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Rissoidae (Mollusca: Gastropoda) from northeast Atlantic seamounts

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Abstract
The gastropod family Rissoidae is revised at the species level for the Lusitanian seamounts, situated between Portugal and Madeira, and the Meteor group of seamounts, situated south of the Azores in the northeast Atlantic Ocean. Based on material obtained by dredging and trawling, 48 species are reported, of which 30 are described as new. There is very little overlap between the assemblages found on both groups of seamounts, with only two shared species. On the Lusitanian seamounts, 24 species were collected. Seven species (six with planktotrophic development) are shared with the mainland shelf or slope and are represented in low numbers. Eleven species are endemic to this seamount group as a whole and of these, three account for 75% of individuals. Of the species not shared with the mainland, only one is found on the four seamounts, eight (three new) are found on two or three seamounts and/or neighbouring islands, and six (all new) are endemic to a single seamount. On the Meteor group, 26 species were found, of which five are shared with the Azores and 20 (all new) are endemic to the seamount group as a whole. Most species are found on only two or three seamounts, whereas nine species are endemic to only one of the seamounts, and of these five are concentrated on Atlantis seamount. Eight endemic species of the Meteor group included in *Porosalvania* n. gen. have very different shapes and occupy discrete bathymetric intervals, but are best interpreted as a local radiation originating from a relatively old colonization of this seamount group. The endemic species, and among them the successful ones, all have a paucispiral protoconch denoting non-planktotrophic development. As in the Macaronesian archipelagos, the Rissoidae are the most species-rich molluscan family on the northeast Atlantic seamounts.

Keywords: *Meteor group seamounts, Lusitanian seamounts, taxonomy, new species, larval dispersal, endemism*

Introduction

Seamounts are conspicuous features of the submarine topography, characterized by an elevation of more than 1000 m above the surrounding sea floor. From a biogeographic point of view, they are isolated as would be aerial islands, because organisms living there are not able to live on the surrounding bathyal or abyssal bottoms and arrived on the seamounts through long-distance dispersal events.

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There has been a growing interest in recent years in the biological exploration of seamounts (Gubbay 2003; Stocks 2004; Stocks et al. 2004), both as a model for marine speciation in an insular context, and as a frontier in the knowledge of marine biological diversity. The OASIS project (Oceanic Seamounts: an Integrated Study), started in 2002 with funding by the European Union, aims to provide an integrated assessment of seamount ecology in the northeast Atlantic using two case studies, among which is Seine seamount (Gubbay 2003; Beck et al. 2006). From what is already known, high levels of endemism in the fauna and a large proportion of undescribed species can be expected from the exploration of seamounts (Wilson & Kaufmann 1987; Rogers 1994; Stocks 2004), and the small ranges of these endemic species causes concern about conservation issues (Christiansen et al. 2000; Christiansen 2003; Rogers 2004).

Small gastropods belonging to the family Rissoidae are a prominent part of the littoral, shelf and upper bathyal molluscan faunas in the Mediterranean, temperate Western Europe and are particularly species-rich in the northeast Atlantic archipelagos: Canary Islands and Madeira (Manzoni 1868a, 1868b; Watson 1873; Moolenbeek & Faber 1987; Moolenbeek & Hoenselaar 1989; Hoenselaar & Goud 1998), the Azores (Dautzenberg 1889; Gofas 1990; Bouchet & Warén 1993; Hoenselaar & Goud 1998), and the Cape Verde Islands (Rolán 1987; Moolenbeek & Rolán 1988; Rolán & Luque 2000).

Thus, not surprisingly, the rissoids are the most abundant and diverse mollusc family on the northeast Atlantic seamounts, but there they are overall very different from previously known insular radiations (preliminary report in Gofas 1992). This paper deals with the species-level systematics of the seamount rissoids, and provides some data for discussing the correlation of dispersal ability to the type of larval development. It follows species-level studies in the same area covering other molluscan families such as Trochidae (Vilvens & Swinnen 2003; Gofas 2005), Triforidae (Bouchet & Fechter 1981; Gofas 2003), Ranellidae (Fechter 1975; Gofas & Beu 2003), Fasciolariidae (Gofas 2000), Muricidae (Houart 1996; Oliverio & Gofas 2006), Pyramidellidae (Peñas & Rolán 1999), Mytilidae (Salas & Gofas 1997), and Pectinidae (Dijkstra & Gofas 2004).

Physiographic and oceanographic setting

In the northeast Atlantic, there are two major groups of seamounts (Figure 1) with a broad array of situations regarding size, depth, age and distance to neighbouring biota. Detailed bathymetric maps of these and other seamounts can be consulted and downloaded from the *Seamount Catalog* (2001) on the EarthRef website.

The Lusitanian seamounts are situated between Portugal and Madeira. Four seamounts in this area have depths less than 500 m in their shallower part, forming small plateaus (Gorringe, 270+170 km^2; Josephine, 210 km^2; Ampère, 200 km^2; Seine, 160 km^2) separated by deep sea (>1000 m). Distances between seamounts are in the order of 200–300 km, as is the distance from Gorringe to the mainland coast of Portugal. Two of the seamounts (Gorringe and Ampère) have small peaks which reach the photic zone at ca 20–40 m and 60 m depth, respectively, whereas others have a flat plateau not shallower than 160 m (Seine) or 200 m (Josephine). The Meteor group of seamounts is more remote, with distances to the mainland in the order of 1500 km, and to the Azores of ca 600 km. The very large Great Meteor seamount forms a flat plateau of nearly 2000 km^2 culminating at ca 300 m depth, surrounded by very steep cliffs which reach down to the surrounding abyssal plain. The other seamounts have a smaller plateau (Irving, ca 750 km^2; Atlantis and Hyères, ca 350 km^2) or have a summit deeper than 600 m (Plato, Tyro, Cruiser).

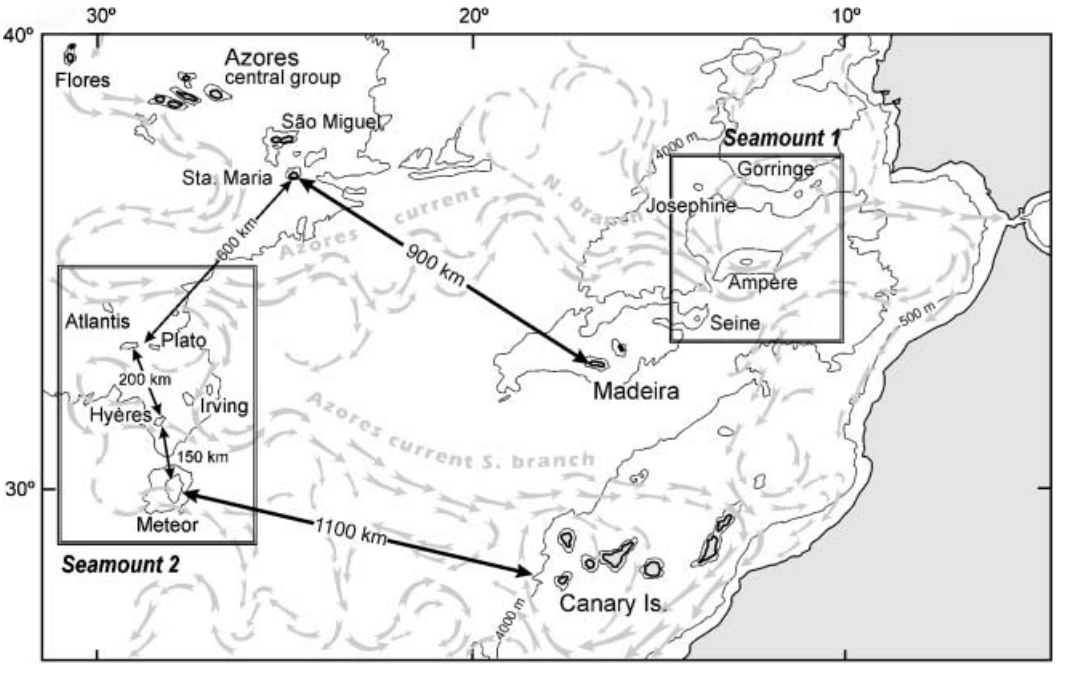

Figure 1. Map showing the location of the northeast Atlantic seamounts and approximate distances to other archipelagos. The arrows indicate the major features of near-surface water circulation, redrawn from data in Johnson and Stevens (2000).

