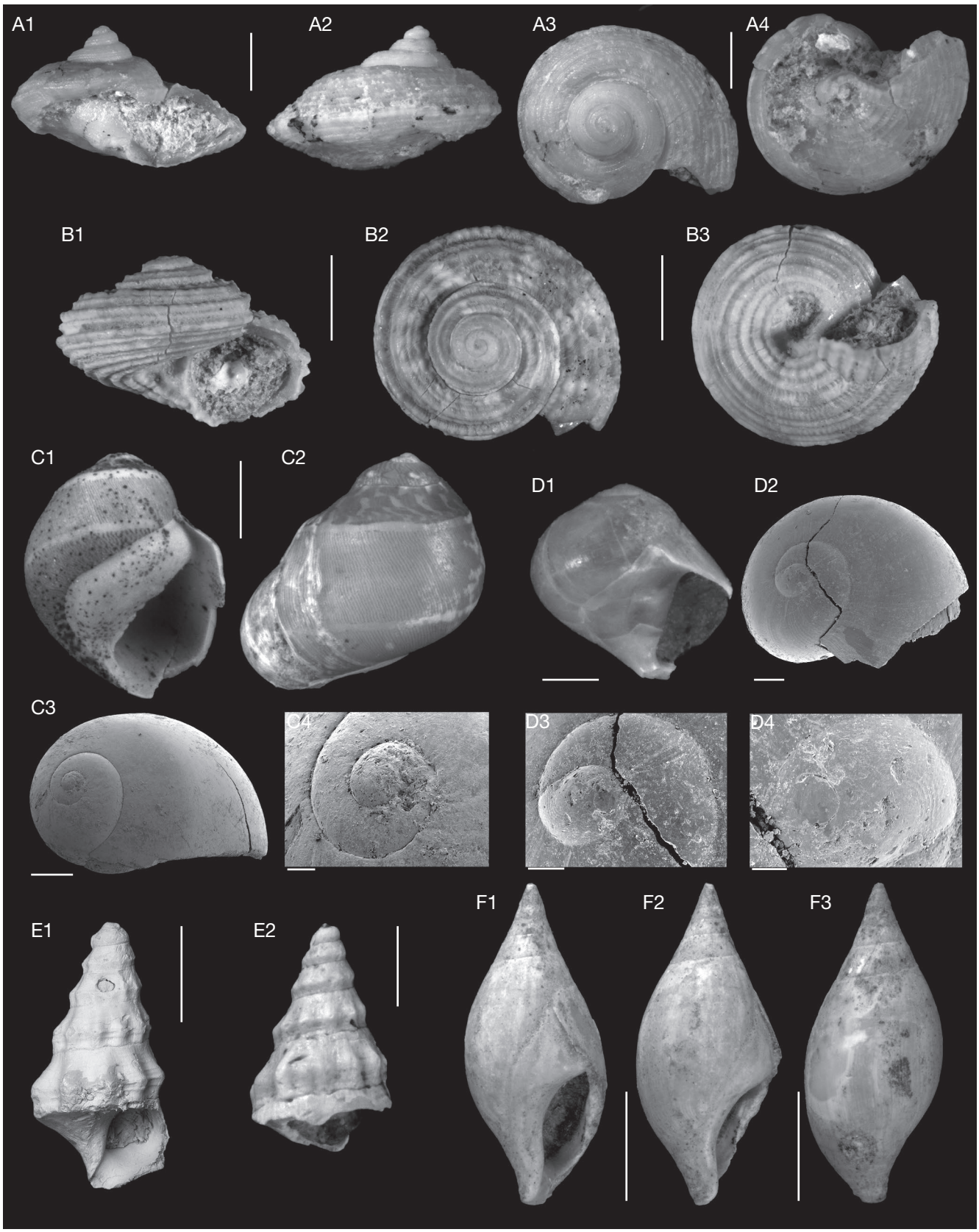

FIG. 3. — **A1**-**A4**, *Paroxystele orientale* (Cossmann & Peyrot, 1917), AMPG(IV) 1506; **B1**-**B3**, *Homalopoma acaste* n. sp., holotype, AMPG(IV) 1512; **C1**, **C2**, *Vitta picta* (Férussac, 1823), AMPG(IV) 1517; **C3**, AMPG(IV) 1543 (SEM image); **C4**, AMPG(IV) 1544 protoconch (SEM image); **D1**-**D4**, *Neritilia neritinoides* (Cossmann & Peyrot, 1917); **D1**, AMPG(IV) 1517; **D2**, AMPG(IV) 1541 (SEM image); **D3**, **D4**, AMPG(IV) 1541 protoconch close-ups; **E1**, **E2**, *Plesiotrochus fallax* (juv.) (Grateloup, 1832), AMPG(IV) 1605; **F1**-**F3**, *Melanopsis* sp., AMPG(IV) 2276. Scale bars: A, C1, C2, E2, 1 mm; B, 2 mm; C3, D3, 100 µm; C4, D1, E1, F, 500 µm; D2, 200 µm; D4, 50 µm.

MATERIAL EXAMINED. — Sample F1: AMPG(IV) 1543-1547 (five specimens); sample F2: 1548-1573 (26 specimens); sample F3: AMPG(IV) 1574, 1575 (two specimens); sample F7: AMPG(IV) 1576-1593 (18 specimens); sample F8: AMPG(IV) 1594-1595 (two specimens).

DIMENSIONS. — Maximal height 6 mm. Operculum: maximum height 1.67 mm.

DISTRIBUTION. — **Oligocene**. NE Atlantic: France (Cossmann & Peyrot 1917; Lozouet *et al.* 2001); Western Tethys-Eastern Proto-Mediterranean Sea: Greece, Iran (Harzhauser 2004), Italy (Esu & Girotti 2010); Paratethys: Austria, Slovakia, Hungary, Germany (Landau *et al.* 2013).
Early Miocene. NE Atlantic: France (Cossmann & Peyrot 1917; Lozouet *et al.* 2001); Proto-Mediterranean Sea: Italy; Greece (Harzhauser & Kowalke 2001).
Middle Miocene. NE Atlantic: France (Cossmann & Peyrot 1917; Lozouet *et al.* 2001); Proto-Mediterranean Sea: Greece (Harzhauser & Kowalke 2001), Turkey (İslamoğlu 2008); Paratethys: Austria (Schaffer 1912; Harzhauser & Mandic 2001).
Middle Miocene. NE Atlantic: France (Cossmann & Peyrot 1917); Proto-Mediterranean Sea: Turkey (Landau *et al.* 2013); Paratethys: Austria (Hörnes 1856), Ukraine (Bałuk 1975), Hungary (Strausz 1966), Slovakia, Bulgaria, Bosnia (Landau *et al.* 2013).

REMARKS
A long list of synonymy is provided in Landau *et al.* (2013); it includes a list of subspecies and forms that have been published due to the wide morphological range, the resemblance to other Neritidae and the variation of the colour patterns. These colour patterns are usually well preserved even in fragmented specimens and vary from thin zigzag patterns on the entire shell to rather uniformly coloured shells with white flammulae. Two light spiral bands may occur, separating the axial patterns.

Opercula were recovered only when still attached to the shell, therefore only the external side is observable.

The morphology of the shell is somewhat variable and larger specimens may be shouldered. Apertural dentition does not alter with ontogeny; the colour pattern is also present since early ontogenetic stages.

Vitta picta is an indicator of brackish or marine littoral environments (Esu & Girotti 2010), in the Oligocene it is abundant in the '*Polymesoda-Tympanotonos*' and '*Tympanotonos-Pirenella*' assemblages as defined by Báldi (1973) (İslamoğlu 2008).

Genus *Smaragdia* Issel, 1869

TYPE SPECIES. — *Nerita viridis* Linnaeus, 1758; subsequent designation by Kobelt (1879). Recent, Mediterranean, Caribbean.

Smaragdia merignacensis (Cossmann & Peyrot, 1917)

Neritina (*Smaragdia*) *merignacensis* Cossmann & Peyrot, 1917: 58, pl. 8, figs 21-24.

MATERIAL EXAMINED. — Sample F10: AMPG(IV) 1596-1599 (four specimens [one juvenile]); sample F11: AMPG(IV) 1600, 1601 (two specimens).

DIMENSIONS. — Maximum diameter: 3 mm (incomplete); maximum height: 2.85 mm (incomplete).

DISTRIBUTION. — **Early Miocene**. Aquitanian. NE Atlantic: France (Cossmann & Peyrot 1917; Lozouet & Londeix 2014a [supplementary material CD-Rom]); Proto-Mediterranean Sea: Greece (this paper); Burdigalian. NE Atlantic: France (Cossmann & Peyrot 1917).

DESCRIPTION
Shell small, convex, with weakly incised suture; aperture wide; columellar area smooth in juveniles and with small denticles in adult shells. Sculpture consists only of inconspicuous growth lines. Colour pattern consists of wavy opisthocline lines interrupted by two white spiral bands.

REMARKS
The specimens from Felli seem to be conspecific with *S. merignacensis* with which it agrees in colour pattern and morphology. The colour pattern is somewhat variable ranging from thinner to broader axial lines of the same shape. Juveniles have a relatively simpler pattern with lines that appear at the adapical suture that are always thinner than in adult ones. This species was reported by Cossmann & Peyrot (1917) from the Aquitanian and Burdigalian of the Aquitaine Basin (France), and although it is not reported from other European locations, the description and illustration fit with the specimens described herein. The largest specimens of the present material are incomplete, but largest fragments suggest a similar size to the French specimens (about 6 mm maximum height).

Smaragdia species are extremely scarce in Miocene fossiliferous localities throughout Europe. *Smaragdia expansa* (Reuss *in* Hörnes, 1856), from the middle Miocene of the Paratethys and north-eastern Atlantic, differs in having a much larger aperture, finer denticles on the columellar area and a more shouldered last whorl.

Recent *Smaragdia* species have been reported to feed selectively on seagrass tissue (Rueda & Salas 2007) and they are always associated with seagrasses (Zuschin *et al.* 2009; Reich *et al.* 2014). Therefore, the presence of *Smaragdia* in Felli suggests the presence of seagrass environments.

Subclass CAENOGASTROPODA Cox, 1960
Superfamily CAMPANILOIDEA Douvillé, 1904
Family PLESIOTROCHIDAE Houbrick, 1990

Genus *Plesiotrochus* Fischer, 1878

TYPE SPECIES. — *Plesiotrochus souverbianus* Fischer, 1878, by monotypy. Recent, Indo-West Pacific.

Plesiotrochus fallax (Grateloup, 1832) (Fig. 3E1, E2)

Cerithium fallax Grateloup, 1832: nos 263, 265. — d'Orbigny 1852: nos 1478, 1480.

Hemicerithium fallax – Cossmann & Peyrot 1922: no. 579, figs 78-83, 89.

Plesiotrochus fallax – Lozouet *et al.* 2001: 21, pl. 10, figs 1-3.

MATERIAL EXAMINED. — Sample F10: AMPG(IV) 1602-1604 (three specimens); sample F11: AMPG(IV) 1605, 1606 (two specimens).

DIMENSIONS. — Maximum height: 2.15 mm (incomplete).

DISTRIBUTION. — **Early Miocene**. NE Atlantic: France (Aquitaine Basin) (Grateloup 1832; Cossmann & Peyrot 1922; Lozouet *et al.* 2001); Proto-Mediterranean Sea: Greece (this paper).

REMARKS

Until now, *Plesiotrochus fallax* had only been recordedin the Aquitanian of the Aquitaine Basin in France, where is somewhat variable (as shown by Lozouet *et al.* (2001)). The present specimens are mostly similar to figures 3a and 3b of Lozouet *et al.* (2001), since the spiral sculpture is inconspicuous, the shell is almost smooth, and the axial varices are relatively rounded. The aperture is broken in all available specimens.

The family Plesiotrochidae was transferred to the superfamily Campaniloidea by Healy (1993) based on recent species.

Modern representatives of the family feed on algae and live in coarse sediments, on reef slopes, sometimes between coral patches and sand with seagrasses (Janssen *et al.* 2011)

Superfamily CERTITHIOIDEA J. Fleming, 1822
Family CERITHIIDAE Fleming, 1822

Genus *Bittium* Gray, 1847

TYPE SPECIES. — *Strombiformis reticulatum* da Costa, 1778 (= *Bittium reticulatum* (da Costa, 1778)), subsequent designation by Gray (1847). Recent, Europe.

Bittium larrieyense Vignal, 1911
(Fig. 4A1-A3)

Bittium vignali var. *larrieyensis* Vignal, 1911: 160, pl. 8, fig. 19.

Bittium vignali – Vignal 1911: 158, pl. 8, fig. 18. — Cossmann & Peyrot 1922: 284, no. 615, pl. 7, figs 31, 32, 47-50.

Bittium reticulatum – Vignal 1911: 157.

Bittium asperulatum – Cossmann & Peyrot 1922: 288, no. 618, pl. 7, figs 66-69.

Bittium larrieyense – Lozouet *et al.* 2001: 24, pl. 6, figs 6a-c.

MATERIAL EXAMINED. — Sample F10: AMPG(IV) 1607-1645 (39 specimens); sample F11: AMPG(IV) 1646-1890 (245 specimens); sample F12: AMPG(IV) 1891-2071 (181 specimens).

DIMENSIONS. — Maximum height: 3.80 mm.

DISTRIBUTION. — **Early Miocene**. Aquitanian. NE Atlantic in France (Cossmann & Peyrot 1922; Lozouet *et al.* 2001) and Greece (this paper). — ?Burdigalian. NE Atlantic in France (Cossmann & Peyrot 1922).

DESCRIPTION

Turreted shell, minute, with six slightly convex teleoconch whorls. Protoconch of 225-250 µm in diameter, consisting of 2.5 whorls; first whorl low conical, convex; second whorl with mid-whorl angulation coinciding with weak spiral cord. Two faint spiral threads appear close above the abapical suture. Transition into teleoconch marked by deep sinusigera above angulation. Early teleoconch starts with two prominent spiral cords, a third cord appears on the second teleoconch whorl and a fourth on the fifth; regularly spaced axial ribs form pointed nodes at intersections with spiral cords. Broad varix formed on last (preserved) whorl. Microsculpture consisting of spirally arranged small granules, present on entire teleoconch. Sutures linear, impressed. Sculpture very constant, with a fourth spiral cord always forming between the first (adapical) and the second cords on the fifth whorl. A sixth spiral cord forms on the sixth whorl above the abapical suture; for the largest specimens more cords form with new ones added always above the abapical suture. Base with two additional spiral cords; aperture drop-shaped, siphonal canal short.

REMARKS

The specimens available are fragmentary; the largest fragment consists of eight teleoconch whorls. The shape can vary in width and whorl height; when present, tubercules are not numerous and not very prominent. Whorls are more convex for wider specimens, with an illusion of deeper sutures due to relatively more prominent sculpture.

This species is the most abundant in all the marine beds of Felli. Previously, it was only known from the Early Miocene of France. Morphologically, the Greek specimens are almost identical to the French type and specimens of collection, thus showing stability in the morphological characters and their variation.

The high variability of this species led to the description of several species and variations by Vignal (1911) and Cossmann & Peyrot (1922), such as *B. vignali* Dollfus, 1909, *Bittium subclathratum* (d'Orbigny, 1852) and *Bittium asperulum* Cossmann & Peyrot, 1922. As discussed by Lozouet *et al.* (2001) these taxa seem to represent only morphotypes of *B. larrieyense.*

Family BATILLARIIDAE Thiele, 1929

Genus *Granulolabium* Cossmann, 1889

TYPE SPECIES. — *Cerithium plicatum* Bruguière, 1792; by original designation. Early Miocene, France.

Granulolabium plicatum (Bruguière, 1792)
(Fig. 4B1-B3)

Cerithium plicatum Bruguière, 1792: 488. — Hörnes 1856: 400, pl. 42, fig. 6.

Granulolabium plicatum – Sacco 1895a, div. var.: 58, pl. 3, fig. 45. — Lozouet 1986: 171, fig. 2 a-d; 2001: 28, pl. 8., figs 1a-b, 2a-c, 3a c. — Harzhauser & Kowalke 2001: 27, pl. 8, figs 1-3. — Harzhauser 2002: 73, pl. 1, fig. 17-20; 2004: 120, pl. 5, figs 1-4. — İslamoğlu 2008: 266, fig. 6-P. — Esu & Girotti 2010: 159, pl. 5, figs 10-13. — Moths *et al.* 2010: 32, pl.10, fig. 6, pl. 34, fig. 8. — Lozouet & Maestrati 2012: 278, figs 180/4-6. — Cluzaud *et al.* 2014: 226, fig. 171I. — Kovács & Vicián 2016: 247, pl. 1, fig. 5.

Cerithium (*Granulolabium*) *plicatum* – Schaffer 1912, div. var.: 151, pl. 51, fig. 36-40.

Pirenella plicata – Cossmann & Peyrot 1921: 267, pl. 5, fig. 99-101, pl. 6, fig. 42-44. — Báldi 1973: 259, pl. 29, fig. 3.

Material examined. — Sample F1: AMPG(IV) 2072-2088 (17 specimens); sample F2: 2089-2138 (50 specimens); sample F3: AMPG(IV) 2139-2166 (28 specimens); sample F7: AMPG(IV) 2167-2226 (60 specimens); sampleF8: AMPG(IV) 2227-2236 (ten specimens); sample F10: AMPG(IV) 2237-2238 (two specimens).

Dimensions. — Maximum height: 35.0 mm.

Distribution. — **Oligocene**. NE Atlantic, Paratethys, North Sea Basin (Harzhauser 2004); Western Tethys-Proto-Mediterranean Sea: Greece, Turkey (Harzhauser 2004; İslamoğlu 2008).
Early Miocene. NE Atlantic (Lozouet *et al.* 2001); Proto-Mediterranean Sea: Greece, Turkey (Harzhauser 2004); Paratethys (Schaffer 1912; Mandic *et al.* 2004); North Sea Basin (Harzhauser 2002; Harzhauser 2004; Büyükmeriç 2017).

Remarks
Granulolabium plicatum has been discussed in depth and compared to similar species by Lozouet (1986) in an effort to clarify the differences between various potamidid and batillariid species. In Lozouet *et al.* (2001), an extensive list of the French literature is presented with the many different names attributed to *G. plicatum*, thus noting the confusion of the authors due to the morphological variability of the species.

The specimens from Felli show some residual colouration patterns that consists of darker and lighter spiral lines that coincide with the ornamentation (the spiral threads are darker and give a brighter colour under UV light).

Granulolabium species are able to withstand variations in salinity and they are known to characterize lagoonal or littoral environments (Latal *et al.* 2006; Esu & Girotti 2010). In the Paratethys (Korneuburg Basin, Austria) the *Granulolabium-Agapilia* biofacies represents slightly energetic conditions of an outer tidal flat (Zuschin *et al.* 2014).

Family Litiopidae Gray, 1847

Genus *Gibborissoia* Sacco, 1895

Type species. — *Bulimus costellatus* Grateloup, 1828 (younger subjective synonym of *Gibborissoia prevostina* (Basterot, 1825)), by original designation. Early Miocene, France.

Gibborissoia varicosa (Basterot, 1825)
(Fig. 4C1-C3)

Rissoa varicosa de Basterot, 1825: 37, pl. 1, fig. 2.

Gibborissoia varicosa – Landau *et al.* 2013: 49, pl. 4, fig. 9 (cum syn.).

Gibborissoia varicosa – Harzhauser *et al.* 2018: 155, fig. 10/N.

Material examined. — Sample F11: AMPG(IV) 2239-2250 (12 specimens); sample F12: AMPG(IV) 2251-2268 (18 specimens).

Dimensions. — Maximum height: 1.40 mm.

Distribution. — **Early Miocene**. NE Atlantic: France (Cossmann & Peyrot 1917; Cossmann 1921; Lozouet *et al.* 2001); Proto-Mediterranean Sea: Italy (Sacco 1895b) (Burdigalian).
Middle Miocene. Proto-Mediterranean Sea: Turkey (Landau *et al.* 2013); Paratethys: Austria (Hörnes 1856), Bulgaria (Zilch 1934), Hungary (Strausz 1966), Poland (Bałuk 1975).