Because of their volcanic origin, and of their remoteness from any detritic sedimentary input, seamounts commonly have hard substrata at depths where the mainland slope is usually smothered by silt and clay originating from the continent. The only sources of sediment input on the seamounts are the products of local erosion, the benthic bioclasts and the shells of pelagic organisms (von Rad 1974).

The geologic origin of the Lusitanian seamounts is intra-plate volcanism fuelled by the Madeira hotspot (Geldmacher et al. 2005), or the interaction of this process with the boundary of Eurasian and African plates in the case of Gorringe. The estimated ages of the seamounts reflect the movement of the African plate over the hotspot (Gorringe, 65–67 million years; Ampère, 31 million years; Seine, 22 million years; the island of Madeira being the most recent construction). Likewise, the Meteor group originated from the activity of a hotspot beneath the mid-Atlantic oceanic lithosphere. Flat-surfaced structures, or the flattened plateaus of the seamounts are believed to have formed near sea-level (Tucholke & Smoot 1990). Age determinations here are not straightforward because individual seamounts have undergone a complex history of sinking and rejuvenation. The oldest structure in the area would be the deep Cruiser plateau at the base of Irving/Cruiser seamount (50–76 million years) now sunken in more than 2000 m. The seamounts, following the reconstructed plate movement, have younger ages (Plato, 40 million years; Tyro, 30 million years; Atlantis, 20 million years; Irving, 17 million years; Meteor 11–16 million years) along a back-and-forth track in the area. Therefore the seamount group as a whole is not more recent than the Lusitanian group despite the situation closer to the accretion ridge of the Atlantic.

The seamounts are intra-plate structures, so that their distance from the mainland or from each other has remained unchanged since their formation. Dispersal is therefore the sole process for benthic life to colonize them.

Circulation pattern

In the studied area, the near-surface circulation (the Azores Current) forms a meandering pattern directed essentially eastwards (Johnson & Stevens 2000 and references therein) with main branches flowing towards Gibraltar to the north and towards the Canary Islands to the south. Despite some associated eddies and countercurrents circulating westwards, this pattern does not favour the transport of larvae from the European mainland towards the seamounts. In deeper water, the Mediterranean outflow has been traced far out in the Atlantic (review in Richardson et al. 2000) and generates large eddies (termed 'Meddies') typically 40–150 km broad, translating westwards in a depth interval 800–1400 m and lasting several years. Meddies collide repeatedly with the seamounts situated on their track, both in the Lusitanian group and the Meteor group. This could provide a pathway for the dispersal of bathyal fauna, albeit the depth interval of the mainland slope in contact with outflowing Mediterranean water is a conspicuously species-poor source area. On a local scale, seamounts may affect the flow of water in their immediate vicinity. Eddies may form and be trapped over seamounts in closed circulations known as Taylor columns (Meincke 1971; Lavelle et al. 2004).

Materials and methods

Material from the North Atlantic seamounts was collected during two *Seamount* expeditions (Figure 1). *Seamount 1* was conducted in September/October 1987 by Philippe Bouchet (Muséum National d'Histoire Naturelle, Paris, hereafter MNHN) with R/V *Le Noroit*, and visited Gorringe, Josephine, Ampère, Lion, and Seine seamounts (57 dredge hauls and 10 beam trawl operations shallower than 1000 m; see Bouchet & Métivier 1988). *Seamount 2* was conducted in January/February 1993 by the author with R/V *Le Suroit* and visited the Great Meteor, Hyères, Irving, Plato, Atlantis, and Tyro seamounts (69 dredge hauls and 16 beam trawl operations shallower than 1000 m; see Gofas 1993). Material collected on Ampère and Seine seamounts during several cruises of R/V *Victor Hensen* and *Poseidon* and considered in the OASIS project (Beck et al. 2006) was also included in this study. A list of the hauls cited in this paper, with coordinates and depth, is given in the Appendix 1.

In the *Seamount* cruises and other MNHN surveys, the coarse fractions, usually above 10 mm, were mostly sorted onboard to phyla, then sorted to species level in the lab. The finer fractions were preserved onboard, and later sieved on 5, 2, 1, and 0.5 mm sieves, and sorted under a stereomicroscope. Drawings of living animals were prepared onboard whenever possible. A provisional listing of molluscs was made for the depth interval shallower than 500 m, recording several thousand specimens representing 242 species in the Lusitanian seamounts, and 182 species in the Meteor group seamounts. Most of the specimens and species are in the size range 1–5 mm. The largest part consisted of shells, and these were taken into account in the mollusc counts. A total of over 25,000 individuals (mostly shells) of Rissoidae were thus obtained from the seamounts. Of these, ca 5000 were collected on the Lusitanian seamounts and ca 20,000 on the seamounts of the Meteor group. The material from *Seamount 1* is shared between the Swedish Museum of Natural History, Stockholm and MNHN; that of *Seamount 2* is deposited in MNHN.

Particular attention was given to cleaning the collecting gear when proceeding from one seamount to another, keeping in mind one of the essential goals which was to check whether particular species were able to disperse between seamounts. The nets were

thoroughly washed on deck and carefully checked to remove sediment during transit between seamounts. During *Seamount 2*, sieves were dipped in methylene blue at every transit, in order to stain any remaining element.

Specimens were measured with precision of ± 0.02 mm using an ocular micrometer under the stereomicroscope for the whole specimens. The corrected magnifications read on the scanning electron micrographs were used for partial views of protoconchs and microsculptures. Measurements of largest and smallest adult specimens or shells in each lot are given with material examined. Specimens selected for scanning electron microscopy (SEM) were cleaned with an ultrasonic cleaner, usually after washing in a 10% solution of sodium-lauryl sulphate, a detergent.

Terminology in shell descriptions follows Cox (1960). Particular attention has been given to protoconchs as taxonomic characters at the species level. The protoconch morphology also provided a clue to the type of larval development (Jablonski & Lutz 1980). The protoconch is interpreted as indicating planktotrophic development when multispiral (typically >2 whorls with a differentiated protoconch 1 and protoconch 2) and as non-planktotrophic when it is paucispiral (typically 1–1.5 whorls with only one unit). Teleoconchs were systematically checked under SEM for microsculptures, which provide useful characters. Rib counts were made on the penultimate whorl rather than the body whorl where the arrangement of ribs is usually disrupted in the vicinity of the outer lip.

Radulae were extracted from selected species by dissolving the whole animal in concentrated chemical-grade NaOH for several hours and rinsing in distilled water. The clean radulae were spread out in a droplet of distilled water on a small piece of laser-printer transparency film, and this was glued to a stub and coated for observation under SEM. The description of the radulae follows the terminology of Ponder (1985).

The classification at the supraspecific level follows Ponder (1985) and Bouchet and Warén (1993).

Similarity between the composition of the rissoid assemblage on different seamounts was assessed using a Bray-Curtis similarity index, taking into account presence/absence data, and quantitative data (transformed into square-root values because of the too broad range of values). For this, analyses were performed using the PRIMER software from Plymouth Marine Laboratory, UK.

The following abbreviations and conventions have been used: MNHN, Muséum National d'Histoire Naturelle, Paris; SMNH, Swedish Museum of Natural History (Naturhistoriska Riksmuseet), Stockholm; actual size (in figure captions), measured from the shell's apex to the abapical end; jv., juvenile shell or specimen; sh., shell, collected without soft parts; spm., specimen, collected alive; sta., sampling station (of a research cruise).

Systematics

Family RISSOIDAE Gray, 1847
Subfamily RISSOINAE Gray, 1847
Genus *Rissoa* Desmarest, 1814

Type species. *Rissoa ventricosa* Desmarest, 1814, subsequent designation by Bucquoy, Dautzenberg and Dollfus, 1884.

Rissoa lilacina Récluz, 1844

Material examined

Ampère—*Seamount 1* sta. DE98, 1 sh. (3.84 × 2.26 mm).

Remarks

This species of the photic zone may be living in the shallowest part of Ampère. It lives in algal turf on the Atlantic coast and in the westernmost Alboran Sea. *Rissoa violacea* Desmarest, 1814 is a similar but distinct species, mostly associated with Mediterranean seagrasses, and with a western limit within the Alboran Sea.

Genus ***Pusillina*** Monterosato, 1884

Type species. Rissoa pusilla Philippi, 1836, by monotypy (preoccupied by *Rissoa pusilla* Grateloup, 1828, renamed *Rissoa philippi* Aradas and Maggiore, 1844).

Pusillina (Pusillina) fuscapex n. sp.
(Figures 2, 3)

Type material

Holotype MNHN 9700 (spm., 1.82 × 1.26 mm) from *Seamount 2* sta. TS270, in MNHN; 30 paratypes MNHN 9729 (1 spm., 1.82 × 1.22 mm and sh., 1.66 × 1.06 to 2.14 × 1.30 mm) from *Seamount 2* sta. DW255 (34°04.9′N, 30°15.3′W, 340 m).

Type locality

Atlantis seamount (34°04.8′N, 30°14.9′W, 330 m).

Material examined

Meteor—*Seamount 2* sta. DE140, 1 sh. (1.95 × 1.22 mm); DW143, 5 sh. (1.94 × 1.25 to 2.02 × 1.25 mm); DW148, 1 old sh. (2.00 × 1.20 mm); DW152, 10 sh. (1.60 × 1.05 to 2.00 × 1.20 mm); TS163, 1 jv. spm. (0.87 × 0.67 mm). Hyères—*Seamount 2* sta. DW182, 7 spm.+566 sh. (jv. 1.47 × 0.95 to 2.47 × 1.32 mm); DW188, 2 sh. (jv. 1.52 × 1.05, 1.80 × 1.12 mm). Atlantis—*Seamount 2* sta. DW255, 1 spm. (1.82 × 1.22 mm) and 390 sh. (includes paratypes, 1.78 × 1.20 to 2.50 × 1.50 mm); DW258, 275 sh. (1.80 × 1.18 to 2.40 × 1.44 mm); TS270, 12 spm. (1.68 × 1.12 to 2.16 × 1.28 mm, and jv.) and 18 sh. (1.80 × 1.20 to 2.10 × 1.42 mm, and jv.); DW274, 250 sh. (1.64 × 1.16 to 2.30 × 1.38 mm).

Etymology

From Latin *fuscus*, brown, alluding to the colour of the apex.

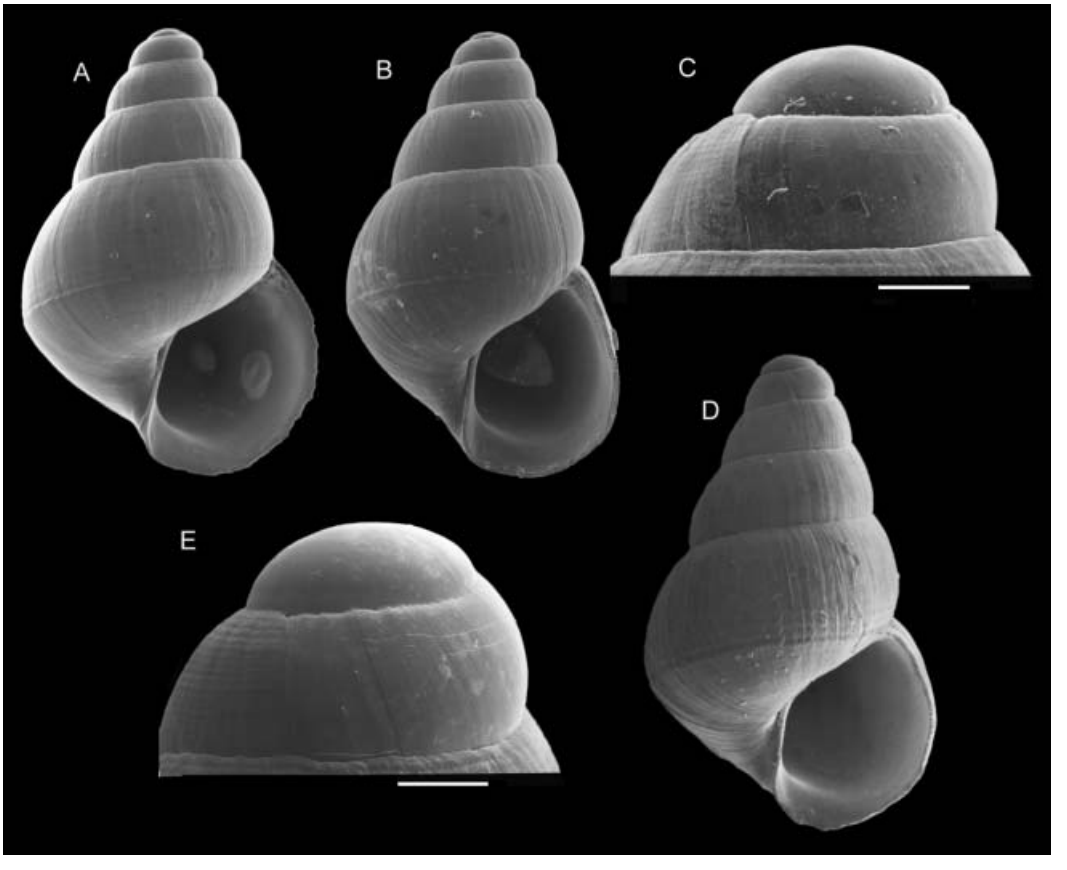

Figure 2. *Pusillina fuscapex* n. sp. (A) Paratype (spm.) from Atlantis seamount, DW255 (340 m), actual size 1.82 mm; (B) paratype (sh.), same locality, actual size 1.82 mm; (C) protoconch of another paratype, same locality; (D) shell from Meteor seamount, DW143 (330 m), actual size 1.94 mm; (E) protoconch of a juvenile specimen from Meteor seamount, TS163 (290 m). Scale bars: 100 µm.

Description

Shell with moderately high spire, up to 2.1 × 1.3 mm (Atlantis), 2.4 × 1.3 mm (Hyères), 2.4 × 1.4 mm (Meteor). Protoconch of 1.5 convex whorls and 340–350 µm maximum diameter; surface of nucleus smooth, final part with scanty, indistinct spiral threads. Teleoconch of 3–3.5 (Atlantis) or 3.5–4.5 (Hyères) moderately convex whorls, with a faint sculpture of weak axial lines and minute spiral striae. Axial lines irregular, in the form of wrinkles parallel to growth stages, fading out on the abapical part of the body whorl. Spiral striae more distinct on the first teleoconch whorl, less so on the body whorl, absent on the periumbilical area. One spiral cord continuing the suture and marking a faint keel on the body whorl, sometimes visible at some distance on the penultimate whorl next to the suture but usually concealed; an indication of one or two much weaker cords adapically to this. Outer lip orthocline, with a thin edge, not definitely thickened externally but sometimes slightly flaring; smooth and not thickened inside. Inner lip thin, quite appressed or leaving an extremely narrow umbilical chink. Shell colour with a brown stain on the first protoconch whorl, the remainder entirely whitish or buff, translucent (Atlantis), with

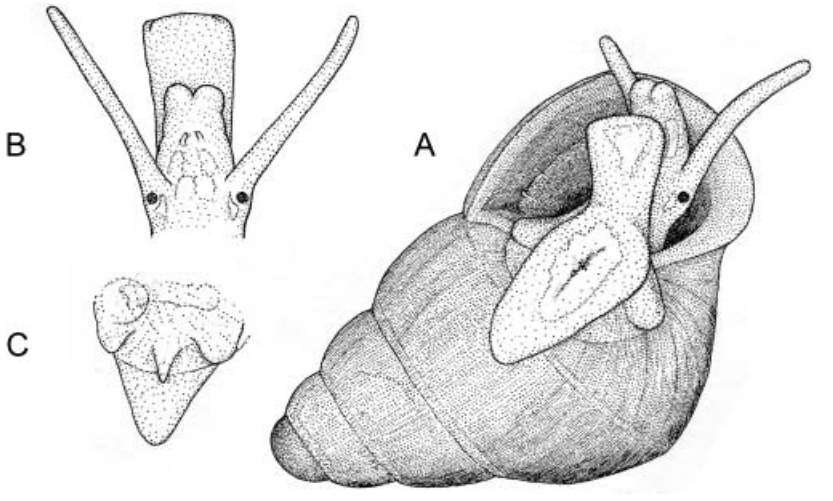

Figure 3. *Pusillina fuscapex* n. sp. (A) Living specimen (holotype) from Atlantis seamount, TS270 (330 m), actual size 1.78 mm; (B) detail of head and propodium; (C) detail of opercular lobes and metapodium.

extremely faint brownish axial flames which become more definite near the abapical suture and along the periphery of the body whorl (Hyères), or uniformly a pale golden brown (some specimens from Meteor). Operculum thin, paucispiral, with eccentric nucleus.