Remarks
Gibborissoia varicosa displays a large morphological variability, which has led to the description of several varieties. It can range from smooth to varicated and from moderately to strongly elongate with a large last whorl. In the Greek material, the shells are all smooth and elongated, often with a larger last whorl. They are more similar in shape to Serravallian representatives of the species from Turkey (Landau *et al.* 2013) than with the specimens from the Aquitanian stratotype as illustrated in Lozouet *et al.* (2001). The Paratethyan subspecies *Alaba costellata anomala* (Eichwald, 1850), as illustrated in Bałuk (1975), is based on minor morphological features that do not suffice for such a separation, therefore was placed in synonymy with *G. varicosa* by Landau *et al.* (2013).

Family Melanopsidae H. Adams & A. Adams, 1854

Genus *Melanopsis* Férussac, 1807

Type species. — *Melania costata* Olivier, 1804, subsequent designation by Gray (1847). Recent, Europe.

Melanopsis sp.
(Fig. 3F1-F3)

Material examined. — Sample F2: AMPG(IV) 2269-2275 (seven specimens); sample F7: AMPG(IV) 2276-2279 (four specimens); sample F10: AMPG(IV) 2280 (one specimen).

Dimensions. — Maximum height: 18.0 mm (incomplete).

Distribution. — **Early Miocene**. Proto-Mediterranean Sea: Greece (this paper).

Description
Elongated fusiform shell with acute apical angle and completely flat whorls. Indistinct sutures; shoulder may be present in some specimens. Aperture ovate elongated with slightly elongated siphonal canal; outer lip not preserved; distinct callus. Very weak sculpture consisting of thin sigmoidal growth lines. Residual colour pattern poorly preserved consisting of thin sigmoidal axial lines of approximately equal width.

Remarks
A single species of *Melanopsis* was found in Felli, including a broken juvenile specimen. The specimens seem to represent an undescribed species, but the available material is not sufficient to formally describe it. All specimens are broken and the apical part is always missing. This species might already have been discussed from other Oligocene and lower Miocene sections in the Mesohellenic Basin as

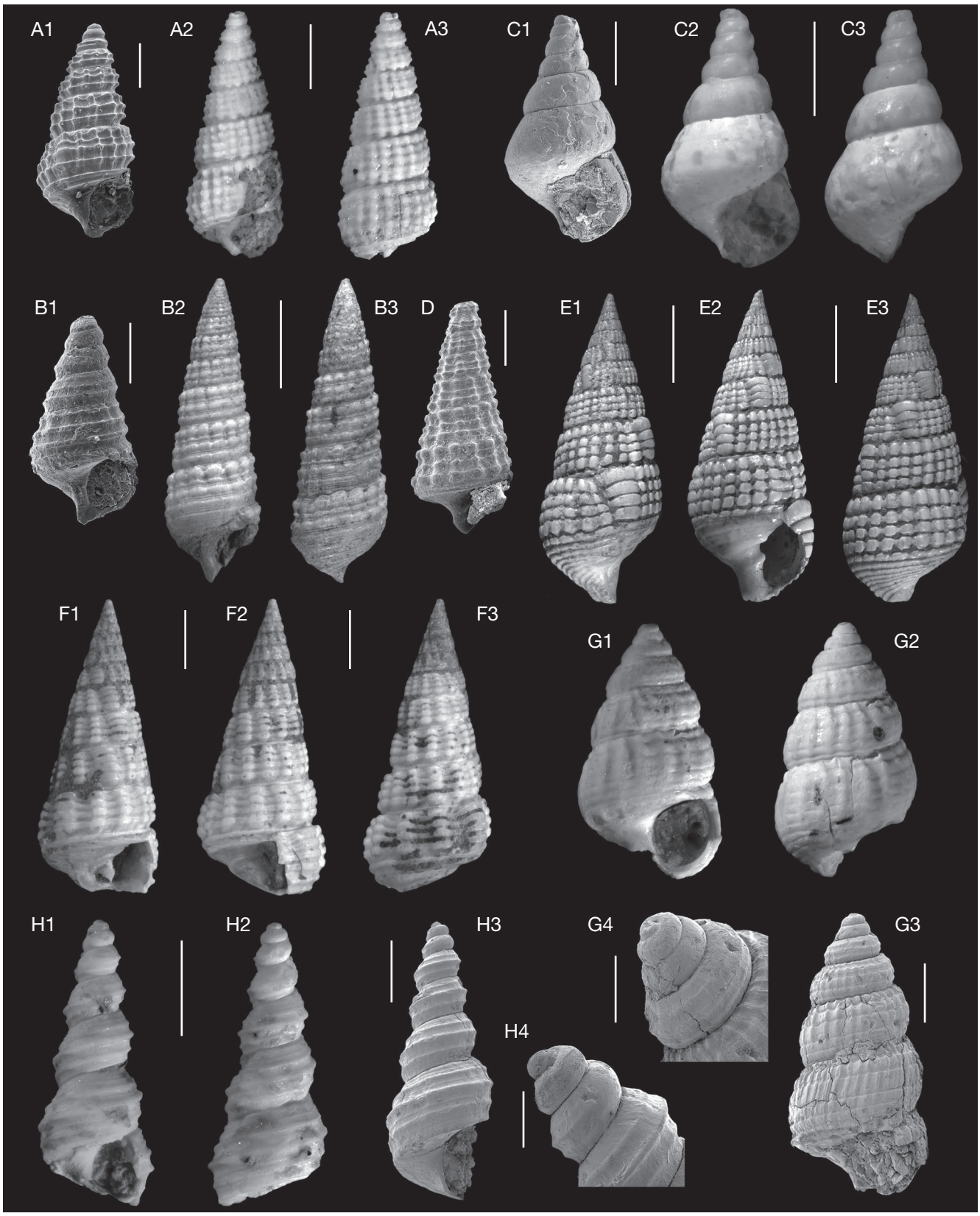

Fig. 4. — **A1**-**A3**, *Bittium larrieyense* Vignal, 1911: **A1**, AMPG(IV) 1891 (SEM image); **A2**, **A3**, AMPG(IV) 1646; **B1**-**B3**, *Granulolabium plicatum* (Bruguière, 1792): **B1**, AMPG(IV) 2089 (SEM image); **B2**, **B3**, AMPG(IV) 2167; **C1**-**C3**, *Gibborissoia varicosa* (de Basterot, 1825): **C1**, AMPG(IV) 2239 (SEM image); **C2**, **C3**, AMPG(IV) 2240; **D**, *Mesohalina margaritacea* (Brocchi, 1814), AMPG(IV) 2294 (SEM image); **E1**-**E3**, *Terebralia lignitarum* (Eichwald, 1830), AMPG(IV) 2304; **F1**-**F3**, *Terebralia subcorrugata* d'Orbigny, 1852, AMPG(IV) 2306; **G1**-**G4**, *Finella perpusilla* (Grateloup, 1827): **G1**, **G2**, AMPG(IV) 2308; **G3**, AMPG(IV) 2309 (SEM image); **G4**, AMPG(IV) 2309, protoconch (SEM image); **H1**-**H4**, *Turritella turris* de Basterot, 1825: **H1**, **H2**, AMPG(IV) 2404; **H3**, AMPG(IV) 2405 (SEM image); **H4**, AMPG(IV) 2405, protoconch (SEM image). Scale bars: A1, C2, C3, G1, G2, H1-H3, 500 µm; A2, A3, D, 1 mm; B1, G3, C1, 400 µm; B2, B3, 5 mm; E1-E3, 10 mm; F1-F3, 2 mm; G4, H4, 200 µm.

Melanopsis impressa Kraus, 1852 by Harzhauser (2004) and Harzhauser & Kowalke (2001). Due to the poor preservation of these specimens a comparison with the specimens from Felli remains difficult. In any case, it is unlikely that the Greek records represent *Melanopsis impressa*, which is a species from the early Miocene of southern Germany (see also discussion in Harzhauser *et al.* 2016) on *Melanopsis hantkeni* Hofmann, 1870). A separation of the species from Felli from *Melanopsis hantkeni* as described by Harzhauser *et al.* (2016) from the Rupelian of the Thrace Basin is based on its colour pattern of blotches forming a vague zig-zag pattern.

Oligocene and early Miocene *Melanopsis* species are frequently found in brackish deposits but are assumed to have favoured freshwater envieronments (Neubauer *et al.* 2016). In the Serravallian of Turkey, it is still found in brackish deposits (Landau *et al.* 2013). In the Pliocene and the Lower Pleistocene of Greece, it is found in brackish deposits with freshwater input (Georgiades-Dikaioulia *et al.* 2002; Moissette *et al.* 2016). Here, the presence of *Melanopsis* is considered to be an indicator of freshwater influx, which is in agreement with the preservation of the specimens.

Family Potamididae H. Adams & A. Adams, 1854

Genus *Mesohalina* Wittibschlager, 1983

Type species. — *Murex margaritaceus* Brocchi, 1814; by original designation. Late Rupelian, Germany.

Mesohalina margaritacea (Brocchi, 1814)
(Fig. 4D)

Murex margaritaceus Brocchi, 1814: 447, pl. 9, fig. 24.

Cerithium (*Tympanotomus*) *margaritaceum* – Schaffer 1912: 154, pl. 52, figs 1, 2.

Tympanotonos margaritaceus – Cossmann & Peyrot 1921: 248, pl. 6, fig. 64. — Báldi 1973: 260, pl. 29, figs 1, 2.

Potamides margaritaceus – Cluzaud *et al.* 2014: 226, fig. 171I.

Mesohalina margaritacea – Harzhauser *et al.* 2016: 28, figs 11-13 (cum syn.).

Material examined. — Sample F1: AMPG(IV) 2281-2283 (three specimens); sample F2: AMPG(IV) 2284-2293 (ten specimens); sample F7: AMPG(IV) 2294-2303 (ten specimens).

Dimensions. — Maximum height: 28.0 mm (incomplete).

Distribution. — **Oligocene**. NE Atlantic: France (Lozouet *et al.* 2001); Proto-Mediterranean Sea: Italy (Esu & Girotti 2010), Greece (Harzhauser 2004), Turkey (İslamoğlu 2008); Paratethys (Reid *et al.* 2008; Harzhauser *et al.* 2016).
Early Miocene. Aquitanian-mid-Burdigalian. NE Atlantic: France (Aquitaine Basin) (Cossmann & Peyrot 1921; Lozouet *et al.* 2001); Proto-Mediterranean Sea: Greece (Harzhauser & Kowalke 2001; Harzhauser 2004), Turkey (Büyükmeriç 2017); Paratethys: Austria, Slovakia, Slovenia (Harzhauser *et al.* 2016).

Remarks
A detailed description of the species is given in Harzhauser *et al.* (2016) and a long list of synonyms is provided by Esu & Girotti (2010). In addition to these descriptions, we observe a fine microstructure between the spiral cords that consists of very subtle fine threads. The specimens are not well enough preserved in order to count the threads, but there seem to be at least three. In Felli, the first (adapical) row of beads becomes more prominent and on some of the largest specimens it develops into a thick spinous keel on the last one or two whorls. The varices described in the largest specimens of the Oligocene (Rupelian) of the Thrace Basin (Harzhauser *et al.* 2016) are not present in the Felli material. Compared to the Oligocene samples from Greece (Harzhauser 2004), the ornamentation is less prominent and the flaring outer lip is less developed. The morphology of the specimens from the Aquitanian stratotype (Lozouet *et al.* 2001) is the most similar to the specimens from Felli.

The enormous shell variability seen in this species has led to the erection of a noumerous subspecific and varietal names (see Esu & Girotti 2010). Although *M. margaritacea* was placed in the Extant West African genus *Tympanotonos* Schumacher, 1817 by many authors, its separation from that genus and its placement in *Mesohalina* was clarified by Wittibschlager (1983), Kadolsky (1995) and Harzhauser *et al.* (2016) based on conchological features of the protoconch and early teleoconch. Reid *et al.* (2008) treat the genus *Mesohalina* as a synonym or subgenus of the genus *Potamides* Brongniart, 1810. Nevertheless, we consider *Mesohalina* to be clearly separated from *Potamides* based on the much broader shell, the angular aperture and the different mode of formation of the sculpture of the early whorls (see Kadolsky 1995).

Genus *Terebralia* Swainson, 1840

Type species. — *Strombus palustris* Linnaeus, 1758; subsequent designation by Sacco (1895b). Recent, Indo-West Pacific.

Terebralia lignitarum (Eichwald, 1830)
(Fig. 4E1-E3)

Cerithium lignitarum Eichwald, 1830: 224.

Terebralia lignitarum – Landau *et al.* 2013 (cum syn.): 51, pl. 4, fig. 11.

Material examined. — AMPG(IV) 2304-2305 (two specimens).

Dimensions. — Maximum height: 91.0 mm.

Distribution. — **Late Oligocene**. Proto-Mediterranean Sea: Turkey (İslamoğlu 2008), Greece (Harzhauser 2004); Paratethys: Hungary (Janssen 1984); east-African-Arabian province: Oman (Harzhauser 2007).
Early Miocene. NE Atlantic: France (Cossmann & Peyrot 1922; Lozouet *et al.* 2001); Proto-Mediterranean Sea: Italy (Sacco 1895b), Greece (Harzhauser & Kowalke 2001), Turkey (Landau *et al.* 2013); Paratethys: Austria (Harzhauser & Kowalke 2001).
Middle Miocene. NE Atlantic: France (Cossmann & Peyrot 1922; Glibert 1949); Paratethys: Austria (Hörnes 1856), Poland (Bałuk 1975), Hungary (Strausz 1966); Eastern Paratethys (Landau *et al.* 2013).

Late Miocene. NE Atlantic: Portugal (Landau *et al.* 2013); eastern Mediterranean Sea: Italy (Sacco 1895b), Greece (Dermitzakis 1972).

Remarks

In the studied material, a few specimens are present that could be juvenile specimens of *T. lignitarum*. The species is well known from the Oligocene and the Miocene of the Paratethys, the Western Tethys – Proto-Mediterranean and the North Atlantic Ocean, and is commonly found in lagoonal or brackish environments. It is also present in the Middle Miocene (Serravallian) of Turkey (Landau *et al.* 2013).

The morphological variation of the species has led to the creation of some varieties, mainly by Sacco (1888, 1895b). The shape of the shell can be more or less elongated, and the sculpture can form some axial tubercules. Landau *et al.* (2013) also provide a full list of synonyms and a discussion on the nomenclature and the morphological variations.

Modern representatives of *Terebralia* are found in mangroves or mudflats (Reid *et al.* 2008). In the fossil record *T. lignitarum* is found in brackish deposits (Landau *et al.* 2013), mudflats (Latal *et al.* 2006) and mangroves (Harzhauser 2007).

Terebralia subcorrugata d'Orbigny, 1852
(Fig. 4F1-F3)

Cerithium corrugatum Basterot, 1825: 54.

Cerithium subcorrugatum – d'Orbigny 1852: 80.

Terebralia subcorrugata – Cossmann & Peyrot 1922: 257, pl. 5, figs 93-98, pl.6, figs 2, 8, 9. — Lozouet *et al.* 2001: 26, pl. 8, figs 6a, b, 7a, b, pl. 10, fig. 10. — Esu & Girotti 2010: 158, pl. 6, figs 4-7. — Cluzaud *et al.* 2014: 226, fig. 171D.

Terebralia cf. *subcorrugata* – Harzhauser 2004: 119, pl. 6, figs 5, 8.

Material examined. — Sample F7: AMPG(IV) 2306, 2307 (two specimens).

Dimensions. — Maximum height: 10.0 mm.

Distribution. — **Oligocene**. NE Atlantic: France (Cossmann & Peyrot 1922; Lozouet 1986), Iran as *T.* cf. *subcorrugata* (Harzhauser 2004); Western Tethys: Italy (Esu & Girotti 2010).
Early Miocene. NE Atlantic: France (Lozouet *et al.* 2001), Proto-Mediterranean Sea: Turkey (İslamoğlu & Taner 2003), Greece (this paper).

Description

Turreted solid shell with flat whorls, with deep sutures. Sculpture consisting of four distinct spiral cords spaced by deep grooves of equal width. A fifth inconspicuous spiral thread appears above the adapical suture. Wide-spaced prominent axial ribs may form small varices; a well-developed varix is present on the last whorl; base of the last whorl bearing four granulated spiral threads. Aperture ovate with prominent columellar fold; siphonal canal thin and short.

Remarks

This species is reported here for the first time from Greece. The two specimens of *T. subcorrugata* found in Felli show the features of both juveniles and adult specimens, although the protoconch is missing. Esu & Girotti (2010) recorded this species in the Oligocene of southern Italy where few specimens were available, illustrating low morphological variation. The Felli material is insufficient to deduce any variability, but as agree in shell characters with the Italian specimens, differingin having weaker and less spiny axial ribs. *Terebralia* cf. *subcorrugata* from the Oligocene of Iran (Harzhauser 2004) has more convex whorls but displays the same axial sculpture. It is easily distinguished from *Granulolabium plicatum* by the more prominent spiral sculpture. The specimens from Felli are morphologically almost identical to the French representatives from the Early Miocene of the Aquitaine Basin housed at the historical Cossmann collection of the Muséum national d'Histoire naturelle (Paris).

Recent representatives of *Terebralia* are limited to the Indo-Pacific Ocean, and are associated with mangrove environments (Plaziat 1995). In the Oligocene of Iran, *T.* cf. *subcorrugata* has been found with *Granulolabium plicatum*, *Vitta* cf. *picta* and Cerithiidae (Harzhauser 2004).

Family Scaliolidae Jousseaume, 1912

Genus *Finella* A. Adams, 1860

Type species. — *Finella pupoides* A. Adams, 1860, by monotypy. Recent, Indo-Pacific.

Finella perpusilla (Grateloup, 1827) n. comb.
(Fig. 4G1-G4)

Rissoa perpusilla Grateloup, 1827: 133, no. 103.

Sandbergeria perpusilla – Landau *et al.* 2013: 48, pl. 54, figs 11-14 (cum. syn.).

Material examined. — Sample F11: AMPG(IV) 2308-2383 (76 specimens); sample F12: AMPG(IV) 2384-2399 (16 specimens).

Dimensions. — Maximum height: 2.10 mm.

Distribution. — **Early Miocene**. NE Atlantic: France (Cossmann & Peyrot 1922); Proto-Mediterranean Sea: Italy (Sacco 1895b), Greece (this paper).
Middle Miocene. NE Atlantic: France (Cossmann & Peyrot 1922; Glibert 1949); Proto-Mediterranean Sea: Turkey (Landau *et al.* 2013); Paratethys: Austria (Hörnes 1856), Poland (Bałuk 1975), Hungary (Strausz 1966), Romania (Zilch 1934).

Remarks

The species is placed here in the genus *Finella* (A. Adams, 1860b) since it bears more common characters with the type of this genus than with *Sandbergeria* Bosquet, 1861 (type species *S. cancellata* Nyst, 1836, Early Oligocene of Belgium). These include a planktotrophic protoconch, a more conical shape, a short and indistinct siphonal canal, a straight columellar with broad callus, which forms a narrow columellar lip (Marquet *et al.* 2008). *Finella perpusilla* has orthocline growth lines and fine ribs, as well as a very characteristic sculpture with regularly spaced inconspicuous spiral furrows (clearly visible

in SEM pictures), absent on the middle part of the whorl. The shape of the shell can vary from more elongated with low whorl expansion, to less elongated and more conical with slightly wider whorls. The Greek specimens are very similar to the Serravallian specimens from Turkey (Landau *et al.* 2013) concerning variabilty of morphology and sculpture.

The species was widespread in the Paratethys during the Miocene (Zuschin *et al.* 2004, 2005, 2006) where it was an important component of the assemblages, but is absent from the NE Atlantic and North Sea Basin. Modern representatives of the genus are detritus feeders that live on mobile bottoms, sometimes associated with corals or seagrass (R. Janssen *et al.* 2011). *Finella bruchae* was also found within a seagrass-associated gastropod fauna in the Early Miocene of India (Harzhauser 2014).

Family Turritellidae Lovén, 1847

Remark

In the present work, and due to the preservation of the specimens, we place the species in the genus *Turritella* (*s.l.*).

Genus *Turritella* (*s.l.*) Lamarck, 1799

Type species. — *Turbo terebra* Linnaeus, 1758, by monotypy. Recent, Indo-West Pacific.

Turritella turris de Basterot, 1825
(Fig. 4H1-H4)

Turritella turris Basterot, 1825: 29, pl. 1, fig. 11. — D'Orbigny 1852: 42, no. 430, 32. — Cossmann & Peyrot 1922: 39, pl. 1, fig. 25, pl. 11, figs 21-24. — Lozouet *et al.* 2001: 29, pl. 7, figs 1a-b.

Turritella (*Turritella*) *turris* – İslamoğlu 2004: 143, pl. 1, fig. 4.

Material examined. — Sample F10: AMPG(IV) 2400-2403 (four specimens); sample F11: AMPG(IV) 2404-2422 (19 specimens); sample F12: AMPG(IV) 2423-2434 (12 specimens).

Dimensions. — Maximum height: 11 mm (incomplete); maximum width: 5 mm.

Distribution. — **Early Miocene**. Aquitanian. NE Atlantic: France (Cossmann & Peyrot 1922; Lozouet *et al.* 2001); Proto-Mediterranean Sea: Greece (this paper). — Burdigalian. NE Atlantic: France (Cossmann & Peyrot 1922); Proto-Mediterranean Sea: Turkey (İslamoğlu 2004) (Burdigalian).
Late Miocene-Pliocene. Eastern Mediterranean Sea: Greece (Koskeridou 1997).

Description

Protoconch smooth, 250 µm in diameter. Transition to protoconch marked by the beginning of teleoconch sculpture. Teleoconch sculpture consisting of three equidistant spiral cords, with cord two being more prominent. Finer cords develop from whorl four and on, below the adapical suture, between the cords and below cord three. Microsculpture consists of very fine irregularly spaced threads between all cords. Apical angle of about 30°. Aperture missing.

Remarks

The specimens are conspecific with *Turritella turris* of the type-region of the Aquitanian (Aquitaine, France). There is little variation in the convexity of the whorls; most convex whorls bear more prominent sculpture and are more angular. There is also some variation in the microsculpture with the spiral threads also becoming more prominent.

Turritellids are suspension feeders partially borrowed in the sand (Allmon 2011).

Superfamily Epitonioidea Berry, 1910 (1812)
Family Epitoniidae Berry, 1910 (1812)

Genus *Nodiscala* de Boury, 1878

Type species. — *Scalaria bicarinata* G.B. Sowerby, 1844, by original designation. Recent, Philippines.

Nodiscala cf. ***rugatina*** de Boury *in* Cossmann, 1912
(Fig. 5A1, A2])

cf. *Nodiscala rugatina* – Cossmann 1912: 85, pl. 5, figs 23-25.

cf. *Opalia* (*Nodiscala*) *rugatina* – Zilch 1934: 228, pl. 10, fig. 72.

Material examined. — Sample F11: AMPG(IV) 2335, 2336 (two specimens).

Dimensions. — Maximum height: 3 mm (incomplete).

Distribution. — **Early Miocene**. Proto-Mediterranean Sea: Greece (this paper).

Description

Protoconch missing. Turreted, slender shell of six regularly convex teleoconch whorls; axial sculpture consists of orthocline and closely-spaced relatively prominent rounded axial costae, no varices present. Suture moderately incised; spiral sculpture composed of irregularly-spaced spiral punctuation. Aperture sub-ovate, incomplete.

Remarks

The specimens of the present material are reminiscent of *Nodiscala rugatina* from the middle Miocene of Romania. The syntypes, illustrated by Cossmann (1912) and Zilch (1934), however display slightly angulated whorls and less prominent axial ribs. Therefore, we identify the distinctly older Greek species as *Nodiscala* cf. *rugatina*.

The Greek specimens are similar to *Nodiscala bezanconi* (de Boury, 1893) from the late Oligocene of France as illustrated in Lozouet & Maestrati (2012), but this species has more convex whorls and deeper sutures. *Nodiscala bimonilifera* (Boettger, 1902), from the middle Miocene of Romania, differs in its more slender cylindrical outline and in its blunt nodes on the last whorl. The Greek specimens also show some resemblances to *Opalia pertusa* (Nyst, 1871) from the Miocene of the Netherlands (A.W. Janssen 1984).

Epitoniid species are known to be parasites on corals (Kokshoorn *et al.* 2007).

Superfamily Triphoroidea Gray, 1847
Family Triphoridae Gray, 1847

Genus *Triphora* (*s.l.*) Blainville, 1828

Type species. — *Triphora gemmata* Blainville, 1828, by monotypy. Recent, Indo-West Pacific.

Triphora (*s.l.*) sp.
(Fig. 5B1, B2)

Material examined. — Sample F10: AMPG(IV) 2437, 2438 (two specimens); sample F11: 2439-2442 (four specimens).

Dimensions. — Maximum height: 2.10 mm (incomplete).

Distribution. — **Early Miocene**. Proto-Mediterranean Sea: Greece (this paper).

Description
Shell minute, turriculate. Protoconch conical of 4.5 whorls. Protoconch II bears two spiral keels and regularly-spaced axial riblets. Four teleoconch whorls preserved. First whorl bears two beaded cords; cord 1 placed below suture; cord 2 above abapical suture. Axial sculpture of smooth, slightly prosocline ribs, weaker than cords, with beads forming at instersections.

Remarks
All of the specimens recovered are incomplete. Therefore, the complete sculpture and structure of the teleoconch are not available. There are some similarities with the species recovered in the Serravallian of Turkey (Landau *et al.* 2013), *Triphora* (*s.l.*) sp., for which the third beaded cord appears on the sixth teleoconch whorl.

A slight concavity of the early teleoconch is reminiscent of *Obesula* sp. (Van Dingenen *et al.* 2016), but no more characters of the present shell can place it in this genus. The present species also has a similar early teleoconch sculpture to *Marshallora adversa* (Montagu, 1803) (Marquet 1996), but with a different protoconch structure and with the aperture missing from our specimen, it is impossible to attribute the species to *Marshallora* (Bouchet, 1985).

Genus *Metaxia* Monterosato, 1884

Type species. — *Murex metaxa* Delle Chiaje, 1828, subsequent designation by Cossmann (1906). Recent, Caribbean.

Metaxia sp.
(Fig. 5C1-C4)

Material examined. — Sample F11: AMPG(IV) 2443, 2444 (two specimens).

Dimensions. — Maximum height: 1.55 mm (incomplete).

Distribution. — **Early Miocene**. Proto-Mediterranean Sea: Greece (this paper).

Description
Dextrally coiled species of elongate, turriculate shape. High, multispiral protoconch with 4.5 whorls; protoconch I convex with delicate sculpture of zigzag spiral threads; protoconch II with narrow axial riblets; keel slightly below midwhorl increasing in strength towards teleoconch. Teleoconch incomplete, consisting of four convex whorls; apical angle of teleoconch 21°. Sculpture comprising 5 spiral cords: two weak cords in adapical part of whorl, two more prominent median ones of which upper one coincides with periphery; one weak spiral cord at abapical suture.

Spiral cords cover broad axial ribs, forming weak nodular intersections on median spiral cords. Aperture missing.

Remarks
The present species has a similar morphology to the type species of the genus, *Metaxia metaxa* (Delle Chiaje, 1828), has a protoconch of 3.5 whorls and flatter teleoconch whorls. Athother similar species is *Metaxia carinapex* van der Linden, 1998 from the eastern Atlantic which has a lecithotrophic protoconch of 2.5 whorls and a teleoconch sculpture is less prominent with less broad axial ribs.

Regarding fossil species, sculpture and morphology are reminiscent of *Metaxia permacra* Lozouet, 1999 from the Late Oligocene of the Aquitaine Basin (France) (Lozouet 1999), which differs mainly in its more slender outline, strongly incised suture and the protoconch, which comprises only 3.5 whorls. *Metaxia merignacensis* (Cossmann & Peyrot 1922) from the Early Miocene of the Aquitaine Basin differs in its extremely elongate shell, prominent spiral cords and shorter protoconch of 3.5 whorls. Although *Metaxia degrangei* sensu Marquet (1996), from the early Miocene of the North Sea Basin is considered a synonym of *M. merignacensis* by Lozouet *et al.* (2001), it is morphologically distinct. The common features with the Greek species include a similar teleoconch sculpture and shell shape, but differences in the protoconch with 5.5 whorls with two spiral keels (Marquet 1996) set it as a separate species.

Family Cerithiopsidae H. Adams & A. Adams, 1854

Genus *Dizoniopsis* Sacco, 1895

Type species. — *Murex tubercularis* Montagu, 1803, by monotypy. Recent, Europe.

Remark
The genus *Dizoniopsis* Sacco, 1895 is used herein based on teleoconch sculpture that bears two rows of beads, following Bouchet *et al.* (2010) and Landau *et al.* (2018).

Dizoniopsis sp.
(Fig. 5D1-D3)

Material examined. — Sample F11: AMPG(IV) 2445-2447 (three specimens).

DIMENSIONS. — Maximum height: 3.20 mm.

DISTRIBUTION. — **Early Miocene:** Proto-Mediterranean Sea: Greece (this paper).

DESCRIPTION
Protoconch missing. Early teleoconch whorls are flat; sculpture consists of two equidistant rows of regularly-spaced rounded beads. The abapical row of beads also has a faint spiral cord between beads. Microsculpture consists only of very fine orthocline growth lines. On later whorls the upper row becomes more elongated axially and forms an angle at the suture. A spiral cord is present abapically on the suture. The base has two spiral cords; small columellar fold; aperture missing.

REMARKS
The morphology of the teleoconch and outline of the present species is similar to *Cerithiopsis* (*s.l.*) cf. *bilineata* (Hoernes, 1848) present in the Serravallian of Turkey (Landau *et al.* 2013). The protoconch is an important character for species-level identification, as it is missing from the recovered specimens, a precise identification is not possible.

Vatopsis bimonilifera (Sandberger, 1859) from the Oligocene of France (Lozouet & Maestrati 2012) is very similar to the present specimen; species of *Vatopsis* all have a spiral as well as an axial sculpture on protoconch whorls.

Cerithiopsis species are feeding on sponges in environments down to 200 m (Marshall 1978).

Superfamily RISSOOIDEA Gray, 1847
Family RISSOINIDAE Stimpson, 1865

Genus *Rissoina* d'Orbigny, 1840

TYPE SPECIES. — *Rissoina inca* d'Orbigny, 1840, by original designation. Recent, Peru.

Rissoina subconoidea (Grateloup, 1847)
(Fig. 5E1, E2)

Rissoa cochlearella var. A *subconoidea* Grateloup, 1847: 4, figs 17, 18.

Rissoina subconoidea – Landau *et al.* 2013: 75, pl. 6, fig. 9 (cum syn.).

MATERIAL EXAMINED. — Sample F10: AMPG(IV) 2448-2450 (three specimens).

DIMENSIONS. — Maximum height: 1.85 mm (incomplete).

DISTRIBUTION. — **Late Oligocene**. NE Atlantic: France (Aquitaine Basin) (Cossmann & Peyrot 1919; Lozouet *et al.* 2001).
Early Miocene. NE Atlantic: France (Aquitaine Basin) (Cossmann & Peyrot 1919; Lozouet *et al.* 2001); Proto-Mediterranean Sea: Greece (Aquitanian, this paper), Italy (Burdigalian, Sacco 1896).
Middle Miocene. NE Atlantic: France (Aquitaine Basin) (Cossmann & Peyrot 1919); Proto-Mediterranean Sea: Turkey (Landau *et al.* 2013); Paratethys: Austria (Hörnes 1856), Poland (Bałuk 1975), Hungary (Strausz 1966).

REMARKS
The species has a characteristic elongated solid shell with slightly opisthocline axial ribs. The subobsolete spiral sculpture of the last whorl mentioned by Landau *et al.* (2013) is not preserved in our incomplete material.

Lozouet *et al.* (2001) treated *Rissoina podolica* Cossmann, 1921 as subjective junior synonym of *R. subconoidea* (Grateloup, 1847), which is followed herein.

During the Early Miocene (Aquitanian and Burdigalian) *R. subconoidea* was relatively widespread in the northeastern Atlantic and the Proto-Mediterranean. According to Ponder (1984), recent *Rissoina* species take shelter beneath stones and in crevices and feed on foraminifers. *Rissoina* species live in littoral environments (Tămaș *et al.* 2013), they are also known from seagrass-associated gastropod communities (Harzhauser 2014).

Genus *Zebinella* Mörch, 1876

TYPE SPECIES. — *Helix decussata* Montagu, 1803, subsequent designation by Von Martens, 1878. Recent, Caribbean.

Zebinella sp.
(Fig. 5F1, F2)

MATERIAL EXAMINED. — Sample F11: AMPG(IV) 2451-2454 (four specimens).

DIMENSIONS. — Maximum height: 3.40 mm (incomplete).

DISTRIBUTION. — **Early Miocene**. Proto-Mediterranean Sea: Greece (this paper).

DESCRIPTION
Shell small, turriculate. Protoconch smooth, incomplete, of at least 2 whorls. Early teleoconch whorls convex, with fine sculpture of slightly opisthocline axial ribs, and a spiral cord approximately at mid-height of the whorl. Teleoconch whorls flat; sculpture consists of the same axial ribs, fine irregularly spaced spiral cords present between ribs. Cords become stronger after the fifth whorl abapically. Sutures fine, linear.

REMARKS
This *Zebinella* species is represented only by incomplete specimens. We place it in *Zebinella* and not *Rissoina* because of the fine axial sculpture and the elongated shape of the shell. It is reminiscent of *Zebinella* cf. *decussata* (Montagu, 1803) from the Serravallian of the Karaman Basin in Turkey (Landau *et al.* 2013). Both taxa have delicate, flattened, opisthocline axial ribs, but the whorls of the Greek species are more convex.

The protoconch is incomplete in the present material, but seems to be smooth. A weak spiral cord appears on the first three teleoconch whorls teleoconch in the adapical half of the whorl, forming a weak angulation as in *Zebinella* cf. *decussata*; some finer spiral threads appear after the fifth teleoconch whorl abapically, which seem to distinguish the present species.

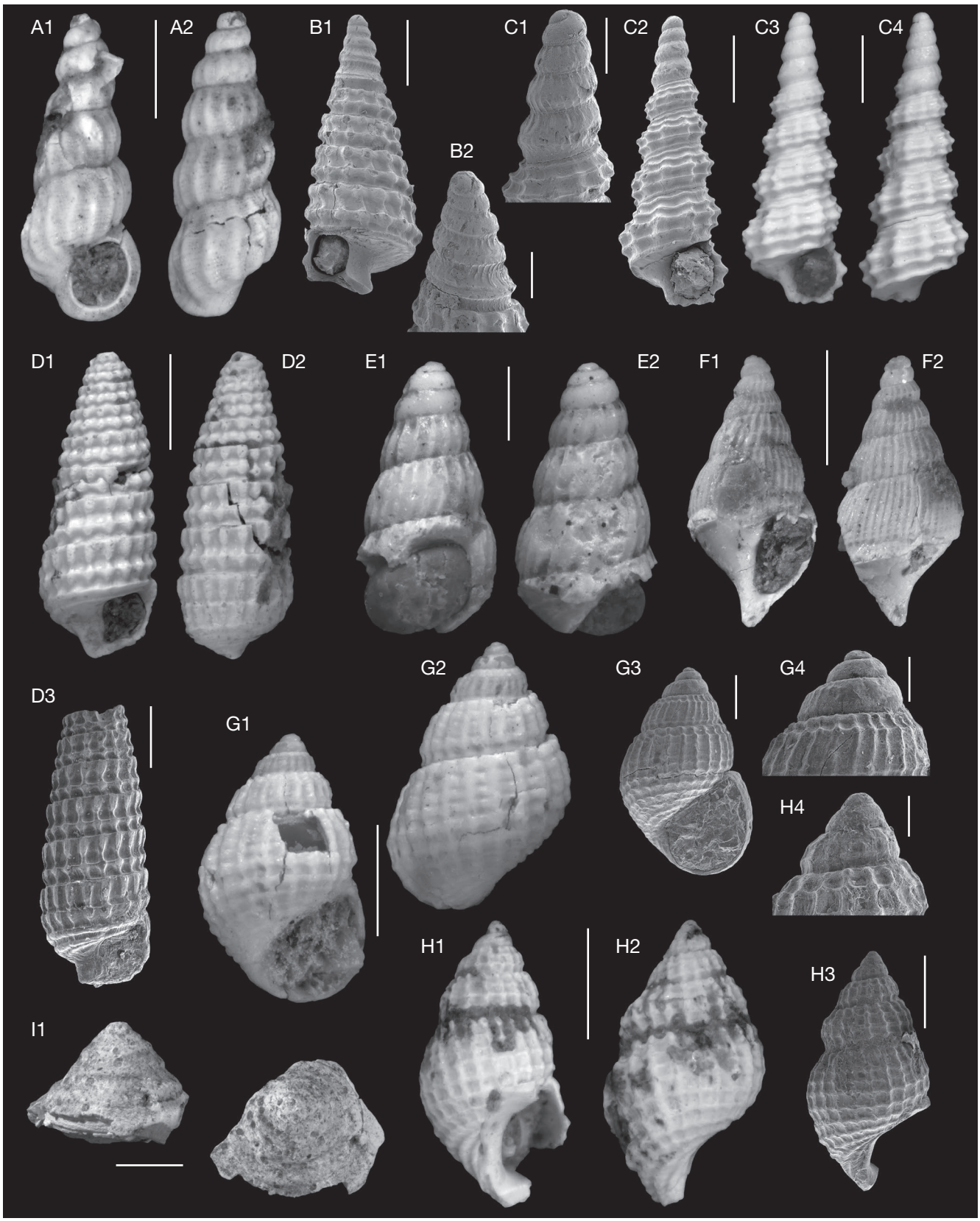

FIG. 5. — **A1**, **A2**, *Nodiscala* cf. *rugatina* de Boury *in* Cossmann, 1912: **A1**, **A2**, AMPG(IV) 2335; **B1**, **B2**, *Triphora* (*s.l.*) sp.: B**1**, AMPG(IV) 2439 (SEM image); **B2**, AMPG(IV) 2439, protoconch (SEM image); **C1**-**C4**, *Metaxia* sp.: **C1**, AMPG(IV) 2443, protoconch (SEM image); **C2**, AMPG(IV) 2443 (SEM image); **C3**, **C4**, AMPG(IV) 2443; **D1**-**D3**, *Dizoniopsis* sp.: **D1**, **D2**, AMPG(IV) 2445; **D3**, AMPG(IV) 2446 (SEM image); **E1**, **E2**, *Rissoina subconoidea* (Grateloup, 1847); **E1**, **E2**, AMPG(IV) 2448; **F1**, **F2**, *Zebinella* sp., AMPG(IV) 2451; **G1**-**G4**, *Alvania amphitrite* n. sp.: **G1**, **G2**, holotype, AMPG(IV) 1503; **G3**, paratype 2, AMPG(IV) 1505 (SEM image); **G4**, paratype 2, AMPG(IV) 1505, protoconch (SEM image); **H1**-**H4**, *Alvania transiens* (Sacco, 1895): **H1**, **H2**, AMPG(IV) 2455; **H3**, AMPG(IV) 2456 (SEM image); **H4**, AMPG(IV) 2456, protoconch (SEM image); **I1**, **I2**, *Xenophora* sp., AMPG(IV) 2461. Scale bars: A, D1-D3, F1, F2, G1, G2, H1-H3, 1 mm; B1, C2-C4, E1, E2, G3, 500 µm; B2, H4, 400 µm; C1, G4, 200 µm; I1, I2, 2 mm.

Recent representatives of the genus have been found on reef slopes and in sands between coral patches (Janssen *et al.* 2011).

Family Rissoidae Gray, 1847

Remark

The family Rissoidae is a diverse family of small-sized caenogastropods (Criscione & Ponder 2012).

Genus *Alvania* Risso, 1826

Type species. — *Alvania europea* Risoo, 1826 (= *Alvania cimex* (Linnaeus, 1758)), subsequent designation by Nevill (1885). Recent, Europe, Mediterranean Sea.

Alvania amphitrite n. sp.
(Fig. 5G1-G4)

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Type material. — Holotype: AMPG(IV) 1503, height 2.50 mm. — Paratype 1: AMPG(IV) 1504, 2.20 mm. — Paratype 2: AMPG(IV) 1505, height 1.95 mm.