Cephalic tentacles cylindrical, with rounded tips. Eyes embedded in a slight swelling at the base of each tentacle. Snout somewhat tapering, distinctly bilobed anteriorly, with tiny bright yellow jaws and large bright yellow buccal mass visible by transparency. Small white masses behind each eye, other more irregular yellowish mass visible by transparency beneath the operculum. Opercular lobes stained anteriorly with grey. Sole of foot colourless, with whitish anterior pedal gland on propodium and very conspicuous posterior pedal gland, with a distinct slit surrounded by a white area, on metapodium. Metapodial tentacle triangular, quite slender. Right pallial tentacle minute, no pallial tentacle on left side. Visceral mass visible by transparency in the spire whorls, uniformly pale brownish.

Remarks

The shell of this species resembles very much some of the species here treated in *Pseudosetia*. It is distinguished from *Pseudosetia amydralox* in being more slender, with a smaller protoconch (ca 340–350 μm instead of 470 μm), from *P. azorica* in lacking spiral sculpture on the abapical part, and from both in having a coloured protoconch (sometimes, also a colour pattern on the teleoconch). The living animal is nevertheless quite different, with a conspicuous, well-developed posterior pedal gland, a single, elongate metapodial tentacle, and a tiny pallial tentacle on the right side only, all pointing to a placement in *Pusillina*. The latter character, which is reported as taxonomically significant by Ponder (1985) was given particular attention and was unambiguously observed on several specimens.

This species also resembles the holotype of *Rissoa quisquiliarum* Watson, 1886 (see Bouchet & Warén 1993, p 676) but differs in that the abapical surface is smooth and well

demarcated, contrary to *R. quisquiliarum* which bears spiral cords. The latter species is not yet clearly identified, but Gofas (1990) tentatively assigned to it a littoral rissoid found on the Azores central group.

The specimens from Hyères differ consistently from those collected on Atlantis in having an additional half-whorl, in being more slender and in having a colour pattern on the teleoconch. The species is very rare on Meteor; among the few shells collected there, some are similar to those from Atlantis whereas others were more slender and had a uniform brown colour not seen elsewhere.

Subgenus *Vicinirissoa* Ponder, 1985

Type species. Rissoa (Cingula) harpa Verrill, 1880, by original designation.

Pusillina (Vicinirissoa) harpula n. sp.
(Figure 4A–F)

Type material

Holotype MNHN 9701 (sh., 1.13 × 0.95 mm) and four paratypes MNHN 9734 (sh., 0.97 × 0.85 to 1.07 × 0.87) from *Seamount 2* sta. DW255, in MNHN.

Type locality

Atlantis seamount (34°04.90′N, 30°15.30′W, 340 m).

Material examined

Ampère—*Victor Hensen* VH97 sta. 97, 2 sh. (0.84 × 0.68 mm, 1.40 × 0.8 mm). Josephine—*Seamount 1* sta. DW45, 1 sh. (1.20 × 0.90 mm); DW61, 9 sh. (1.17 × 0.92 to 1.50 × 1.10 mm). Hyères—*Seamount 2* sta. DW200, 3 sh. (1.30 × 1.07 to 1.35 × 1.17 mm). Cruiser—*Seamount 2* sta. DW237, 3 sh. (0.93 × 0.80 mm). Atlantis—*Seamount 2* sta. DW255, the type lot; DW261, 2 sh. (1.50 × 1.25 to 1.62 × 1.20 mm); DW263, 1 sh. (1.67 × 1.22 mm).

Etymology

The name is derived from that of the type species of *Vicinirissoa*, with the diminutive *-ula*.

Description

Shell with moderately high spire and rounded whorls, up to 1.6 × 1.2 mm. Protoconch of 1.25 rather convex whorls, with nucleus smooth, the remainder with six to seven minute, wavy and irregular, widely separated spiral threads. Teleoconch of ca 1.75–2.25 very convex whorls, sculptured with very strong, flexuous axial ribs (16–20 on the penultimate whorl), and minute spiral threads, similar to those of the protoconch but densely set, overrunning the ribs. Body whorl with a faint keel in continuation of the suture, overrun by