Dimensions. — Maximum height: 2.50 mm; maximum width: 1.70 mm.

Etymology. — Named after the Nereid Amphitrite of Greek mythology, wife of Poseidon and protector of marine animals (as noun in apposition).

Type locality. — Felli village section, 40°01'4.55"N, 21°33'34.37"E, Mesohellenic Basin, Grevena area, Greece.

Type level. — Pentalofos Formation, Aquitanian, lower Miocene.

Diagnosis. — Shell small; protoconch consisting of about 2.5 whorls. Sculpture reticulated, ad- and abapical spiral cords strengthened, whorls flat, suture deep. Last whorl tall and rounder; aperture wide, teardrop-shaped.

Distribution. — **Early Miocene**. Proto-Mediterranean in Greece (this paper).

Description

Small, ovoid species; protoconch of 2.5 rounded smooth whorls, measuring 0.29 mm in height and 0.34 mm in width. Teleoconch of 3.5-4 flat whorls, last whorl occupies approximately 70% of total length. Sculpture consisting of 12 axial ribs and 6 spiral cords; second and last spiral cords stronger, middle cords more closely-spaced. Base with 5 spiral cords and faint axial riblets; no umbilicus; aperture wide, tear-drop shaped; outer lip somewhat inflated.

Remarks

The protoconch whorls are convex whereas the teleoconch whorls are flat. The spiral sculpture bears a prominent first adapical spiral cord which forms a weak subsutural collar. The spiral cords are regularly spaced except for the first (adapical) and last (abapical) cords which have a slightly larger space between the central cords of the spire. The reticulated aspect of the sculpture is maintained on the base of the shell.

The present species has a sculpture that is quite similar to *Alvania oceani* (d'Orbigny, 1852) but differs consistently in having a more prominent sculpture, with ribs being less prominent than in *A. oceani*; other differences include the absence of varices on early teleoconch whorls, the absence of an umbilical chink, and the overall shape being less elongated than in *A. oceani*. Another similar species from the Aquitanian of SW France is *Alvania mariae* (d'Orbigny, 1852) which has flat early teleoconch whorls, a thicker shell, about 7 axial ribs and a smaller aperture.

Alvania areolifera (Sandberger, 1863) from the Oligocene of the Paratethys, as illustrated by Garilli & Parrinello (2014), has a similar spiral sculpture with closely-spaced spiral cords at the middle of each whorl, but this species has a thicker shell, more prominent axial sculpture and finer and more numerous spiral cords.

Alvania critica Boettger, 1907 differs in having a more pronounced axial sculpture and a smaller aperture as illustrated from the middle Miocene of Turkey (Landau *et al.* 2013). *Alvania perregularis* (Sacco, 1907) has a more elongated aspect, a more finely reticulated teleoconch sculpture, a more prominent subsutural collar and a smaller aperture (Landau *et al.* 2013).

Alvania transiens (Sacco, 1895)
(Fig. 5H1-H4)

Alvania (*Acinopsis*) *sculpta*? var. *transiens* Sacco, 1895b: 27.

Alvania (*Alvania*) *transiens* – Tămaș *et al.* 2013: 61, fig. 2i.

Alvania transiens – Landau *et al.* 2013: 73, pl. 6, fig. 8 (cum syn.).

Material examined. — Sample F11: AMPG(IV) 2455-2459 (five specimens).

Dimensions. — Maximum height: 3.25 mm.

Distribution. — **Early Miocene**. Aquitanian. Proto-Mediterranean Sea: Greece (this paper); Paratethys: Austria (Landau *et al.* 2013). — Burdigalian. Proto-Mediterranean: Italy (Sacco 1895b).
Middle Miocene. Proto-Mediterranean Sea: Turkey (Landau *et al.* 2013); Paratethys: Austria (Cossmann 1921; Kowalke & Harzhauser 2004), Hungary (Strausz 1966), Poland (Bałuk 1975), Romania (Tămaș *et al.* 2013).
Late Miocene. Proto-Mediterranean Sea: Italy (Sacco 1895b).
Early Pliocene. central Mediterranean: Italy (Sacco 1895b).

Description

Shell elongated; protoconch conical, of 2.5 slightly inflated whorls. Four rather flat teleoconch whorls with reticulated sculpture of 9-10 axial ribs and 5 regularly spaced spiral cords, third cord significantly weaker. Base with 5 spiral cords, axial sculpture intersects the 3 first spiral cords thus maintaining the reticulated aspect; 2 spiral cords thick and prominent. Aperture tear-drop shaped; no umbilicus, inner lip smooth, outer lip missing in all specimens.

Remarks
Very characteristic species, due to its particular sculpture, elongated shape and conical protoconch. The early Miocene *Alvania venus* (d'Orbigny, 1852) is slightly reminiscent of *A. transiens* due to its prominent, reticulated sculpture. Kowalke & Harzhauser (2004) discussed the relationship between *A. transiens* and *A. venus*; Landau *et al.* (2013) presented a full list of synonymy which also illustrated the similarities of the two species. Another species with distinct cancellate sculpture is *Alvania falsivenus* Lozouet, 2015 from the Early Oligocene of SW France (Lozouet 2015). It differs from the present species in having a less elongate protoconch and shell, and a less pronounced sculpture in early teleoconch whorls.

Superorder LATROGASTROPODA Bouchet *et al.* 2017
Superfamily Cypraeoidea Rafinesque, 1815

Family Cypraeidae Rafinesque, 1815

Remark
Description is made following Dolin & Lozouet (2004) and Landau *et al.* (2013).

Genus *Praerosaria* Dolin & Lozouet, 2004

Type species. — *Cypraea* (*Proadusta*) *splendens* var. *exflaveola* Sacco, 1894 (= *Praerosaria exflaveola* (Sacco, 1894)). Early Oligocene (Rupelian), France.

?*Praerosaria* sp.
(Fig. 10A-H)

Material examined. — Sample F11: AMPG(IV) 2460 (one specimen).

Dimensions. — Length: 17.00 mm; height: 8.50 mm; width: 10.50 mm.

Distribution. — **Early Miocene**. Proto-Mediterranean Sea: Greece (this paper).

Description
Shell small, solid, pyriform, posteriorly swollen. 18 closely spaced columellar teeth, 22 closely spaced labral teeth, fossula convex, smooth with 4 faint columellar teeth apically; terminal fold moderately developed. Venter smooth, convex; outer lip smooth convex. Anterior marginated on both left and right profiles. Left profile rounded; right profile angled from anterior to posterior margins. Posterior edge with callus and with marginated, less inflated in profile. Aperture moderately sigmoidal, narrow slightly widening anteriorly. Siphonal canal wider than anal canal.

Preserved colour pattern consists of two series of faded punctuations; posteriorly a more distinct disc is present.

Remarks
This species is most likely represented by two more specimens that are poorly preserved, broken and deformed. The generic assignment is uncertain since the intra-specific morphological variation cannot be assessed.

Apical and adapical margins, narrow aperture with small teeth, convex-inflated ventral and outer lip and distinguishable line on the right profile seem to be the key characters shared by all of the species of *Praerosaria* as pictured by Dolin & Lozouet (2004).

Most of the species of the then new genus *Praerosaria* described by Dolin & Lozouet (2004) are of similar dimensions to the Greek specimen. Morphologically, the present species is close to the type species of the genus, *P. exflaveola* (Sacco, 1894), by having marginated edges, a similar terminal fold, and almost the same number of closely-spaced teeth. Another similar species form the Chattian of the Aquitaine Basin (SW France) is *P. charlenae* Dolin & Lozouet, 2004 which has slightly more prominent columellar denticles and a less inflated shell dorsally. Indeed, all of the species of *Praerosaria* seem to be uniform in shell characters, presenting variations that mainly affect the number of columellar and labial denticles and width of the outer lip.

Superfamily Xenophoroidea Troschel, 1852 (1840)
Family Xenophoridae Troschel, 1852 (1840)

Genus *Xenophora* Fischer von Waldheim, 1807

Type species. — *Xenophora laevigata* Fischer von Waldheim (= *Xenophora conchiliophora* (Born, 1870)), subsequent designation by Gray (1847). Recent, Caribbean.

Xenophora sp.
(Fig. 5I1-I4)

Material examined. — Sample F10: AMPG(IV) 2461 (one specimen).

Dimensions. — Mean diameter: 5.10 mm (incomplete).

Distribution. — **Early Miocene**. Proto-Mediterranean Sea: Greece (this paper).

Description
A fragment comprising 5 flat, teleoconch whorls shouldered on the abapical suture; apical angle 80°. Suture regular, deeply incised; small circular grains are attached along the suture. Base and aperture of the shell missing.

Remarks
Due to the fragmentary preservation a clear identification is difficult. The apical angle is similar to *X. deshayesi* (Michelotti, 1847) and *X. italica* (Grateloup, 1845); the apex and first teleoconch whorls of the specimen from Felli are most similar to *X. italica* mainly because of the flattened whorls and the linear suture that is visible when not obstructed by the agglutinated elements as it is observed for this species in Landau *et al.* (2013).

According to Ponder (1983), important characters for the separation of species of Xenophoridae are missing from the specimen of Felli, such as the sculpture and shape of the base, the width of the peripheral flange, the umbilical characters and the shape of the basal lip. The characters used here are the spire angle, the shape of the whorls and the mode of attachment of particles. Like the specimen from Felli, *X. italica* is reported to agglutinate smaller-sized objects such as sand grains and small shell fragments (Landau *et al.* 2013). Nevertheless, it is doubtful that the specimen from Felli is conspecific with *X. italica*, as this species is known so far exclusively from middle Miocene localities (Landau *et al.* 2013).

Xenophora cumulans (Brongnart, 1823) sensu Harzhauser (2004) from the Oligocene of the Mesohellenic Basin is distinctly different, mainly by having an apical angle that varies between 90 and 100°.

Xenophorids are known to be deposit feeders living on mobile bottoms (Ponder 1983).

Order NEOGASTROPODA Wenz, 1938
Superfamily VOLUTOIDEA Rafinesque, 1815
Family VOLUTIDAE Rafinesque, 1815

Genus *Athleta* Conrad, 1853

TYPE SPECIES. — *Voluta rarispina* Lamarck, 1811, by original designation. Early Miocene, Europe (Aquitane, France).

Athleta rarispina (Lamarck, 1811)
(Fig. 6C1-C4)

Voluta rarispina Lamarck, 1811: 79.

Athleta rarispina – Landau *et al.* 2013: 205, pl. 68, fig. 2; pl. 80, fig. 4 (cum syn.).

MATERIAL EXAMINED. — Sample F11: AMPG(IV) 2462, 2463 (two specimens).

DIMENSIONS. — Maximum height: 39.0 mm.

DISTRIBUTION. — **Latest Oligocene-Earliest Miocene**. Paratethys: Hungary (Báldi 1973).
Early Miocene. NE Atlantic: France (Peyrot 1928); Proto-Mediterranean Sea: Italy (Sacco 1890), Turkey (İslamoğlu 2004); Paratethys: Germany (Landau *et al.* 2013).
Middle Miocene. NE Atlantic: France (Peyrot 1928); Proto-Mediterranean Sea: Turkey (Landau *et al.* 2013); Paratethys: Austria (Hörnes 1856), Poland (Bałuk 1997), Hungary (Strausz 1966).
Late Miocene. Proto-Mediterranean Sea: Italy (Landau *et al.* 2013), Greece (Symeonidis 1966), Turkey (İslamoğlu & Taner 2003).

REMARKS

Two specimens recovered from the present material bearing the characteristic features of *Athleta rarispina* (Lamarck, 1811), with few spiral lines in the abapical part of the shell and three columellar folds (as opposed to *A. ficulina* (Lamarck, 1811) that has more numerous folds). Protoconch and early teleoconch features are poorly preserved. The larger of the two specimens has a somewhat irregular sculpture, with irregularly formed spines (forming different angles relative to the surface of the shell) and two growth stops that affect the overall appearance of the sculpture by attenuating two rows of spines.

A full list of synonymy is provided by Landau *et al.* (2013), which also illustrates the confusion of *A. rarispina* and *A. ficulina* due to their overall similar morphologies, while bringing out the differences of the shells (including the different colouration patterns)

In the Early Miocene of Greece, only *A. ficulina* has been reported from both the Aquitanian and the Burdigalian of the Mesohellenic Basin so far (Harzhauser *et al.* 2002).

Superfamily BUCCINOIDEA Rafinesque, 1815
Family COLUMBELLIDAE Swainson, 1840

Genus *Costoanachis* Sacco, 1890

TYPE SPECIES. — *Columbella turrita* Sacco, 1890 (= *Costoanachis saccostata* Radwin, 1968), by original designation.

Costoanachis cf. ***terebralis*** (Grateloup, 1834)
(Fig. 6A1, A2)

cf. *Nassa terebralis* Grateloup, 1834: 271, no. 512.

cf. *Costoanachis terebralis* – Landau *et al.* 2013: 188, pl. 28, fig. 11, pl. 66, fig. 8, pl. 67, fig. 1 (cum syn.).

MATERIAL EXAMINED. — Sample F11: AMPG(IV) 2464-2466 (three specimens); sample F12: AMPG(IV) 2467 (one specimen).

DIMENSIONS. — Maximum height: 5 mm.

DISTRIBUTION. — *Costoanachis terebralis*, **Early Miocene.** NE Atlantic (Aquitanian-Burdigalian): France (Peyrot 1925; Lozouet *et al.* 2001); North Sea Basin (late Burdigalian-Langhian): the Netherlands (A.W. Janssen 1984), Germany (Stein *et al.* 2016).
Costoanachis terebralis, **Middle Miocene**. NE Atlantic: France (Peyrot 1925; Landau *et al.* 2013); Proto-Mediterranean Sea: Turkey (Landau *et al.* 2013); Paratethys: Poland (Bałuk 1995), Austria (Hörnes 1852), Hungary (Strausz 1966).
Costoanachis terebralis, **Late Miocene**. NE Atlantic: France, Portugal (Landau *et al.* 2013).
Costoanachis cf. *terebralis*, Proto-Mediterranean Sea: Greece (this paper).

REMARKS

The specimens recovered from the present material are very close to *Costoanachis terebralis* (Grateloup, 1834), which is a rather widespread European species. Its members present morphological variations that mainly concern the width of the shell and the spacing of axial sculpture. The present specimens are on the more slender side of the morphology, most similar to the specimens described in A.W. Janssen (1984).

It differs from *C. corrugata* (Brocchi, 1814) in having a smaller shell and no spiral sculpture, although some very inconspicuous spiral threads are observed between the axial ribs in a juvenile specimen from Felli. The protoconch is multispiral and dome-shaped, the corrosion of the recovered shells does not allow for a detailed description.

Family Melongenidae Gill, 1871 (1854)

Genus *Melongena* Schumacher, 1817

Type species. — *Melongena fasciata* Schumacher, 1817, by monotypy. Recent, Carabbean.

Melongena lainei (de Basterot, 1825)
(Fig. 11A-C)

Pyrula lainei de Basterot, 1825: 67, pl. 7, fig. 8.

Melongena lainei – Sacco 1904: 32, pl. 9, figs 23, 24. — Lozouet *et al.* 2001: 62, pl. 28, figs 1a & b, 2, 3 (cum syn.). — Harzhauser & Kowalke 2001: 365, fig. 6.2. — Harzhauser 2007: 106, pl. 6, fig. 3. — Lozouet 2014: 285, fig. 209 A-G.

Material examined. — AMPG(IV) 2467, 2468 (two specimens).

Dimensions. — Maximum height: 98.0 mm (incomplete).

Distribution. — **Late Oligocene**. Paratethys: Hungary (Báldi 1973); Indo-Pacific Ocean: Oman (Harzhauser 2007).
Early Miocene. Aquitanian. NE Atlantic: France (Lozouet *et al.* 2001; Lozouet 2014); Proto-Mediterranean Sea: Greece (Harzhauser & Kowalke 2001); Burdigalian. NE Atlantic: France (Lozouet *et al.* 2001; Lozouet 2014); Proto-Mediterranean Sea: Italy (Sacco 1904).

Remarks
Two specimens of the species were recovered, that can be easily distinguished from other species of *Melongena* mainly by having a spiral sculpture of spiral angular cords separated by deep furrows (of variable width), an elongated slightly pyriform shape, and has a single row of shoulder spines.

Melongena lainei has been found in the neighbouring location of Agapi in the Aquitanian of the Mesohellenic Basin (Harzhauser & Kowalke 2001). *Melongena lainei semseyiana* (Erdös, 1900) is found in the late Oligocene of the Mesohellenic Basin; it is considered to represent a chrono-subspecies (Harzhauser 2004) and is treated as belonging to the *M. semseyana* lineage by Landau *et al.* (2013). In the middle Miocene of the Proto-Mediterranean (Turkey), this melongenid is replaced by *M. jaapi* Landau, Harzhauser, İslamoğlu & Silva, 2013, a species easily distinguished from *M. lainei* in having shorter spires and a more inflated last whorl.

Modern representatives of *Melongena* live in the intertidal zone (some can be found up to depths of 30 m) of the Caribbean, the Panama, and Indo-Pacific bio-provinces and are predators mainly on bivalves (including burrowing species) (Lozouet & Londeix 2014b). In the fossil record, *M. lainei* is present in brackish-water paleocommunities in the Proto-Mediterranean during the Aquitanian and the Burdigalian (Harzhauser & Kowalke 2001; Lozouet *et al.* 2001).

Superfamily Turbinelloidea Rafinesque, 1815

Family Costellariidae MacDonald, 1860

Remark
Costellariidae is a diverse family of carnivorous gastropods that are widely distributed in tropical and temperate latitudes today with some genera being infaunal (Fedosov *et al.* 2015, 2017; Vermeij 2017). The phylogenetic relationships have shown the family to be monophyletic (Fedosov *et al.* 2015), and the generic taxonomy was rearranged by Fedosov *et al.* (2017).

Genus *Pusia* Swainson, 1840

Type species. — *Mitra microzonias* Lamarck, 1811, by monotypy. Recent, Indo-Pacific.

Remark
For a discussion on the phylogenetic relationships and the taxonomic status of the genus *Pusia* Swainson, 1840 see Fedosov *et al.* (2017).

Pusia cf. ***pyramidella*** (Brocchi, 1814)
(Fig. 6B[1, 2])

cf. *Voluta pyramidella* Brocchi, 1814: 318, pl. 4, fig. 5.

cf. *Pusia pyramidella* – Landau *et al.* 2013: 215, pl. 34, figs 7-9; pl. 68, fig. 9 (cum syn.).

Material examined. — Sample F11: AMPG(IV) 2469-2472 (four specimens).

Dimensions. — Maximum height: 3.20 mm.

Distribution. — **Early Miocene**. Proto-Mediterranean Sea: Greece (this paper).
Early-Middle Miocene. North Sea Basin (A.W. Janssen 1984).
Middle Miocene. Proto-Mediterranean Sea: Turkey (Landau *et al.* 2013).
Late Miocene. Proto-Mediterranean Sea: Italy (Landau *et al.* 2013).
Early Pliocene. Western and central Mediterranean (Landau *et al.* 2013).
Late Pliocene. Central Mediterranean (Malatesta 1974; Landau *et al.* 2013).

Remarks
Although the protoconchs of the recovered specimens are corroded, the sculpture and the overall shape of the shells are indicative of *Pusia pyramidella*. As Landau *et al.* (2013) mention, this species has many similarities with *P. ebenus* (Lamarck, 1811) but differs in protoconch sculpture, a feature that cannot be assessed here. Most of the specimens from Felli bear ribs on early teleoconch whorls that dissipate and are absent on later whorls. All of the specimens are juveniles, showing the characteristic sculpture of the species on the first four teleoconch whorls.

A full list of synonyms and a discussion on related species is presented in detail in Landau *et al.* (2013). Due to the conchological similarities with *Pusia ebenus* (Lamarck, 1811), which is assigned to *Pusia* (*Ebenomitra*) subgenus by Fedosov *et al.* (2017), we chose to include the present species in the genus *Pusia* with no certainty regarding its subgeneric affinities.