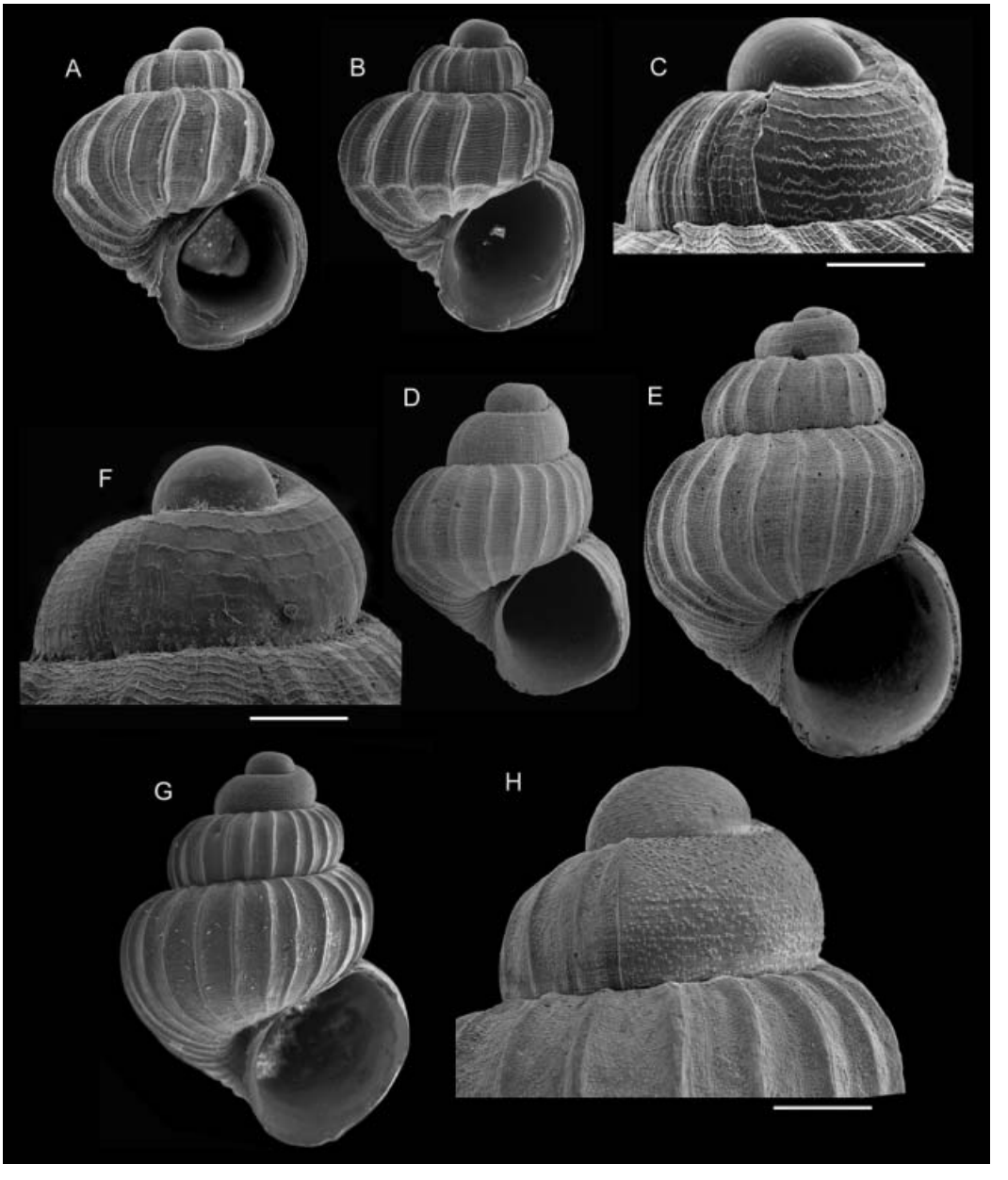

Figure 4. (A–F) *Pusillina (Vicinirissoa) harpula* n. sp. (A) Holotype (sh.) from Atlantis seamount, DW255 (340 m) (340 m), actual size 1.13 mm; (B) paratype (sh.), same locality, actual size 1.07 mm; (C) protoconch of the same paratype; (D, E) shells from Josephine seamount, DW61 (200–205 m), actual size 1.10 and 1.50 mm; (F) protoconch of another shell, same locality. (G, H) '*Scalaria*' *atomus* Smith, 1890 from St Helena Is., leg. Turton (MNHN). (G) Shell, actual size 1.30 mm; (H) protoconch of another shell. Scale bars: 100 μm.

the axial ribs which are continued on the periumbilical area. Aperture oval, with nearly continuous peristome. Outer lip slightly opisthocline, not thickened, smooth inside. Inner lip thin, bordering a well-defined umbilicus. Shell colour entirely white, translucent.

Remarks

This species resembles *Pusillina harpa* (Verrill, 1880), the type species of *Vicinirissoa* Ponder, 1985. It differs in being smaller, having the periumbilical area bound by a keel, having more acute axial ribs, and less crowded spiral lines on the protoconch. The shells collected in deeper water (DW261, DW263) are rather old and worn; they are slightly larger than on the summit of the seamount, but maintain the same number of whorls.

Bouchet and Warén (1993, p 639) mentioned this species as 'an undescribed species, evidently closely related to *A[lvania]. adinogramma*'. Although both species do have a similar spiral microsculpture, the other characters indicate that such a relationship is not so close. Conversely, there is a striking similarity between the present species and '*Scalaria*' *atomus* Smith, 1891, an endemic species of uncertain taxonomic position from sublittoral depths on St Helena island (Figure 4G, H). The two species differ only by the details of microsculpture, more organized as threads in *P. harpa* and as granules in '*S.*' *atomus*.

The relationship of *Vicinirissoa* with *Pusillina* s. str. is not demonstrated, but considering the scanty material available and the absence of data on living animals of the new species, the systematic arrangement follows Ponder (1985) and Bouchet and Warén (1993).

Genus *Alvania* Risso, 1826

Type species. Alvania europea Risso, 1826, subsequent designation by Nevill, 1885 (=*Alvania cimex* (Linné, 1758)).

The genus *Alvania* is here taken in a very broad sense, as a catchall genus for species of Rissoidae having both spiral and axial sculpture on the shell, until some phylogeny is unravelled. This is a difficult task in this speciose group, and requires a broader geographic scope. Most characters currently considered for species definition are highly liable to convergence.

Alvania cancellata (da Costa, 1778)
(Figure 5A, B)

Material examined

Gorringe—*Seamount 1* sta. DW04, 7 sh. (jv.); DW05, 3 sh. (jv., old sh.); DE09, 1 sh. (jv.); DW15, 1 sh. (jv, old sh.); DW33, 1 sh. (4.90 × 2.98 mm). Seine—*Seamount 1* sta. DE72, 1 sh. (jv.). Ampère—*Seamount 1* sta. DE98, 7 sh. (jv. or broken).

Remarks

This species is common in the Azores (see Gofas 1990) and is capable of crossing the inter-archipelago distances during its planktotrophic larval stage. However, it is extremely rare on the seamounts where it currently does not find the shallow sublittoral rubble or rocky bottoms on which it normally lives. The few shells collected may represent pseudo-populations, and some of the occurrences could even be subfossil shells which date back to Pleistocene low water stands. This species was also recorded from Gorringe by Ávila and Malaquias (2003).

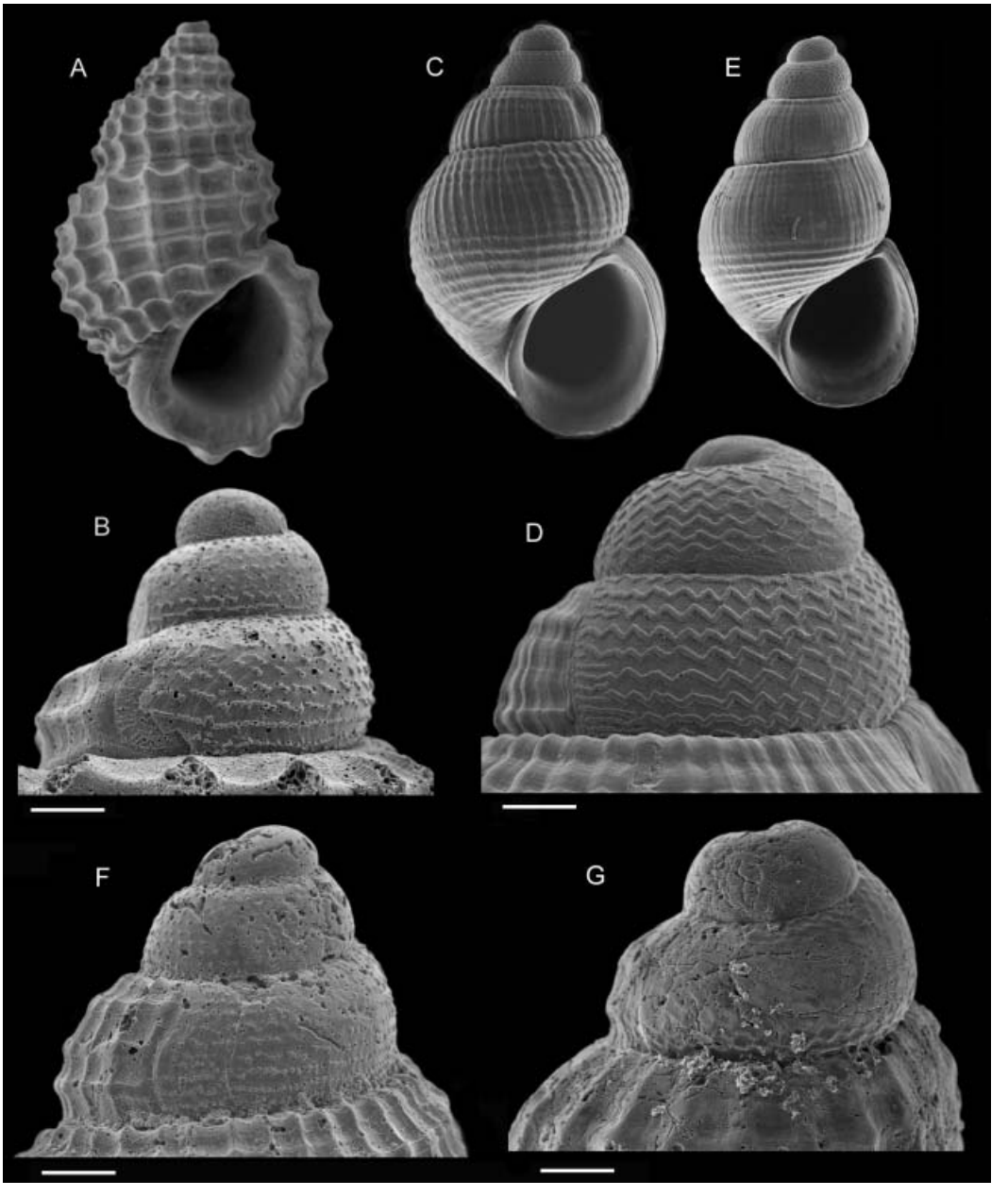

Figure 5. *Alvania* species from Lusitanian seamounts, shared with the mainland shelf. (A) *A. cancellata* (da Costa, 1778), shell from Gorringe seamount, DW33 (55–70 m), actual size 4.90 mm; (B) *A. cancellata*, protoconch of a shell from Ampère seamount, DE98 (300–325 m); (C) *A. zylensis* Gofas and Warén, 1982 from Gorringe seamount, CP20 (305–320 m), actual size 2.25 mm; (D) protoconch of the same specimen; (E) *A. zylensis* from Ampère seamount, DW92 (117–129 m), actual size 2.00 mm; (F) *A. punctura* (Montagu, 1803), protoconch of a shell from Gorringe seamount, CP 20; (G) *Alvania vermaasi* van Aartsen, 1975, protoconch of a shell from Gorringe seamount, DW08 (470–485 m). Scale bars: 100 μm.