Superfamily Conoidea Fleming, 1822

Remark

Conoidean gastropods are predatory carnivores (Uribe *et al.* 2017); the family Mangeliidae includes infaunal species (Vermeij 2017).

Family Conidae Fleming, 1822

Remark

The taxonomy of Recent representatives of this hyperdiverse family of predatory gastropods has become more stable after molecular phylogenetic studies (Puillandre *et al.* 2014). For fossil species, a thorough taxonomic revision of Paratethys Conidae by Harzhauser & Landau (2016) sheds light on the previous confusion of chresonyms; it also gives a clear description of generic characters that we follow in the present work.

Genus *Lautoconus* Monterosato, 1923

Type species. — *Conus mediterraneus* Hwass *in* Bruguière, 1792 (= *Lautoconus ventricosus* (Gmelin, 1791)).

?*Lautoconus* sp.
(Fig. 12A-F)

Material examined. — Sample F10: AMPG(IV) 2473 (one specimen).

Dimensions. — Height: 26.0 mm; width: 14.5 mm.

Distribution. — **Early Miocene**. Proto-Mediterranean Sea: Greece (this paper).

Description

Shell inflated, sides slightly convex. Protoconch not preserved. Moderately low spire; whorl tops with 3 cords; last whorl with prominent, slightly rounded shoulder. Spiral sculpture in adapical half of the shell, consists of irregularly-spaced striae. Aperture poorly preserved, appears moderately wide. Colour pattern consists of irregularly-spaced dots of variable sizes.

Remarks

The specimen recovered in the present material although incomplete, shows some characters that would place it closer to the genus *Lautoconus* Monterosato, 1923. These are mainly the whorl tops with sculpture, the shouldered last whorl and the spiral sculpture at the base of the shell. Some doubts arise since the early teleoconch spiral structure cannot be assessed and the subsutural flexure cannot be measured due to the preservation of the specimen. This does not allow for a certain attribution to the genus *Lautoconus*. Nevertheless, the present specimen has similar spiral and whorl top sculpture with the type specimen of the genus.

The species seems to have only a primary colour pattern, with the bands of dots being equidistant whereas spirally, their disposition is irregular (distance between each dot). The pattern is comparable to that of *Kalloconus berghausi* (Michelotti, 1847) from the middle Miocene of Turkey as illustrated in Landau *et al.* (2013).

Family Mangeliidae P. Fischer, 1883

Genus *Mangelia* Risso, 1826

Type species. — *Mangelia striolata* Risso, 1826, subsequent designation by Herrmannsen (1852). Recent, Mediterranean.

Mangelia (*s.l.*) sp.
(Fig. 6D1-D4)

Material examined. — Sample F11: AMPG(IV) 2474-2477 (four incomplete specimens).

Dimensions. — Maximum height: 3.66 mm (incomplete); maximum width: 1.55 mm.

Distribution. — **Early Miocene**. Proto-Mediterranean Sea: Greece (this paper).

Description

Protoconch multispiral, dome shaped, eroded, consists of 3 whorls, maximum diameter is 400 µm. Teleoconch of 3.5 whorls; axial sculpture composed of opisthocline regularly-spaced rounded ribs, about 12 on each whorl; fine axial regularly spaced growth lines. Spiral sculpture has four main equidistant cords; the second cord is more prominent and forms an angle of the spire from the second teleoconch whorl on. Spaces between cords occupied by secondary finer cords, two between each main spiral cord. Microsculpture consists of finer and irregularly spaced spiral cords. Intersections of growth lines and cords forms beads. Suture smooth; aperture missing; observed inner lip smooth.

Remarks

The preservation state of the specimens does not allow a certain generic assignment. In one specimen of the studied material, part of the protoconch II sculpture is preserved; it consists of eroded axial riblets. The overall shape and sculpture that consists of finely beaded cords, is typical of members of the family.

A morphologically similar species from the Middle Miocene (Serravallian) of Turkey is *Mangelia* sp. (Landau *et al.* 2013), with a similar spiral sculpture, yet less angular whorls than the present species.

A similar species from the Miocene of the North Sea Basin is *Sorgenfreispira plicatelloides* (Nordsieck, 1979) (A.W. Janssen 1984; Moths *et al.* 2010); it has a similar protoconch in shape and shouldered teleoconch whorls. *Sorgenfreispira sorgenfreii* (Nordsieck, 1979) is another species from the Miocene of the Netherlands that has some similarities (protoconch shape and teleoconch sculpture) but with less axial ribs and more rounded whorls. In the stratotype area of the Aquitanian (Aquitaine, France), there are no recorded species of *Sorgenfreispira*, but other Mangeliidae are present. Namely *Bela elegantissima* (Peyrot, 1931) which resembles the present species in having a similar teleoconch sculpture and shouldered whorls, but is much larger in size (maximum height about 8 mm) and has six teleoconch whorls.

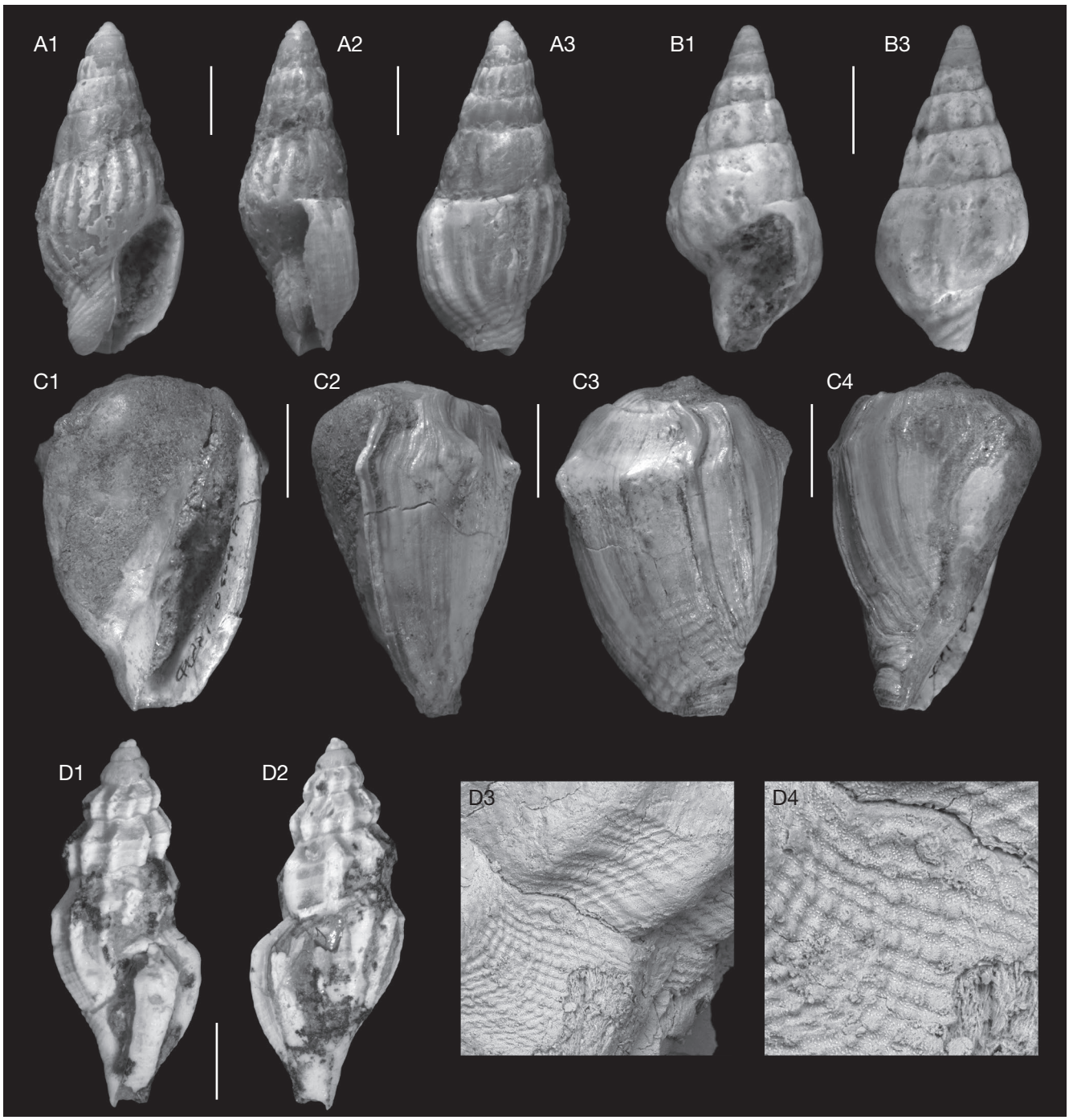

FIG. 6. — **A1**-**A3**, *Costoanachis* cf. *terebralis* (Grateloup, 1834), AMPG(IV) 2467; **B1**, **B2**, *Pusia* cf. *pyramidella* (Brocchi, 1814), AMPG(IV) 2469; **C1**-**C4**, *Athleta rarispina* (Lamarck, 1811), AMPG(IV) 2462; **D1**-**D4**, *Mangelia* (*s.l.*) sp.: **D1**, **D2**, AMPG(IV) 2474; **D3**, **D4**, AMPG(IV) 2475, detail of microsculpture (SEM images). Scale bars: A1, A2, B1, B2, D1, D2, 1 mm; C1-C4, 10 mm; D3, 300 µm; D4, 100 µm.

Subclass HETEROBRANCHIA Burmeister, 1837
Superfamily MATHILDOIDEA Dall, 1889
Family MATHILDIDAE Dall, 1889

Genus *Mathilda* Semper, 1865

TYPE SPECIES. — *Turbo quadricarinatus* Brocchi, 1814 (= *Mathilda quadricarinata* (Brocchi, 1814)), subsequent designation by de Boury (1883). Pliocene, Italy.

Mathilda sp.
(Fig. 7A1-A3)

MATERIAL EXAMINED. — Sample F10: AMPG(IV) 2478 (one specimen).

DIMENSIONS. — Height: 3.14 mm.

DISTRIBUTION. — **Early Miocene**. Proto-Mediterranean: Greece (this paper).

Description
Elongated turriculate shell; apical angle *c.* 29°. Protoconch consisting of two whorls, smooth, bulbous, perpendicular to the teleoconch; diameter 500 µm. Teleoconch with relatively flat whorls; sculpture consisting of three equidistant spiral cords; two cords placed immediately below adapical and above abapical suture; third cord in mid-whorl, more prominent. Fourth very fine spiral cord appears between adapical two cords on fourth teleoconch whorl. Axial sculpture of regularly spaced fine riblets, forming beads at intersections with spiral cords. Suture impressed, emphasized by adjoining beaded spiral cords; aperture missing.

Remarks
Mathilda peyroti (Cossmann & Peyrot 1922) is the most similar species, with the main difference being that the fourth, finer cord appears on whorl 5 of the teleoconch. The apical angle ranges from 20 to 23° for *M. peyroti* (Cossmann & Peyrot 1922), whereas for the present specimen it is of about 29°. The present species also differs from *M. granosa* (Borson, 1821), in having less prominent sculpture and a thicker cord below the suture. Another Miocene species is *M. margaritula*, which differs mainly by forming more prominent nodes at the intersections of cords and axial ribs.

According to Gründel & Nützel (2013), Mathildidae feed on Cnidaria.

Superfamily Acteonoidea d'Orbigny, 1843

Family Acteonidae d'Orbigny, 1843

Type species. — *Bulla tornatilis* Linnaeus, 1758, by original designation. Recent, Europe.

Remark
The genus *Acteon* is here used based on shell morphology, whereas modern species are assigned in Acteonidae genera based on their radula.

Acteon cf. ***pinguis*** d'Orbigny, 1852
(Fig. 7B1, B2)

cf. *Acteon pinguis* d'Orbigny, 1852: no. 521, 36. — Peyrot 1932: 157, no. 1376, pl. 11, figs 55-57, pl. 14, figs 12, 13. — Lozouet *et al.* 2001: 79. — Harzhauser 2002: 125, pl. 12, fig. 7.

Material examined. — Sample F10: AMPG(IV) 2479-2481 (three specimen); sample F11: AMPG(IV) 2482, 2483 (two specimens); sample F12: AMPG(IV) 2484-2487 (four specimens).

Dimensions. — Maximum height: 1.85 mm.

Distribution. — **Early Miocene.** Aquitanian. NE Atlantic: France (Aquitaine Basin) (Peyrot 1932; Lozouet *et al.* 2001); Proto-Mediterranean: Greece (this paper). — Burdigalian. NE Atlantic: France (Aquitaine Basin) (Peyrot 1932); Paratethys: Austria (Harzhauser 2002).

Description
Juvenile and incomplete specimens with intorted smooth protoconch. Apical angle of 55°. Two teleoconch whorls, sculpture typical with regularly-spaced pitted grooves, suture deeply impressed; aperture tear-drop shaped, no umbilicus, outer lip regularly convex.

Remarks
A single species of *'Acteon'* has been found, represented mainly by juveniles. The sculpture, apical angle coincide with those of *A. pinguis* but the juvenile and incomplete specimens does not allow a clear identification. Variation in sculpture consists of the grooves that bear less prominent pits and have a smoother aspect abapically. The last whorl of the specimens observed has slightly deeper grooves which could possibly be a feature dominating the sculpture of later whorls.

The shape of the shell and the convexity of the whorls are reminiscent of *Acteon semistriatus* (Férussac, 1822). The sculpture and overall morphology of the recovered specimens is most similar to *A. pinguis* d'Orbigny, 1852. Nevertheless, the protoconch seems slightly wider and less inflated, which could be due to intraspecific variability. Moreover, specimens recovered show various traces of predation from molluscs and possibly decapods.

Order RINGICULIDA Bouchet *et al.* 2017
Superfamily Ringiculoidea Philippi, 1853
Family Ringiculidae Philippi, 1853

Genus *Ringicula* Deshayes, 1838

Type species. — *Ringicula ringens* (Lamarck, 1804), subsequent designation by Gray (1847). Eocene, France.

Ringicula minor (Grateloup, 1838)
(Fig. 7C1, C2)

Auricula ringens var. b. *minor* Grateloup, 1838: 286, pl. 6, fig. 8.

Ringicula minor – Landau *et al.* 2013: 326, pl. 52, fig.16, pl. 76, fig. 14, pl. (cum syn.).

Material examined. — Sample F11: AMPG(IV) 2488-2531 (44 specimens); sample F12: AMPG(IV) 2532-2540 (nine specimens).

Dimensions. — Maximum height: 4.70 mm.

Distribution. — **Early Miocene**. NE Atlantic: France (Peyrot 1932; Lozouet *et al.* 2001; Lesport & Cahuzac 2005; Cahuzac *et al.* 2012); Proto-Mediterranean Sea: Greece (this paper); Paratethys: Slovakia (Harzhauser *et al.* 2011).
Middle Miocene. NE Atlantic: France (Peyrot 1932); Proto-Mediterranean Sea: Turkey (Landau *et al.* 2013); Paratethys: Austria (Hörnes 1852), Hungary (Strausz 1966).

Remarks
In many specimens the outer lip and the parietal callus are not callous. This was also observed in French representatives of *Ringicula minor* from the Aquitaine Basin (Lozouet *et al.* 2001). The large number of fragments documents that this species was among the most frequent species in the shallow-marine assemblage of Felli.

Ringicula minor is a widespread European species (Harzhauser 2014; Landau *et al.* 2013).

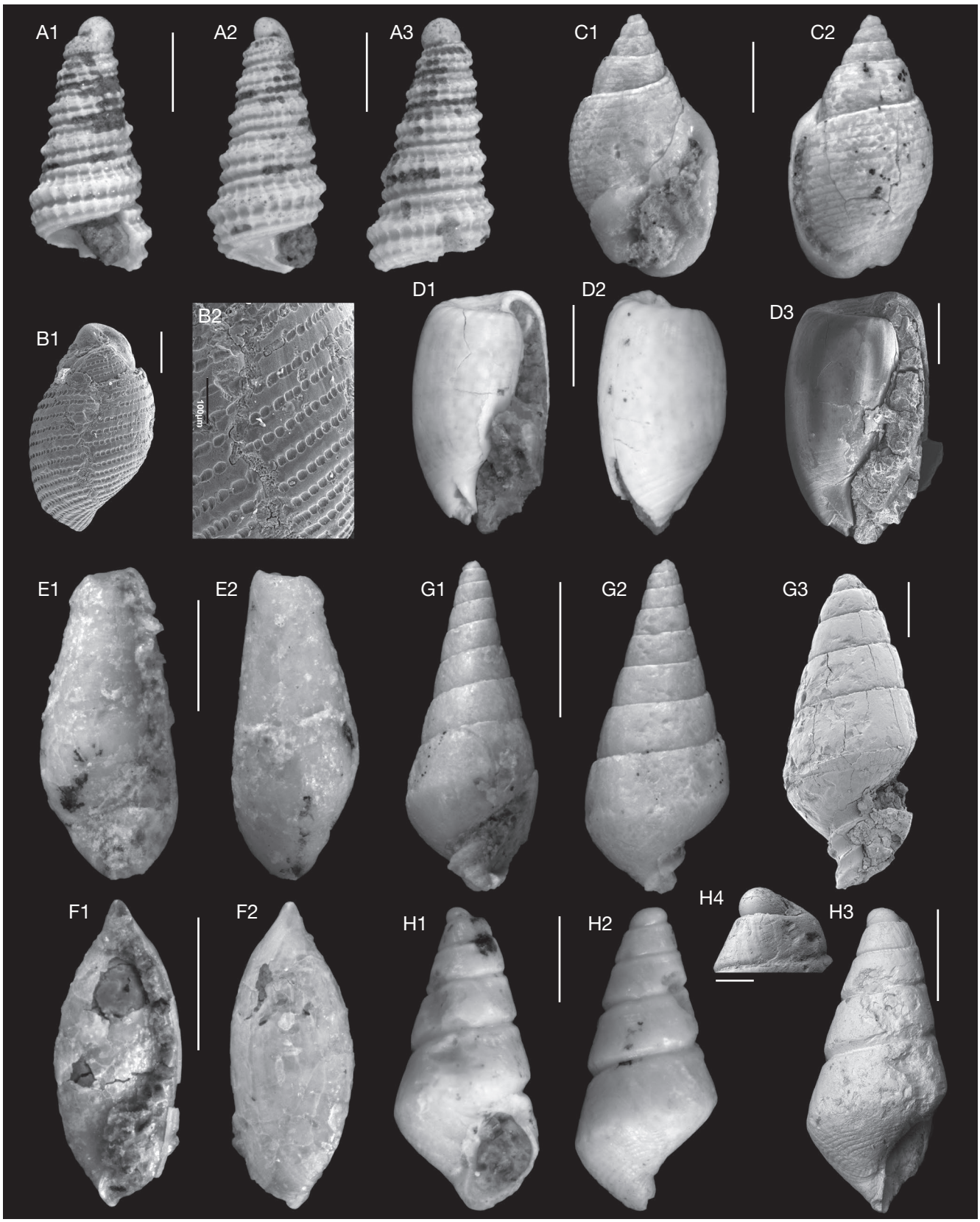

FIG. 7. — **A1**-**A3**, *Mathilda* sp., AMPG(IV) 2478; **B1**, **B2**, *Acteon* cf. *pinguis* d'Orbigny, 1852: **B1**, AMPG(IV) 2479 (SEM image); **B2**, AMPG(IV) 2479, detail of microsculpture (SEM image); **C1**, **C2**, *Ringicula minor* (Grateloup, 1838), AMPG(IV) 2488; **D1**-**D3**, *Retusa truncatula* (Bruguière, 1792): **D1**, **D2**, AMPG(IV) 2541; **D3**, AMPG(IV) 2542 (SEM image); **E1**, **E2**, *Pyrunculus* sp., AMPG(IV) 2545; **F1**, **F2**, *Volvulella acuminata* (Bruguière, 1792), AMPG(IV) 2547; **G1**-**G3**, *Pyramidella* cf. *plicosa* Bronn, 1838: **G1**, **G2**, AMPG(IV) 2554; **G3**, AMPG(IV) 2555 (SEM image); **H1**-**H3**, '*Odostomia*' sp. 1, AMPG(IV) 2557; **H3**, AMPG(IV) 2557 (SEM image); **H4**, AMPG(IV) 2557, apex (SEM image). Scale bars: A1-A3, C1, C2, E1, E2, F1, F2, G1, G2, H1, H2, 1 mm; B1, 200 µm; B2, H4, 100 µm; D1, D2, H3, 500 µm; D3, G3, 400 µm.