Alvania cimicoides (Forbes, 1844)

Material examined

Gorringe—*Seamount 1* sta. DW15, 1 spm. and 1 sh. (3.86 × 2.20 mm), 3 jv. sh.; DW16, 27 sh. (2.70 × 1.60 to 4.16 × 2.26 mm); CP30, 1 sh. (jv.). Josephine—*Seamount 1* sta. DW38, 5 sh. (3.16 × 1.86 to 3.60 × 2.20 mm); DW43, 3 sh. (2.84 × 1.80 to 3.26 × 2.00 mm). Seine—*Seamount 1* sta. DE72, 2 sh. Ampère—*Seamount 1* sta. DE95, 1 sh. (jv.), DE98, 10 sh. (3.02 × 1.76 to 3.20 × 1.86 mm).

Remarks

This is a common species in the upper bathyal of the European mainland, and has been well illustrated in Bouchet and Warén (1993, p 624–627). The multispiral protoconch denotes a planktotrophic development and facilitates the occurrence of the species on all four Lusitanian seamounts.

Alvania zylensis Gofas and Warén, 1982
(Figure 5C–E)

Material examined

Gorringe—*Seamount 1* sta. DW05, 15 sh. (1.76 × 1.12 to 2.18 × 1.34 mm; DW06, 19 sh. (1.70 × 1.16 to 2.22 × 1.50 mm); DW08, 6 sh. (1.84 × 1.28 to 2.08 × 1.38 mm); DE09, 17 sh. (1.80 × 1.16 to 2.60 × 1.30 mm); CP12, 1 sh.; DW16, 15 sh. (1.82 × 1.26 to 2.44 × 1.46 mm); CP20, 1 spm. (2.25 × 1.40 mm) and 3 sh. (2.40 × 1.56 mm). Ampère—*Seamount 1* sta. DW92, 7 sh. (1.62 × 1.06 to 2.58 × 1.44 mm); DE98, 1 sh. (2.48 × 1.68 mm); *Victor Hensen* VH97 sta. 296, 3 sh. (1.90 × 1.16 to 2.16 × 1.24 mm); sta. 298, 2 sh. (1.94 × 1.18, 2.50 × 1.32 mm) and 3 jv. sh.

Remarks

This species has a multispiral protoconch although there is some variation in its number of whorls. It is uncommon on the Ibero-Moroccan shelf, where it is restricted to circalittoral hard bottoms. On Gorringe and Ampère, it is not so rare possibly due to availability of its preferred habitat. It was also recorded from Gorringe by Ávila and Malaquias (2003).

Alvania punctura (Montagu, 1803)
(Figure 5F)

Material examined

Gorringe—*Seamount 1* sta. DW16, 1 sh. (1.96 × 1.26 mm); CP20, 1 sh. (1.60 × 1.00 mm). Ampère—*Seamount 1* sta. DE98, 2 sh. (1.96 × 1.22 to 2.22 × 1.42 mm).

Remarks

This is also a species with a planktotrophic development, here coming close to the southernmost part of its range.

Alvania vermaasi van Aartsen, 1975
(Figure 5G)

Material examined

Gorringe—DW08, 2 sh. (2.12 × 1.22 to 2.46 × 1.32 mm).

Remarks

This is the only rissoid species with a paucispiral protoconch shared with the mainland fauna. Gofas and Warén (1982) erred in considering *Alvania vermaasi* as a synonym of *A. imperspicua* Pallary, 1920. The latter is a different species, endemic to a small stretch of coastline between Casablanca and Essaouira, Morocco, and lives among intertidal rocks. *Alvania vermaasi* is smaller, more delicate and slender, and lives subtidally on rubble; both species, and also *A. zylensis*, share the peculiar microsculpture of zig-zag lines on the protoconch.

Alvania adinogramma Bouchet and Warén, 1993
(Figure 6)

Alvania adinogramma Bouchet and Warén 1993, p 638–639.

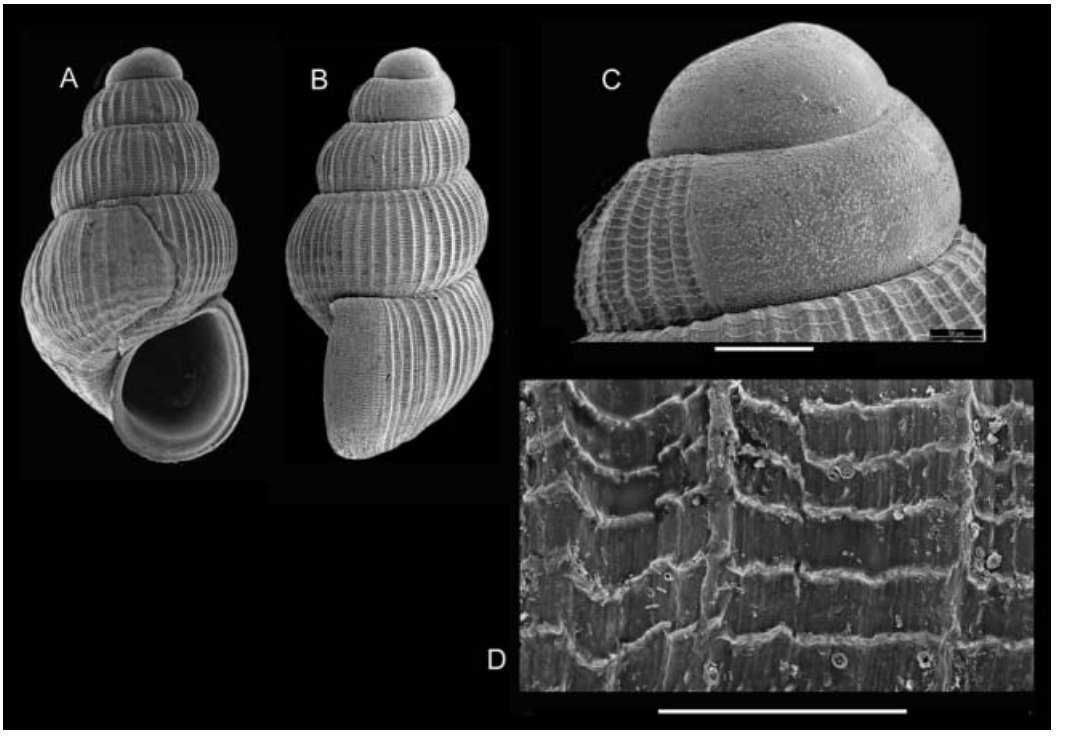

Figure 6. *Alvania adinogramma* Bouchet and Warén, 1993. (A, B) Specimen from Josephine seamount, DW45 (315–335 m), actual size 1.56 mm; (C) protoconch; (D) microsculpture, same specimen. Scale bars: 100 µm (C); 50 µm (D).

Type material

Holotype (sh., 1.64 × 0.91 mm) from *Seamount 1* sta. DW16 and 14 paratypes from the type locality (7 sh., 1.05 × 0.75 to 1.67 × 1.00 mm, in MNHN; 7 sh. in SMNH).

Type locality

Gorringe seamount (36°31′N, 11°32′W, 255–265 m).

Material examined

Gorringe—*Seamount 1* sta. DW08, 1 sh. (1.45 × 0.80 mm); DE10, 1 sh. (1.55 × 0.85 mm); CP12, 1 sh. (1.8 × 1.15 mm; Bouchet and Warén 1993, Figure 1432); DW15, 2 sh. (1.20 × 0.82 mm); DW16, 1 sh. (1.60 × 0.92 mm); DW21, 1 sh. (1.10 × 0.75 mm). Josephine—*Seamount 1* sta. DW45, 1 sh. (1.56 × 0.82 mm; SEM).

Description

Shell with a moderately high spire and a blunt apex, moderately solid, up to 1.8 × 1.1 mm. Protoconch of 1.25 convex whorls; surface of larval whorls covered by minute granules, distributed so as to form broad spiral bands. Teleoconch of 2.5–3.25 whorls, with a sculpture of thin but elevated axial ribs, minute spiral threads and very faint spiral cords restricted to the abapical area. Ribs ca 28–36 (Gorringe, 33 on holotype), ca 45 (Josephine) on the penultimate whorl, with adapical termination hardly prominent along the suture, reaching quite far on the abapical part of the body whorl and there gradually fading out; becoming more crowded behind the outer lip. Spiral cords very low and faint, as broad as the interspaces, developed mainly on the periumbilical area of the body whorl, hardly visible on adapical part of body whorl and on spire whorls. Spiral threads minute but very distinct, attenuated on the crest of the axial ribs, separated by interspaces about two to six times as broad. Outer lip slightly prosocline, with a thin edge and thickened externally at a distance from the edge by a broad rim, overrun by the spiral microsculpture but not by the cords; smooth and not thickened inside. Inner lip thin, bordering a small umbilical chink. Shell colour entirely white, translucent in fresh shells.

Remarks

This species constitutes with *Alvania microstriata* Hoenselaar and Goud, 1998 and *A. seinensis* n. sp. a group which seems restricted to the Lusitanian seamounts and Madeira, and does not resemble closely any of the European mainland species. There is a quite broad range of variation among specimens attributed to *A. adinogramma* by Bouchet and Warén (1993, p 638–639), some having twice as many ribs as others. The few specimens from Josephine have more ribs than those from Gorringe.

Alvania microstriata Hoenselaar and Goud, 1998
(Figure 7A–D)
Alvania microstriata Hoenselaar and Goud 1998, p 91–92.

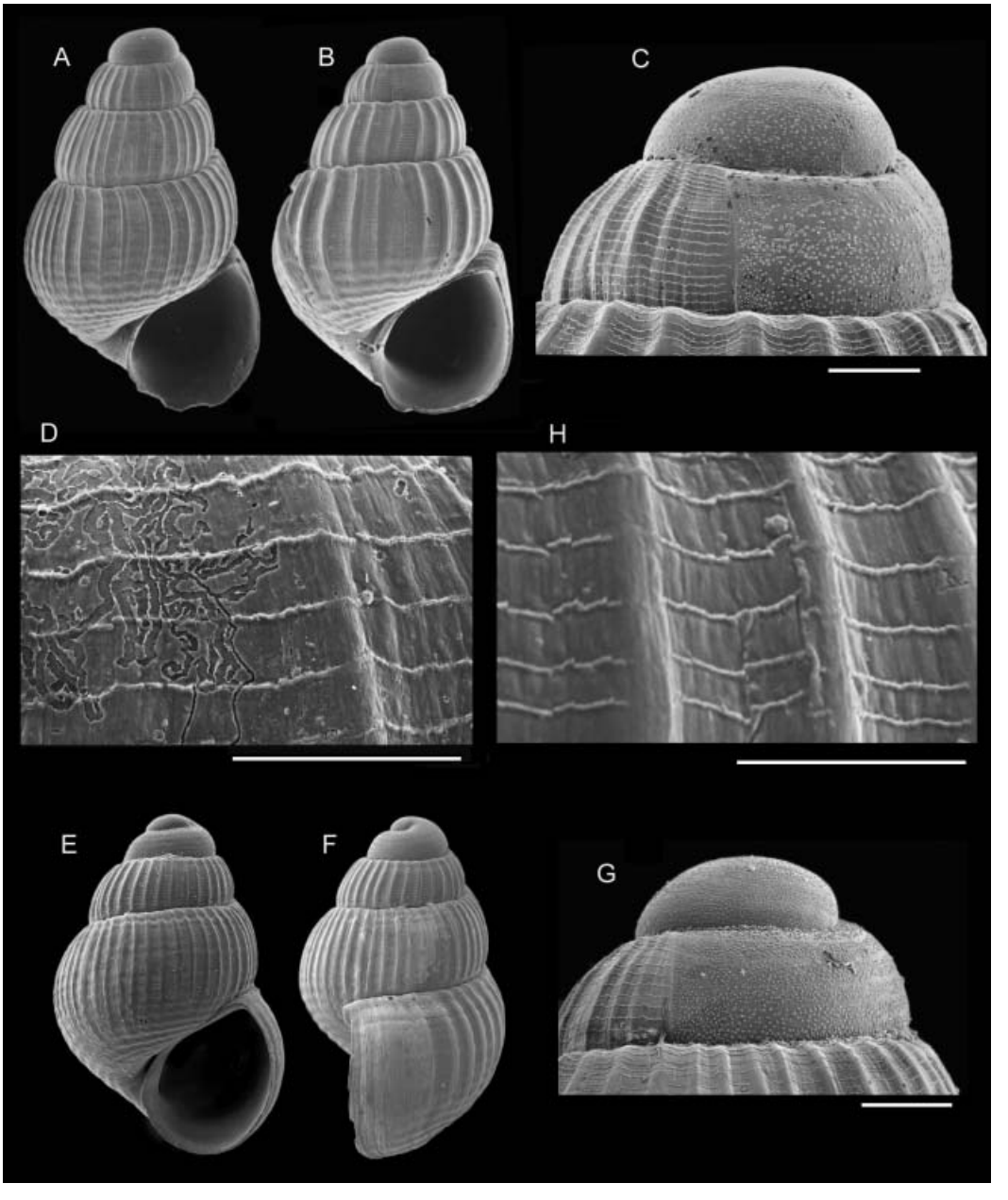

Figure 7. (A–D) *Alvania microstriata* Hoenselaar and Goud, 1998. (A, B) Shells from Seine seamount, DE84 (450–455 m), actual size 1.57 and 1.54 mm; (C) protoconch, same shell as B; (D) microsculpture, same shell as A. (E–H) *Alvania seinensis* n. sp. (E, F) Holotype (sh.) from Seine seamount, DE72 (165 m), actual size 1.40 mm; (G) protoconch of the holotype; (H) microsculpture. Scale bars: 100 μm (C, G); 50 μm (D, H).

Type material

Holotype (1.70 × 1.08 mm) in Nationaal Natuurhistorisch Museum, Leiden (NNM 57684), eight paratypes (NNM 57685) and seven paratypes (private collection of H. J. Hoenselaar) from the type locality.

Type locality

Madeira (32°07′N, 16°51′W, 360 m).

Material examined

Seine—*Seamount 1* sta. DE82, 34 sh. (jv. 0.98 × 0.74 to 1.80 × 1.26 mm); sta. DE84, 29 sh. (jv. 0.96 × 0.72 to 1.75 × 1.08 mm, SEM); *Poseidon 309* sta. BG7, 20 sh. (1.90 × 1.20 to 2.32 × 1.25 mm).

Description

Shell with a moderately high spire and a blunt apex, moderately solid, adults up to 2.3 × 1.2 mm. Protoconch of 1.25 convex whorls; surface of larval whorls covered by minute granules arranged in five to six blurry spiral bands. Teleoconch of 2.5–3.0 whorls, with a sculpture of axial ribs, minute spiral threads and very faint spiral cords more developed on the abapical area. Ribs ca 20–25 on the penultimate whorl, thin, somewhat flexuous, with adapical termination bulging along the suture, and very gradually fading out on the abapical part of the body whorl. Spiral cords very low and faint, as broad as the interspaces, developed mainly on the periumbilical area of the body whorl, hardly visible on adapical part of body whorl and on spire whorls; a shallow subsutural furrow demarcating the bulging termination of the axial ribs along the suture. Spiral threads very minute but well marked, sometimes overrunning the axial ribs, usually abutting on their crests, separated by interspaces about six to eight times as broad, less distinct on the abapical area. Outer lip orthocline or slightly opisthocline with a flexuous profile, with a thin edge not thickened externally even on large, apparently full-grown specimens, smooth and not thickened inside. Inner lip thin, bordering a narrow umbilicus. Shell colour entirely white, translucent.