Order CEPHALASPIDEA P. Fischer, 1883

Remark

Cephalaspidea have been studied recently with an aim to better understand the phylogeny of this diversified order of marine gastropods (Malaquias *et al.* 2009; Oskars *et al.* 2015). Even though the relationships between families was clarified by Oskars *et al.* (2015), the superfamilies Bulloidea Gray, 1827 and Diaphanoidea Odhner, 1914 (1857) remain non monophyletic, with the family Retusidae being paraphyletic.

Superfamily Bulloidea Gray, 1827
Family Retusidae Thiele, 1925

Genus *Retusa* T. Brown, 1827

Type species. — *Bulla obtusa* Montagu, 1803, by subsequent designation (Iredale 1915). Recent, Europe.

Retusa truncatula (Bruguière, 1792)
(Fig. 7D1-D3)

Bulla truncatula Bruguière, 1792: 377.

Retusa truncatula – Landau *et al.* 2013: 337, pl. 77, fig. 11 (cum syn.).

Material examined. — Sample F11: AMPG(IV) 2541-2544 (four specimens).

Dimensions. — Maximum height: 0.62 mm.

Distribution. — **Early Miocene**. Proto-Mediterranean Sea: Greece (this paper) (Aquitanian); Paratethys: Austria (Harzhauser 2002) (Burdigalian).
Middle Miocene. NE Atlantic: France (Peyrot 1932); Proto-Mediterranean Sea: Turkey (Landau *et al.* 2013); Paratethys: Austria (Hörnes 1856; Berger 1953), Poland (Bałuk 1970), Hungary (Strausz 1966).
Late Miocene. NE Atlantic: Portugal (Landau *et al.* 2013), Mediterranean Sea: Italy (Sacco 1896).
Early Pliocene. NE Atlantic: Spain (Landau *et al.* 2011), central Mediterranean Sea: Italy (Chirli 2013).
Early Pleistocene. central and eastern Mediterranean Sea: Italy (Cerulli-Irelli 1910), Greece (Koskeridou *et al.* 2009).
Early-Middle Pleistocene. eastern Mediterranean Sea: Greece (Nielsen *et al.* 2006).
Recent. NE Atlantic, Baltic Sea to Canary Islands and Mediterranean Sea (Thompson 1988; MolluscaBase 2018).

Remarks

Juveniles, small specimens and fragments of *Retusa truncatula* were recovered in the Greek material. The morphology of the specimens of the present material is consistent with the range of variation of *R. truncatula*.

Retusa truncatula has been recorded widely in the fossil record and it is still present in the northeastern Atlantic and Mediterranean (Landau *et al.* 2013; MolluscaBase 2018). It is possible that we are dealing with a cryptic species since the taxon seems very long-lived and widespread. As Oskars *et al.* (2015) mention, the phylogenetic relationships of the family should be investigated in detail, which could bring more information relative to the fossil representatives of the family Retusidae.

Genus *Pyrunculus* Pilsbry, 1895

Type species. — *Bulla pyriformis* A. Adams *in* Sowerby, 1850, by monotypy. Recent, China Sea.

Pyrunculus sp.
(Fig. 7E1, E2)

Material examined. — Sample F11: AMPG(IV) 2545, 2546 (two specimens [1 incomplete]).

Dimensions. — Maximum height: 2.80 mm.

Distribution. — **Early Miocene**. Proto-Mediterranean Sea: Greece (this paper).

Description

Shell small, fragile, elongated pyriform, one whorl visible. Sculpture of fine growth lines. Apex angular, apical umbilicus narrow (0.34 mm); umbilicus not observable; anterior end rounded; aperture long, wide anteriorly, narrowing abruptly at about ⅖ of its length. Outer lip morphology not preserved.

Remarks

One complete specimen and a second, incomplete specimen of a *Pyrunculus* species are available. The species is reminiscent of the widespread Miocene *Pyrunculus elongatus* (Eichwald, 1830) but differs in its smaller size, more slender outline and the more pronounced concavity in the upper part of the last whorl. Moreover, its apex is wider and straighter than in *P. elongatus*. Dorsally, the outline forms an almost straight line on the left side, whereas the right side is more angular, with a small angle at about ⅔ of the height of the shell.

The Greek specimens seem to represent a new species, but due to the low number of available specimens and their moderate preservation; we refrain from describing it formally as new.

Family Rhizoridae Dell, 1952

Genus *Volvulella* Newton, 1891

Type species. — *Bulla acuminata* Bruguière, 1792, by subsequent designation (Adams 1862). Recent, Europe.

Volvulella acuminata (Bruguière, 1792)
(Fig. 7F1, F2)

Bulla acuminata Bruguière, 1792: 376.

Volvulella acuminata – Landau *et al.* 2013: 339, pl. 78, fig. 2 (cum syn.).

Material examined. — Sample F11: AMPG(IV) 2547-2549 (three specimens).

Dimensions. — Maximum height: 2.32 mm.

Distribution. — **Early Miocene**. Proto-Mediterranean Sea: Italy (Sacco 1897), Greece (this paper).

Middle Miocene. Proto-Mediterranean Sea: Turkey (Landau *et al.* 2013); Paratethys: Austria (Berger 1953), Hungary (Strausz 1966); North Sea Basin: the Netherlands (A.W. Janssen 1984), Germany (Moths *et al.* 2010).
Late Miocene. NE Atlantic (Landau *et al.* 2013).
Early Pliocene. NE Atlantic, North Sea Basin (Landau *et al.* 2013); western Mediterranean (Landau *et al.* 2011); eastern Mediterranean: Greece (Koskeridou *et al.* 2017).
Early Pleistocene. Central Mediterranean: Italy (Cerulli-Irelli 1910).
Recent. Eastern Atlantic, Norway to Angola into Mediterranean (Landau *et al.* 2013).

Remarks

Minute species, with a characteristic pointed apex. The morphology of the shells of the present material is consistent with the representatives of this species. As mentioned for *Retusa truncatula*, *Vollvulela acuminata* is either an extremely long lived species or a species complex that includes specimens that have similar and indistinguishable morphologies.

In the Early Miocene the species is missing from the Aquitanian and Loire Basins in France, where *Volvulella acuta* (Grateloup, 1827) is present (Landau *et al.* 2013).

Superfamily Cylichnoidea H. Adams & A. Adams, 1854
Family Cylichnidae H. Adams & A. Adams, 1854

Genus *Cylichna* Lovén, 1846

Type species. — *Bulla cylindracea* Pennant, 1777 (= *Cylichna cylindracea* (Pennant, 1777)), subsequent designation by Hermannsen (1852). Recent, Europe.

Cylichna cf. ***sublaevis*** (d'Orbigny, 1852)

cf. *Bulla sublaevis* d'Orbigny, 1852: 95, n°1772.

cf. *Bulla laevis* – Grateloup 1837: 400, pl. 3, figs 35, 36 (*non* Defrance).

cf. *Bullinella* (*Cylichnina*) *sublaevis* – Peyrot 1932: 187, no. 1396, pl. 13, figs 31, 33.

cf. *Cylichna sublaevis* – Lozouet *et al.* 2001: 81, pl. 37, figs 2a, b.

Material examined. — Sample F11: AMPG(IV) 2550-2553 (four specimens).

Dimensions. — Maximum height: 2.20 mm.

Distribution. — **Early Miocene**. NE Atlantic: France (Aquitaine Basin) (d'Orbigny 1852; Peyrot 1932; Lozouet *et al.* 2001); Proto-Mediterranean Sea: Greece (this paper).

Remarks

A species of *Cylichna* was recovered, whose morphology bears many similarities with *Cylichna sublaevis* (d'Orbigny, 1852) despite the poor preservation. The shell is subcylindrical, smooth, with sculpture consisting of inconspicuous growth lines; adapically the outer lip rises above the apex and forms a narrow apical perforation. The aperture is partially broken in all specimens; the inner lip is small and bears a small fold. No colour pattern can be observed in the Greek specimens, although it is mentioned by Peyrot (1932) that the species had axial zig-zag-shaped lines. The specimens from Greece seem to be smaller than those mentioned by Peyrot (1932) (5.5 mm) but this is most probably due to the preservation of these fragile shells in the present material, with larger size specimens being very fragmented.

Superorder PYLOPULMONATA Bouchet *et al.*, 2017
Superfamily Pyramidelloidea Gray, 1840

Family Pyramidellidae Gray, 1840

Remark

This family has incited many discussions and works over the years both for recent and for fossil species. Almost all of the species are ectoparasites of soft-bodied invertebrates (e.g. polychaete worms and other molluscs) (Dinapoli *et al.* 2011).

Taxonomic descriptions have been based on the teleoconch morphology and especially on the protoconch according to descriptions and illustrations of Peñas *et al.* (1996). Works on the phylogenies of the family are few, which complicates the correct assignment of species to genera.

Subfamily Pyramidellinae Gray, 1840

Genus *Pyramidella* Lamarck, 1799

Type species. — *Trochus dolabratus* Linnaeus, 1758 (= *Pyramidella dolabrata* (Linnaeus, 1758)), by monotypy. Recent, Caribbean.

Pyramidella cf. ***plicosa*** Bronn, 1838
(Fig. 7G1-G3)

cf. *Pyramidella plicosa* Bronn, 1838: 1026, pl. 40, fig. 24.

cf. *Pyramidella plicosa* – Landau *et al.* 2013: 304, pl. 52, fig. 5 (cum syn.).

Material examined. — Sample F11: AMPG(IV) 2554-2556 (three specimens).

Dimensions. — Maximum height: 5.00 mm, diameter. 2.20 mm.

Distribution. — **Early Miocene**. Proto-Mediterranean Sea: Italy (Sacco 1892), Greece (this paper).
Middle Miocene. Proto-Mediterranean Sea: Turkey (Landau *et al.* 2013); North Sea Basin: Belgium (Glibert 1952), Denmark, Germany (Landau *et al.* 2013), the Netherlands (A.W. Janssen 1984).
Late Miocene. Central Mediterranean: Italy (Sacco 1892); North Sea Basin: Denmark, Belgium (Landau *et al.* 2013).
Early Pliocene. Western Mediterranean (Landau *et al.* 2013); central Mediterranean (Malatesta 1974); North Sea Basin (Glibert 1958).
Late Pliocene. Central Mediterranean: Italy (Sacco 1892); North Sea Basin (Marquet 1998).
Early Pleistocene. Central Mediterranean: Italy (Cerulli-Irelli 1914).

Description

Small, moderately slender, high conical shell; apical angle 30°. Protoconch of type A, partially immersed. Teleoconch consisting of seven, flat whorls with narrowly incised suture, resulting in

faintly gradate spire. Transition into convex base weakly angulated. Aperture tear-shaped with 3 columellar folds and a narrow canal.

Remarks

A complete list of synonymy is provided by Landau *et al.* (2013). Several varieties have been created due to the morphological variability of the species; the length, the angulation and width of the last whorl, and the strength of the three columellar folds. In the present material, only one protoconch was preserved, of type A and partially immersed, therefore no variability can be observed. There is a variation with size of the columellar teeth of the Greek specimens, the smallest specimen bears more prominent folds in contrary to the largest specimen for which they are moderately developed.

The species differs from *Pyramidella grateloupi* (d'Orbigny, 1852) from the type region (SW France, Aquitaine) in being more slender, having a less incised suture and having a less cyrtoconoid outline.

Subfamily Odostomiinae Pelseneer, 1928

Genus *Odostomia* J. Fleming, 1813

Type species. — *Turbo plicatus* Montagu, 1803 (= *Odostomia plicata* (Montagu, 1903)), subsequent designation by Gray (1847). Recent, Europe.

Remark

Odostomia has been used for including Pyramidellidae with a smooth shell and a columellar tooth (Høisæter 2014). Since then, it has included species with these characters that cannot be classified with certainty in other genera of Odostominae. Here, we use it *sensu lato*.

'*Odostomia*' *s.l.* sp. 1
(Fig. 7H1-H4)

Material examined. — Sample F11: AMPG(IV) 2557 (one specimen).

Dimensions. — Maximum height: 1.75 mm.

Distribution. — **Early Miocene**. Proto-Mediterranean Sea: Greece (this paper).

Description

Type C partially immersed tilted protoconch. Teleoconch whorls shouldered, smooth and flat, sutures deeply incised, V-shaped. Sculpture on the base of the shell consists of fine spiral grooves and axial growth lines. Last whorl slightly angular; aperture rhomboid; umbilicus very restricted; columellar tooth moderately developed.

Remarks

The present species is easily set apart from other Odostomiinae by having a conical shape, a relatively solid shell with flat whorls and very distinct sutures. The partially immersed protoconch forms an acute angle with the first teleoconch whorl of about 45°. The almost indistinguishable subsutural collar gives a shouldered aspect to the whorls and accentuates the sutures.

Morphologically, it is most similar, regarding the shape of the whorls, the protoconch and the aperture, to the recent species *Odostomia didyma* (Verrill & Bush, 1900) (= *Eulimastoma didymum* (Verrill & Bush, 1900)?). Nevertheless, the genus *Eulimastoma* Bartsch, 1916 is characterised by spiral microstructure which is not observed on the present specimen, possibly due to the preservation of the shell.

Furthermore, the shape and overall morphology of *Odostomia* (*Pyramistomia*) *fehrae* van Aartsen, Gittenberger & Goud, 1998 is similar. The latter species is classified in *Pyramistomia* Cossmann, 1921 at the subgenus level, on grounds of having similarities with *Odostomia deubeli* Boettger, 1901 (= *Pyramistomia deubeli* Boettger, 1901) (type species of *Pyramistomia*) (van Aartsen *et al.* 1998). In a revision of the genus *Eulimastoma* Bartsch, 1916, Pimenta & Absalão (2004) mention that *O.* (*Pyramistomia*) *fehrae* is related. In the present state of knowledge of the apomorphies of these genera, it is not possible to assign the present specimen with certainty, thus its placement in *Odostomia s.l.*

'*Odostomia*' *s.l.* sp. 2
(Fig. 8A1, A2)

Material examined. — Sample F11: AMPG(IV) 2558, 2559 (two specimens).

Dimensions. — Maximum height: 1.30 mm.

Distribution. — **Early Miocene**. Proto-Mediterranean Sea: Greece (this paper).

Description

Type B planispiral and partially immersed protoconch. Teleoconch of three flat whorls; sculpture consists of inconspicuous orthocline growth lines; sutures impressed. Last whorl angular; umbilicus small and narrow, aperture oval, outer lip missing.

Remarks

The shell is short and conical; all specimens have a type B protoconch with an arch-shaped suture (Peñas & Rolán 2010). The apex of the protoconch forms a concavity to the suture between protoconch and first teleoconch whorl, which is a feature, observed in some specimens with type B partially immersed protoconchs in the genus *Eulimastoma*. Nevertheless, the present specimen lacks other characters that could place it in the latter genus (inflated suprasutural band, sculpture of the base of the shell).

Genus *Megastomia* Monterosato, 1884

Type species. — *Odostomia conspicua* Alder, 1850, by original designation. Recent, Europe.

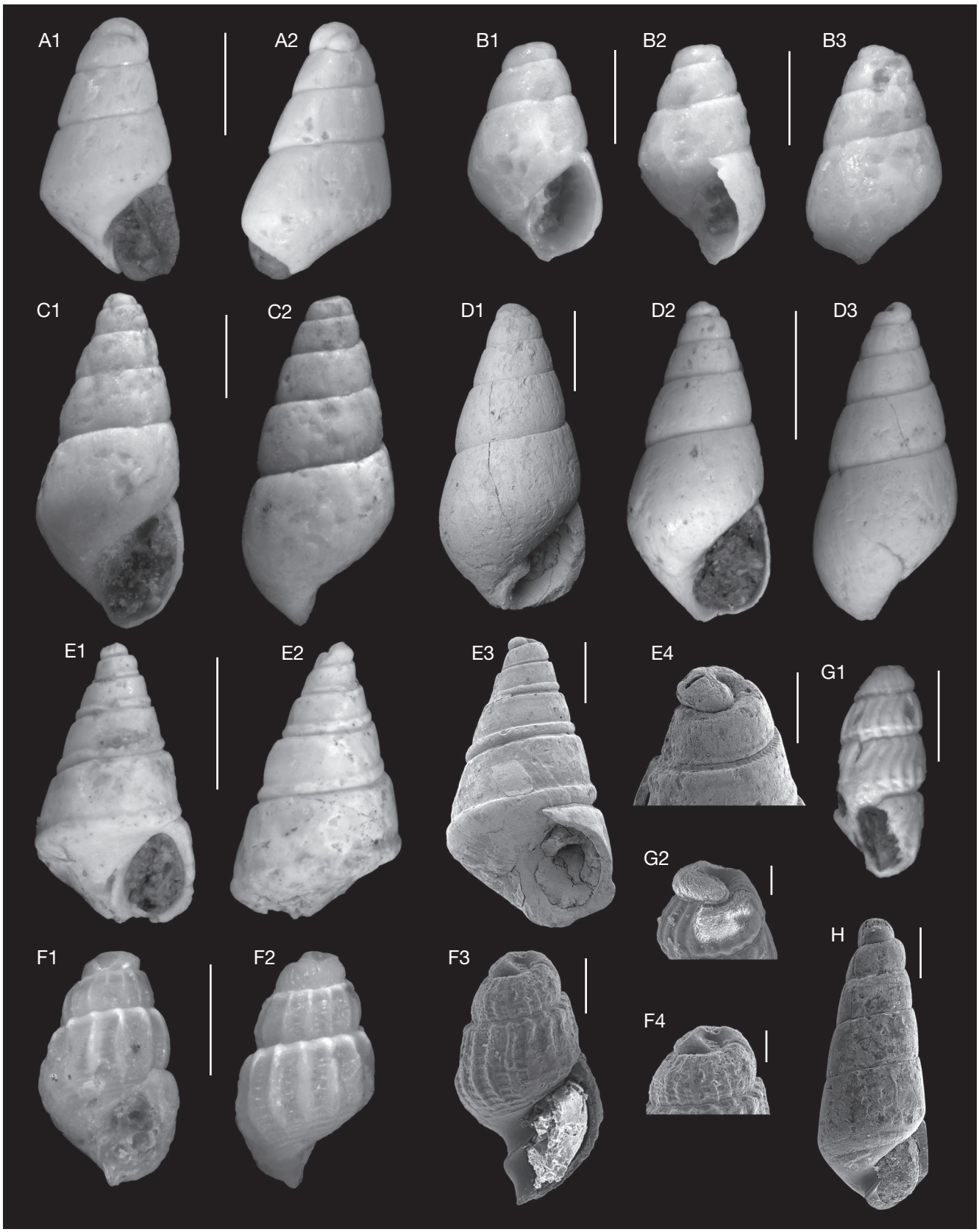

FIG. 8. — **A1**, **A2**, '*Odostomia*' sp. 2, AMPG(IV) 2558; **B1**-**B3**, *Megastomia* sp. 1, AMPG(IV) 2560; **C1**, **C2**, *Brachystomia* sp., AMPG(IV) 2570; **D1**-**D3**, *Megastomia* sp. 2: **D1**, AMPG(IV) 2563; **D2**, **D3**, AMPG(IV) 2564; **E1**-**E4**, *Pyramistomia aliakmoni* n. sp.: **E1**, **E2**, holotype, AMPG(IV) 1500; **E3**, paratype 1, AMPG(IV) 1501 (SEM image); **E4**, AMPG(IV) paratype 1, AMPG(IV) 1501, protoconch (SEM image); **F1**-**F4**, *Parthenina* sp. 1: **F1**, **F2**, AMPG(IV) 1573; **F3**, AMPG(IV) 1574 (SEM image); **F4**, AMPG(IV) 1574, apex (SEM image); **G1**, **G2**, *Parthenina* sp. 2: **G1**, AMPG(IV) 2575; **G2**, AMPG(IV) 2575, apex (SEM image); **H**, ?*Syrnola* sp., AMPG(IV) 2577 (SEM image). Scale bars: A1, A2, B1-B3, D1, G1, H, 500 µm; C1, C2, D2, D3, E1, E2, 1 mm; E3, F1, F2, 400 µm; E4, F3, 200 µm; F4, G2, 100 µm.

Megastomia sp. 1
(Fig. 8B1-B3)

MATERIAL EXAMINED. — Sample F11: AMPG(IV) 2560-2562 (three specimens).

DIMENSIONS. — Maximum height: 1.20 mm.

DISTRIBUTION. — **Early Miocene**. Proto-Mediterranean Sea: Greece (this paper).

DESCRIPTION
Small, solid shell with broad conical outline; spire angle *c.* 26°. Intorted type C protoconch of *c.* 300 µm diameter, resulting in very blunt apex. Axial sculpture consisting of inconspicuous, orthocline growth lines. Whorls only faintly convex, sutures impressed and linear. Last whorl inconspicuously angular at periphery; accounting for about 60% of total height. Columella weakly concave with central columellar tooth; outer lip smooth. Six elongate teeth appear behind aperture in last whorl. Umbilicus reduced to narrow chink.

REMARKS
The generic placement is based on the presence of elongate teeth behind the outer lip (Peñas & Rolán 1999; Robba 2013). All available specimens are very small and might represent subadult specimens. The type C protoconch distinguishes this species from the widespread Miocene to Recent European *Megastomia conoidea* (Brocchi, 1814). Among the Recent species of *Megastomia*, only *M. lorioli* (Hornung & Mermod, 1924) develops a type C protoconch (Bogi & Cuneo 1999). This Lessepsian migrant differs from the Aquitanian species from Greece in its strongly incised suture. The extant *Odostomia lukisii* Jeffreys, 1859 has a very similar shell morphology, with an immersed type C protoconch, but lack the teeth within the outer lip.

Megastomia sp. 2
(Fig. 8D1-D3)

MATERIAL EXAMINED. — Sample F11: AMPG(IV) 2563-2569 (seven specimens).

DIMENSIONS. — Maximum height: 2.20 mm.

DISTRIBUTION. — **Early Miocene**. Proto-Mediterranean Sea: Greece (this paper).

DESCRIPTION
Moderately slender, solid shell; apical angle *c.* 27°. Partially immersed, type B protoconch. Teleoconch comprising four feebly convex, smooth whorls, with inconspicuous microscopical orthocline growth lines separated by impressed sutures. Last whorl attaining about 60% of total height; slightly angulated at periphery. Columella concave with narrow columellar fold; aperture ovate; outer lip with five observable spiral lines. No umbilicus.

REMARKS
Two protoconch whorls are visible on the shells (including the nucleus). Type B protoconch and columellar tooth place this shell in the *Odostomia* group, and the spiral striations of the inner lip in the *Megastomia* genus. It is also separated from '*Odostomia*' sp. 2 of the present material, in having a more immersed protoconch and more rounded whorls.

The overall morphology is similar to *M. conoidea* with the main difference being that the protoconch of the Greek specimen is of type B a slightly more rounded last whorl. The size and protoconch type coincides with that of *Odostomia* sp. from the stratotype region of the Aquitanian (Aquitaine Basin, SW France) (Lozouet *et al.* 2001). Nevertheless, the Greek specimen has a more conical shape and spiral sculpture on the inner lip that differentiates it.

Genus *Brachystomia* Monterosato, 1884

TYPE SPECIES. — *Odostomia rissoides* Hanley, 1844 (= *Brachystomia scalaris* (MacGuillivray, 1843)), subsequent designation by Crosse (1885). Recent, Europe.

REMARK
Due to the few shell characters of the genus, species belonging to *Brachystomia* Monterosato, 1884 have been included in *Ondina* de Folin, 1870 and *Auristomia* Monterosato, 1884 used as genera or subgenera (Lozouet *et al.* 2001; Høisæter 2014).

Brachystomia sp.
(Fig. 8B1, B2)

MATERIAL EXAMINED. — Sample F11: AMPG(IV) 2570-2572 (three specimens).

DIMENSIONS. — Maximum height: 2.00 mm.

DISTRIBUTION. — **Early Miocene**. Proto-Mediterranean Sea: Greece (this paper).

DESCRIPTION
Moderately slender shell with apical angle of *c.* 25°. Intorted type C protoconch of *c.* 210 µm diameter. Teleoconch consisting of five weakly convex smooth whorls; suture non-canaliculate impressed. Last whorl attains 60% of total height with faint angulation; base moderately convex, slowly contracting. Narrow ovate aperture; columella with small fold not visible in direct apertural view. Umbilicus reduced to barrow chink.

REMARKS
The apex appears blunt due to the completely intorted protoconch which is a character separating the genera *Brachystomia* Monterosato, 1884 and *Odostomia* Fleming, 1813 (Robba 2013; Landau & LaFollette 2015). Furthermore, the shell is smooth and the protoconch very flat which are characters shared with the type species of the genus *B. scalaris* MacGuillivray, 1843 as described and illustrated by Høisæter (2014). Based on the similarities

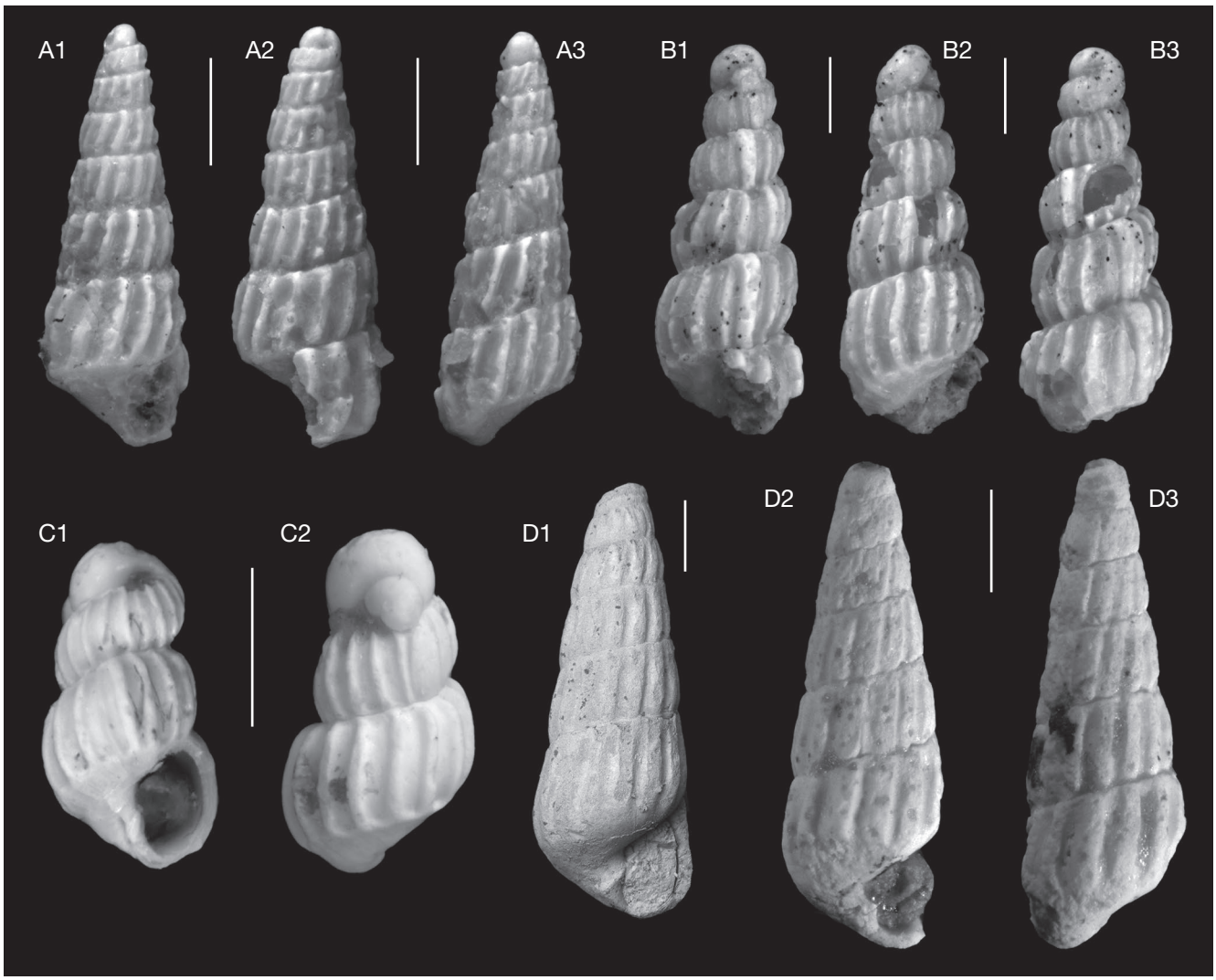

FIG. 9. — **A1**-**A3**, *Turbonilla* (*s.l.*) sp. 1, AMPG(IV) 2580; **B1**-**B3**, *Turbonilla* (*s.l.*) sp. 2, AMPG(IV) 2583; **C1**, **C2**, *Turbonilla* (*s.l.*) sp. 3, AMPG(IV) 2584; **D1**-**D3**, *Turbonilla* (*s.l.*) sp. 4: **D1**, AMPG(IV) 2586 (SEM image); **D2**, **D3**, AMPG(IV) 2687. Scale bars: 500 µm.

The shape of the Greek shells share the basic characters of the genus *Brachystomia* Monterosato, 1884 *Odostomia* (*Brachystomia*) sp. from the Miocene of the North Sea Basin (Moths *et al.* 2010). It has an intorted protoconch, a smooth shell, and similar aperture with a narrow umbilical chink and a columellar tooth not clearly visible in direct apertural view. Nevertheless, the latter specimen has a less blunt apex and is slightly longer (maximum height: 2.40 mm) than the Greek specimen. The general aspect and morphology is also close to *Odostomia fusulus* Monterosato, 1878 (Landau *et al.* 2013) (= *Auristomia fusulus* (Monterosato, 1878)), including the structure of the protoconch, but it is narrower and has a smaller aperture. *Odostomia elisabethae* Boettger, 1907 from the Serravallian of the Karaman Basin (Turkey) is another morphologically close species with a less intorted protoconch, clearly defined umbilicus, much more prominent umbilical fold, and smaller aperture than the Greek specimen. Lastly, the overall morphology is close to *Ondina cicatricosa* Lozouet, Lesport & Renard, 2001, especially regarding the apex and the proportion of the last whorl, the main differences with the Greek specimen are the opisthocline growth lines, the inconspicuous spiral sculpture which is absent from *Brachystomia* sp., and the deep umbilicus.

Genus *Pyramistomia* Cossmann, 1921

TYPE SPECIES. — *Odostomia deubeli* Boettger, 1902, by monotypy. Middle Miocene of Romania.

Pyramistomia aliakmoni n. sp.
(Fig. 8E1-E4)

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TYPE MATERIAL. — Holotype: sample F11: AMPG(IV) 1500. — Paratype 1: sample F11: AMPG(IV) 1501. — Paratype 2: sample F11: AMPG(IV) 1502.

DIMENSIONS. — Maximum height: 1.95 mm; maximum width: 1.00 mm.

ETYMOLOGY. — Named after the river god Aliakmon of Greek mythology (son of Oceanus and Tethys), who lived in the river Aliakmon where the specimen was collected.

TYPE LOCALITY. — Felli village section, 40°01'4.55"N, 21°33'34.37"E, Mesohellenic Basin, Grevena area, Greece.

TYPE LEVEL. — Pentalofos Formation, Aquitanian, lower Miocene.

DIAGNOSIS. — Small-sized species of *Pyramistomia* with pyramidal shape, type C inverted protoconch, smooth whorls, canaliculated suture with distinct axial threads, and single, prominent spiral cord at abapical suture.

DISTRIBUTION. — **Early Miocene**. Proto-Mediterranean Sea: Greece (this paper).

DESCRIPTION

Small solid pyramidal shell, apex blunt. Protoconch of type C, completely intorted. Teleoconch of 4-4.5 whorls. Suture canaliculated, impressed with distinct axial threads. Prominent spiral cord at abapical suture. Axial sculpture of inconspicuous strongly prosocline irregularly spaced growth lines; spiral threads on base. Columella thickened, with small tooth, bordering a narrow umbilical chink.

REMARKS

This species is set apart from other members of the family by its solid shell, its type C protoconch, and its strong spiral sculpture that consists of a prominent suprasutural spiral cord. Few species of *Pyramistomia* have been described in the fossil record and recent species are also scarce (Landau *et al.* 2013). *Pyramistomia deubeli* (Boettger, 1902) is a relatively well-known species from the middle Miocene of Europe (Paratethys, Proto-Mediterranean Sea). It differs from *P. aliakmoni* n. sp. in its additional spiral cord below the adapical suture and the broader outline. Recent species of *Pyramistomia* described by Peñas & Rolán (1999) and discussed by Landau *et al.* (2013) seem to belong to the genus *Odostomia*, and the placement in a particular genus is uncertain. The recent *Odostomia fehrae* Van Aartsen, Gittenberger & Goud, 1998, placed in *Pyramistomia* by van Aartsen *et al.* (1998), might rather be related with *Eulimastoma* according to Pimenta & Absalão (2004).

Genus *Parthenina* Bucquoy, Dautzenberg & Dollfus, 1883

TYPE SPECIES. — *Turbo interstinctus* J. Adams, 1797 (= *Parthenina interstincta* (J. Adams, 1797)), by original designation.

REMARK

This genus was used by Peñas & Rolán (2017) for recent deep water Pyramidelloidea from the Central and South Pacific. These authors assumed that the Indo-Pacific species should be placed in *Prestoniella* Saurin, 1958. Here, the European species of the Early Miocene of the Proto-Mediterranean are considered to belong to *Parthenina* as suggested by Landau *et al.* (2013).

Parthenina sp. 1 (Fig. 8F1-F4)

MATERIAL EXAMINED. — Sample F11: AMPG(IV) 2573, 2574 (two specimens).

DIMENSIONS. — Maximum height: 1.00 mm.

DISTRIBUTION. — **Early Miocene**. Proto-Mediterranean Sea: Greece (this paper).

DESCRIPTION

Minute shell; type C protoconch. Two teleoconch spires preserved; axial sculpture consists of slightly sigmoidal and regularly spaced orthocline smooth ribs; spiral sculpture consists of flat spiral cords. Abapically, the cords overlap with the ribs. Aperture tear-shaped; strong columellar fold.

REMARKS

The sculpture and type C protoconch are similar to *Chrysallida longula* (Boettger, 1907) from the middle Miocene of the Paratethys and the Proto-Mediterranean (Landau *et al.* 2013).

Parthenina longula (Boettger, 1907) differs from the Greek shell in its much more prominent axial ribs, the less convex first teleoconch whorl and the absence of the weak sutural cord. The weak sutural cord around the upper suture also allows a separation of this species from *Parthenina amaciata* (Nrusina, 1966), *P. majae* Landau, Harzhauser, İslamoğlu & Da Silva, 2013 and *P. obtusa* (Brown, 1827) as described by Landau *et al.* (2013) for the Serravallian (Middle Miocene) of Turkey. Furthermore, the sculpture of the shell is reminiscent of *Parthenina belgica* Glibert, 1958 (e.g. in Moths *et al.* 2010), with this species having a more elongated shell. It also differs from *Parthenina pygmaea* (Grateloup, 1838) in having a finer spiral sculpture.

Parthenina sp. 2 (Fig. 8G1, G2)

MATERIAL EXAMINED. — Sample F11: AMPG(IV) 2575, 2576 (two incomplete specimens).

DIMENSIONS. — Maximum height: 1.18 mm

DISTRIBUTION. — **Early Miocene**. Proto-Mediterranean Sea: Greece (this paper).

DESCRIPTION

Elongated pupoid small shell; type C smooth protoconch. Apex blunt; first teleoconch whorl flat. Three teleoconch whorls preserved, whorls 2 and 3 almost flat; axial sculpture consists of slightly sigmoidal and opisthocline rounded ribs; spiral sculpture includes one abapical cord present between ribs. Sutures deep, V-shaped. Narrow umbilicus; columellar tooth present; aperture missing.

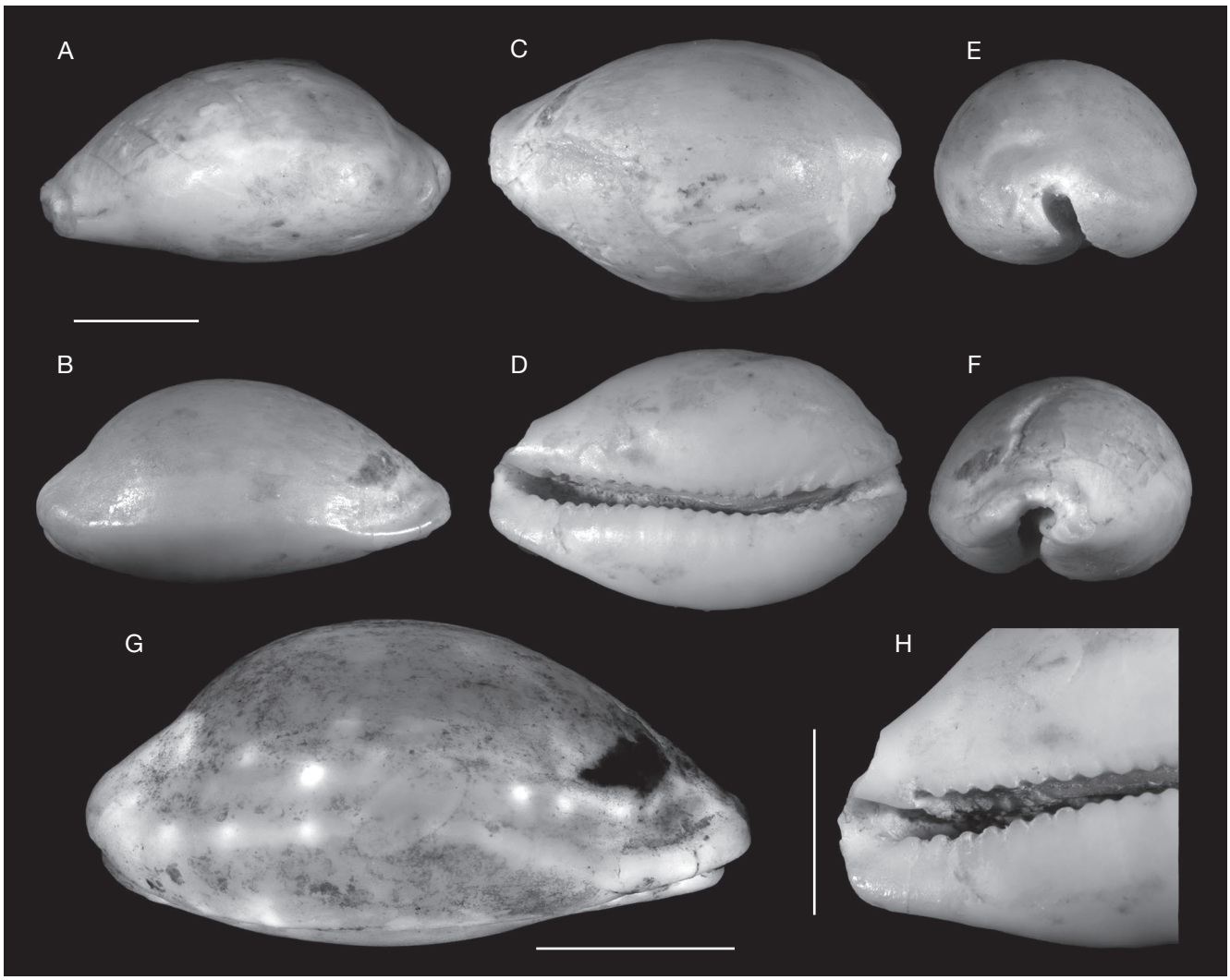

Fig. 10. — ?*Praerosaria* sp.: **A-H**, AMPG(IV) 2460; **G**, AMPG(IV) 2460, under UV light. Scale bars: 5 mm.

Remarks

The present shell is morphologically very close to *Parthenina obtusa* (Brown, 1817) as illustrated by Landau *et al.* (2013). Nevertheless, the Greek species differs in having a marked angulation close above the lower suture from the first teleoconch whorl on, and steeper flanks. In the stratotype region of the Aquitanian (SW France), *Parthenina degrangei* (Cossmann & Peyrot, 1917) has a similar axial sculpture (Lozouet *et al.* 2001) that becomes more strongly opisthocline on the last whorl, and bear two spiral cords above the lower suture on the two last teleoconch whorls whereas the Greek species only has one.

Subfamily Syrnolinae Saurin, 1958

Genus *Syrnola* A. Adams, 1860

Type species. — *Syrnola gracillima* A. Adams, 1860, by monotypy. Recent (Holocene), Japan.

Remark

According to van Aartsen *et al.* (2000), *Syrnola* members have a clearly defined columellar tooth.

?*Syrnola* sp.
(Fig. 8H)

Material examined. — Sample F11: AMPG(IV) 2577-2579 (three specimens).

Dimensions. — Maximum height: 1.83 mm

Distribution. — **Early Miocene**. Proto-Mediterranean Sea: Greece (this paper).

Remarks

The specimens are placed only tentatively in this genus since the protoconch is weathered, and could possibly be of type A2; the columella bears a clearly defined tooth as in *Syrnola* species (van Aartsen *et al.* 2000). The overall morphology

of the shell is very similar with the Eocene species *Syrnola polygyrata* (Deshayes, 1861), with the later species having a type A1 protoconch.

Subfamily Turbonillinae Bronn, 1849

Genus *Turbonilla* Risso, 1826

Type species. — *Turbonilla costulata* Risso, 1826 (= *Turbonilla lactea* (Linnaeus, 1758)), subsequent designation by Hermannsen (1852). Pleistocene, France.

Remark

The genus *Turbonilla* is characterized by species with elongated and ornate shells, and type A helicoidal protoconchs (Peñas & Rolán 2010). As shown by Schander *et al.* (2003) relationships within some major gastropod clades have still not been studied. The Pyramidellidae is one such group, comprising more than 6000 named species in more than 350 genera. We sequenced part of the mitochondrial 16S gene from 32 species in an attempt to clarify pyramidellid phylogeny and employed a successive alignment approach that allowed us to maximize the phylogenetic signal of the data. Neighbour-joining, maximum parsimony and likelihood analyses recovered two distinct clades. One clade consisted of Noemiamea which nested within Odostomia (sensu stricto, the subfamily Turbonillinae Bronn, 1849 is polyphyletic. In the work by Landau & LaFollette (2015) on Miocene deposits of Venezuela it was possible to differenciate between *Chemnitzia* d'Orbigny 1840 and *Turbonilla s.s.* Risso, 1826. Herein, we use *Turbonilla s.l.* since the preservation of the shells does not allow a certain generic attribution or identification to the species level.

Turbonilla s.l. sp. 1
(Fig. 9A1-A3)

Material examined. — Sample F11: AMPG(IV) 2580-2582 (three specimens).

Dimensions. — Maximum height: 2.15 mm (incomplete), diameter: 0.65 mm.

Distribution. — **Early Miocene**. Proto-Mediterranean Sea: Greece (this paper).

Description

Type A2 helicoidal protoconch forming an angle of 115° with the axis of the shell; diameter: 195 µm. Largest available fragmentary specimen consisting of six flat teleoconch whorls forming moderately slender shell of *c.* 22°; sculpture consisting of opisthocline convex equally-spaced ribs numbering 6 on last preserved whorl, separated by concave interspaces of roughly same width. Axial ribs terminating as distinct tips at adapical suture (not fading out) and passing into weak spiral cord at transition into base on last preserved whorl. No spiral sculpture. Sutures linear and impressed; no columellar fold; aperture missing.

Remarks

The present species shares many morphological similarities with *Turbonilla spiculoides* Cossmann & Peyrot, 1917 from the Early Miocene of France (Aquitaine) as far as the sculpture is concerned. The protoconch is very similar in terms of size for the Greek species and *T. spiculoides*. The main difference is that *T. spiculoides* has more rounded ribs and the space between the ribs is shallower. Moreover, its teleoconch whorls are slightly convex (Cossmann & Peyrot 1917; Lozouet *et al.* 2001). Other similar species are *T. gastaldi* (Semper, 1865) and *T. superstructa* Boettger, 1907, which present similar sculptures but can be less slender and have more convex whorls.

Turbonilla s.l. sp. 2
(Fig. 9B1-B3)

Material examined. — Sample F11: AMPG(IV) 2583 (one specimen).

Dimensions. — Maximum height: 2.58 mm (incomplete), diameter: 1.00 mm.

Distribution. — **Early Miocene**. Proto-Mediterranean Sea: Greece (this paper).

Description

Type A2 helicoidal protoconch of three whorls forming angle of 125° relative to shell axis; diameter: 360 µm. Last whorl disproportionately larger than the first two. Fragmentary teleoconch consisting of 4.5 convex whorls with incised suture; spire angle about 20°. Sculpture consisting of blunt, faintly opisthocline to sigmoidal axial ribs with convex tops. Spacing slightly irregular with smooth, moderately deep interspaces. Each whorl bears two varix-like axial ribs; first and second one placed under the tip of the protoconch and on opposite side. No spiral sculpture. Aperture missing.

Remarks

This species of *Turbonilla* is characterized by its convex whorls, the prominent sculpture with two varix-like axial ribs per whorl and the allometric growth of the last protoconch whorl.

Turbonilla koeneniana Sacco, 1892 as figured by A.W. Janssen (1984) from the Miocene of the Netherlands is a closely similar species, which differs by having more convex whorls, a slightly more conical shape and randomly placed varices of variable width. Nevertheless, the protoconch has a similar structure with a very inflated last whorl. The different varieties of *T. pseudocostellata* with prominent costae presented by Sacco (1892) differ from the present specimen by having more rounded ribs, no varices, more slender shape, less prominent protoconch and less impressed sutures.

Turbonilla s.l. sp. 3
(Fig. 9C1, C2)

Material examined. — Sample F11: AMPG(IV) 2584-2585 (two specimens).

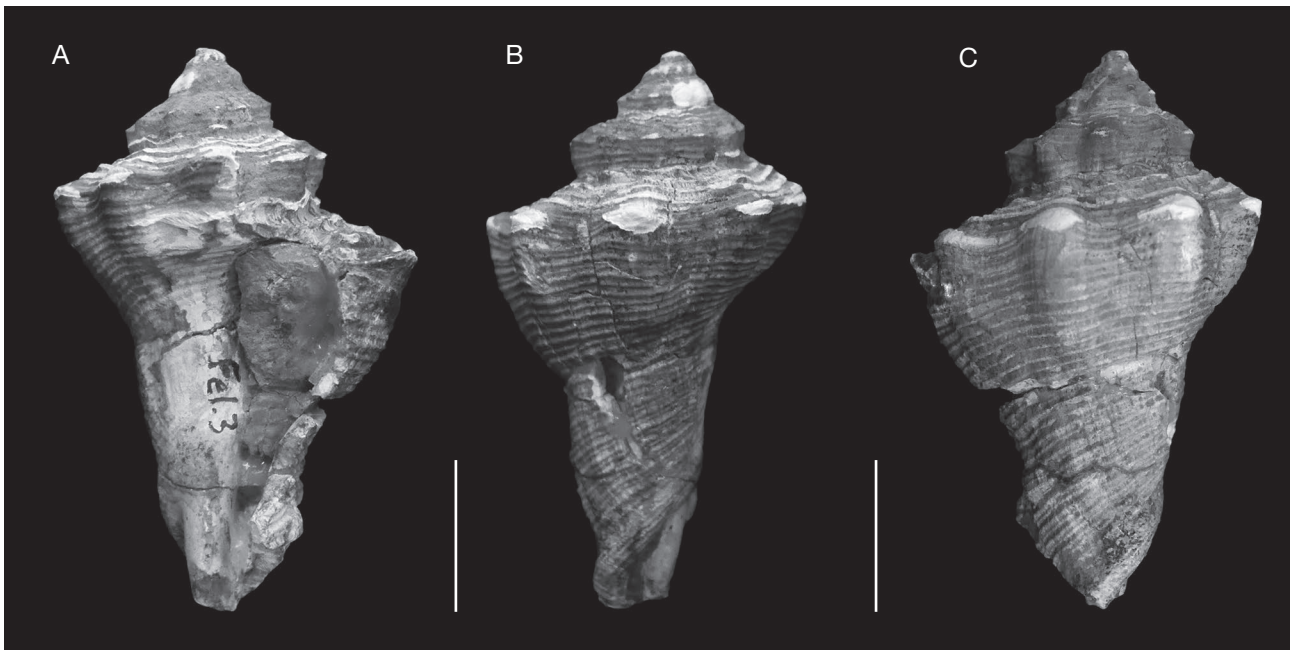

FIG. 11. — *Melongena lainei* (de Basterot, 1825), AMPG(IV) 2467. Scale bars: 10 mm.

DIMENSIONS. — Maximum height: 1.25 mm

DISTRIBUTION. — **Early Miocene**. Proto-Mediterranean in Greece (this paper).

DESCRIPTION
Type A2 helicoidal protoconch; four convex teleoconch whorls preserved. Protoconch forms an angle of about 105° with the axis of the shell. Teleoconch sculpture consists of closely and regularly spaced prosocline fine axial ribs. Inconspicuous columellar fold; aperture missing.

REMARKS
A third species of *Turbonilla* is present. The sculpture is reminiscent of *Turbonilla* sp. 1, but the axial ribs are less prominent, more rounded and more closely spaced; the whorls are also more convex.

Turbonilla s.l. sp. 4
(Fig. 9D1-D3)

MATERIAL EXAMINED. — Sample F11: AMPG(IV) 2586-2593 (eight incomplete specimens).

DIMENSIONS. — Maximum height: 1.85 mm; maximum width: 0.75 mm.

DISTRIBUTION. — **Early Miocene**. Proto-Mediterranean Sea: Greece (this paper).

DESCRIPTION
Elongated, turreted shell, apex missing. Longest teleoconch recovered bears six almost flat whorls; sutures linear, faintly impressed; axial sculpture consists of 6-7 flat almost orthocline ribs, spaces between ribs are smooth. Base smooth; aperture sub-rectangular, columellar fold moderately developed, outer lip straight.

REMARKS
This is the largest species of *Turbonilla*, with a maximum width of 0.75 mm; all of the shells recovered are incomplete. Some type A protoconchs recovered could be attributed to this species although not with certainty (incomplete specimens with only one teleoconch whorl). The ribs have a curved and opisthocline structure (not sigmoidal) which is more prominent in the first teleoconch whorls.

Since the present material is incomplete it cannot be attributed with certainty to a species, although it shares many similarities with *T.* (*Turbonilla*) *gastaldi* auct. (non Semper, 1861) (A.W. Janssen 1984; Landau *et al.* 2013) in terms of sculpture and shape of the aperture. It differs from *T. spiculoides* in having less inflated whorls and a flatter axial sculpture. *Turbonilla* cf. *superstructa* Boettger, 1907 from the Serravallian of Turkey (Landau *et al.* 2013) has a comparably elongated shell yet with more convex whorls.

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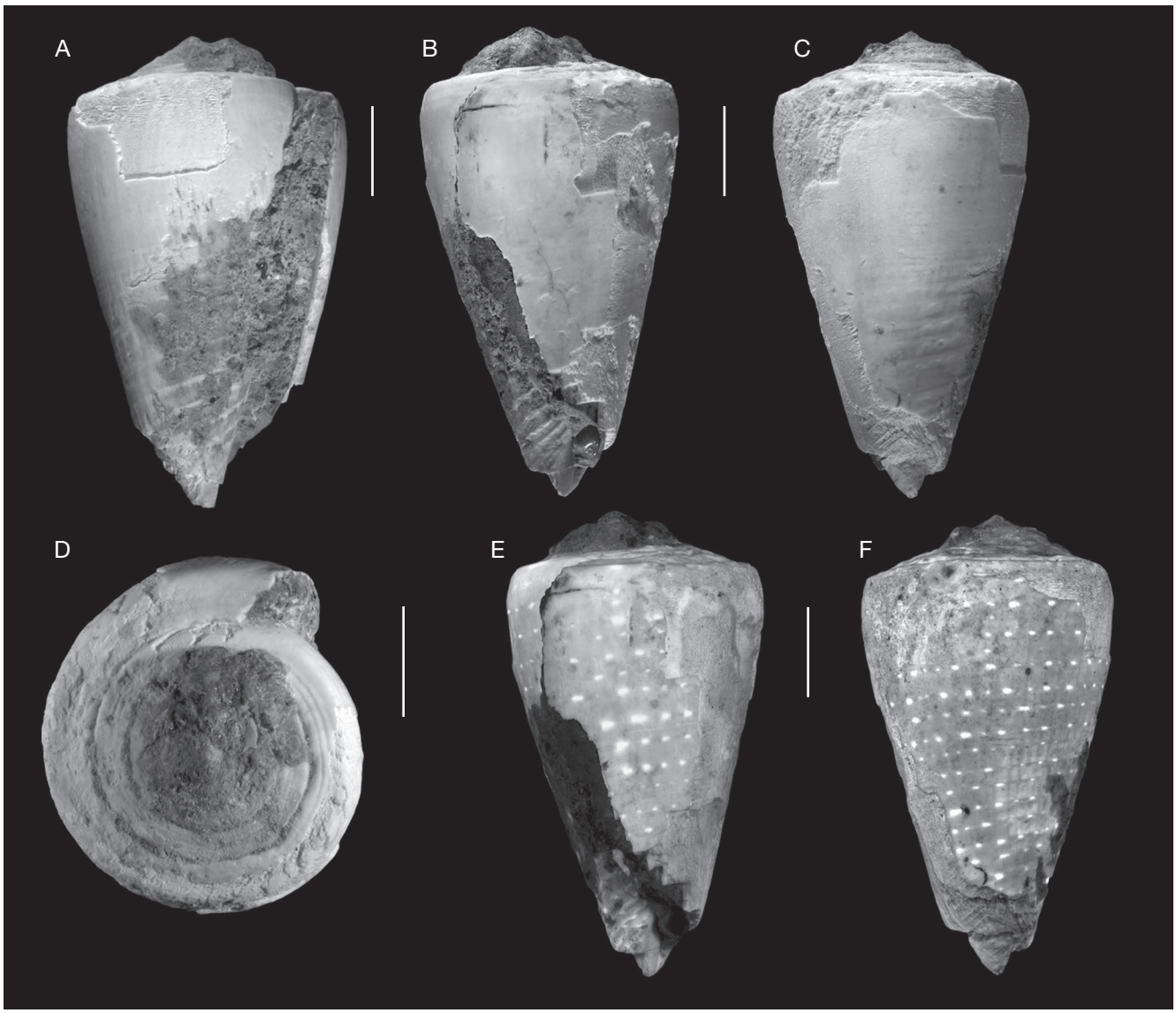

Fig. 12. — ?*Lautoconus*. sp.: **A**-**D**, AMPG(IV) 2473; **E**, **F**, AMPG(IV) 2473, under UV light. Scale bars: 5 mm.

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Appendix 1. — Dataset used for the Cluster Analysis figuring all specimens identifiable at least to the family-level.

	Samples							
Species	F1	F2	F3	F7	F8	F10	F11	F12
Gastropods								
Melongena lainei	0	0	0	1	0	0	0	0
Vitta picta	5	26	2	18	2	2	0	0
Granulolabium plicatum	17	50	28	60	10	1	0	0
?*Theodoxus* sp. 1	0	1	1	0	0	0	0	0
?*Theodoxus* sp. 2	0	0	0	0	1	0	0	0
Mesohalina margaritacea	0	10	0	1	0	0	0	0
Melanopsis sp.	0	7	0	1	0	0	0	0
Cerithidae sp.	0	2	0	1	0	0	0	0
Neritilia neritinoides	0	17	0	1	0	0	0	0
Rissoidae sp.	0	0	0	3	0	0	0	0
Dizoniopsis sp.	0	0	0	0	0	0	3	0
Terebralia subcorrugata	0	0	0	2	0	0	0	0
Terebralia lignitarum	0	0	0	2	0	0	0	0
Mathilda sp.	0	0	0	0	0	1	0	0
Plesiotrochus fallax	0	0	0	0	0	3	2	0
Xenophora sp.	0	0	0	0	0	1	0	0
Homalopoma acaste n. sp.	0	0	0	0	0	3	4	0
Smaragdia merignacensis	0	0	0	0	0	3	3	1
Turritella turris	0	0	0	0	0	4	19	12
Nodiscala cf. *rugatina*	0	0	0	0	0	0	2	0
Bittium larrieyense	0	0	0	0	0	39	230	181
Retusa truncatula	0	0	0	0	0	0	4	0
Volvulella acuminata	0	0	0	0	0	0	3	0
Cylichna cf. *sublaevis*	0	0	0	0	0	0	4	0
Pyrunculus sp.	0	0	0	0	0	0	4	0
Zebinella sp.	0	0	0	0	0	0	4	0
Finella perpusilla	0	0	0	0	0	8	76	16
Triphora (*s.l.*) sp.	0	0	0	0	0	2	4	0
Metaxia sp.	0	0	0	0	0	0	2	0
Xenophora sp.	0	0	0	0	0	1	0	0
Cerithiopsis (*s.l.*) sp. 2	0	0	0	0	0	0	1	0
Gibborissoia varicosa	0	0	0	0	0	0	12	18
Costoanachis terebralis	0	0	0	0	0	0	3	2
Pusia cf. *pyramidella*	0	0	0	0	0	0	4	0
Athleta rarispina	0	0	0	0	0	0	1	0
Acteon cf. *pinguis*	0	0	0	0	0	3	2	4
Rissoina subconoidea	0	0	0	0	0	3	0	0
Alvania amphitrite n. sp.	0	0	0	0	0	2	15	0
Alvania transiens	0	0	0	0	0	3	5	0
Paroxystele orientalis	0	0	0	0	0	0	1	0
Cerithium sp.	0	0	0	0	0	0	3	2
Jujubinus sp.	0	0	0	0	0	0	1	0
Ringicula minor	0	0	0	0	0	0	44	9
Pyramidella plicosa	0	0	0	0	0	0	3	0
'*Odostomia*' (*s.l.*) sp. 1	0	0	0	0	0	0	1	0
'*Odostomia*' (*s.l.*) sp. 2	0	0	0	0	0	0	2	0
Megastomia sp. 1	0	0	0	0	0	0	3	0
Megastomia sp. 2	0	0	0	0	0	0	7	0
Brachystomia sp.	0	0	0	0	0	0	3	0
Pyramistomia aliakmoni n. sp.	0	0	0	0	0	0	3	0
Parthenina sp. 1	0	0	0	0	0	0	2	0
Parthenina sp. 2	0	0	0	0	0	0	2	0
?*Syrnola* sp.	0	0	0	0	0	0	3	0
Turbonilla (*s.l.*) sp. 1	0	0	0	0	0	0	3	0
Turbonilla (*s.l.*) sp. 2	0	0	0	0	0	0	1	0
Turbonilla (*s.l.*) sp. 3	0	0	0	0	0	0	2	0
Turbonilla (*s.l.*) sp. 4	0	0	0	0	0	0	12	0
Naticidae sp.	0	0	0	0	0	5	15	10
Nassarius (*s.l.*) sp.	0	0	0	0	0	3	8	5
Capuloidea sp.	0	0	0	0	0	2	4	0
?*Lautoconus* sp.	0	0	0	0	0	0	1	0
Conus (*s.l.*) sp.	0	0	0	0	0	0	1	0
Seila sp.	0	0	0	0	0	0	1	0
Eulima sp.	0	0	0	0	0	0	4	0

Appendix 1. — Continuation.

Species	Samples							
	F1	F2	F3	F7	F8	F10	F11	F12
Bivalves								
Chama sp.	0	0	0	0	0	5	8	6
Arca sp.	0	0	0	0	0	5	10	6
Acar sp.	0	0	0	0	0	3	1	1
Glycymeris sp.	0	0	0	0	0	2	9	7
Pectinidae sp.	0	0	0	0	0	6	10	5
Ostreidae sp.	0	0	0	0	0	8	15	6
Lucinidae sp.	0	0	0	0	0	2	10	4
Nucula sp.	0	0	0	0	0	1	0	0
Cardiidae sp.	0	0	0	0	0	5	10	6

LIST OF FAMILIES