Remarks

This species shares with *A. adinogramma* several characters such as the microsculpture of fine threads and the bands of granules on the protoconch, which indicate that they belong to the same species group. It differs in having the ribs bulging adapically along the suture, with a distinct subsutural furrow instead of an inconspicuous subsutural depression, and in consistently lacking the thickening on the external part of the outer lip.

It is noteworthy that this species was collected only on Seine seamount, situated nearest to the type locality, Madeira.

Alvania seinensis n. sp.
(Figure 7E–H)

Type material

Holotype MNHN 9702 (sh., 1.40 × 0.98 mm) and 20 paratypes MNHN 9743 (sh., 1.40 × 0.90 to 1.60 × 1.00 mm) from *Seamount 1* sta. DE72, in MNHN.

Type locality

Seine seamount (33°45′N, 14°21′W, 165 m).

Material examined

Seine—*Seamount 1* sta. DE71, 2 sh. (1.44 × 0.88, 1.44 × 0.92 mm); DE72 [includes types], 59 sh. (jv. 1.05 × 0.75 to 1.60 × 1.00 mm); DE73, 2 sh. (1.50 × 0.93, 1.44 × 0.93 mm).

Etymology

This species is named after Seine seamount, to which it is endemic.

Description

Shell with a moderately high spire and a blunt apex, moderately solid, adults up to 1.6 × 1.0 mm. Protoconch of 1.25 convex whorls; surface of larval whorls covered by minute granules arranged in five to six blurry spiral bands. Teleoconch of 2.5–3 whorls, with a sculpture of axial ribs, minute spiral threads and very faint spiral cords more developed on the abapical area. Ribs ca 40–47 on the penultimate whorl, thin, somewhat flexuous, with adapical termination bulging along the suture, and very gradually fading out on the abapical part of the body whorl. Spiral cords very low and faint, as broad as the interspaces, developed mainly on the periumbilical area of the body whorl, hardly visible on adapical part of body whorl and on spire whorls; a shallow subsutural furrow demarcating the bulging termination of the axial ribs along the suture. Spiral threads very minute but well marked, sometimes overrunning the axial ribs, usually abutting on their crests, separated by interspaces about six to eight times as broad, less distinct on the abapical area. Outer lip orthocline with a flexuous profile, with a thin edge, thickened externally at a distance of the edge by a broad rim, smooth and not thickened inside. Inner lip thin, bordering a narrow umbilicus. Shell colour entirely white, translucent.

Remarks

The specimens from the summit of Seine seamount (collected in 165–190 m) differ consistently from those collected more deeply (DE82 and DE84, in a 320–455 m depth interval), and from the Madeiran types of *Alvania microstriata*, by having much finer and more numerous ribs (more than 40 on the penultimate whorl), a more distinct subsutural furrow and an outer lip which is thickened externally at a distance of the edge. These are deemed to represent a different species, because none of these forms was recorded in DE90 at an intermediate depth (250–256 m) despite abundance of *Crisilla ovulum*. *Alvania adinogramma* is similar in sculpture and in the construction of the aperture, but is more slender in shape.

Alvania micropilosa n. sp.
(Figure 8)

Type material

Holotype MNHN 9703 (sh., 2.58 × 1.74 mm) and 20 paratypes MNHN 9744 (5 spm. and 15 sh., 2.44 × 1.78 to 2.80 × 1.90 mm) from *Seamount 2* sta. DW152, in MNHN.

Type locality

Meteor seamount (30°02.0′N, 28°22.1′W, 470 m).

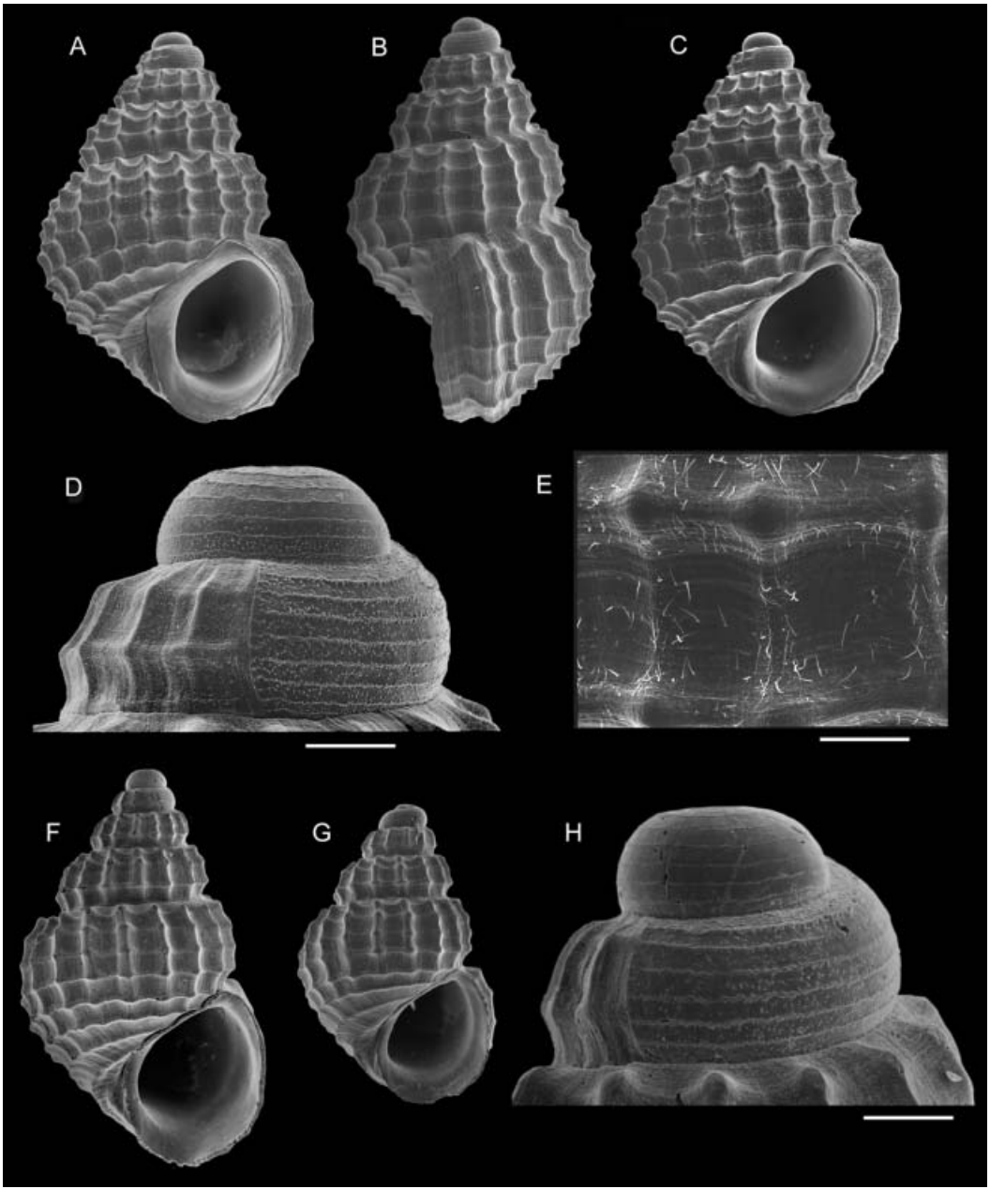

Figure 8. *Alvania micropilosa* n. sp. (A) Holotype (sh.) from Meteor seamount, DW152 (470 m), actual size 2.58 mm; (B, C) paratypes (sh.), same locality, actual sizes 2.74 and 2.56 mm; (D) protoconch of holotype; (E) detail of holotype, showing the minute periostracal hairs; (F, G) shells from Hyères seamount, DW182 (480 m), actual sizes 2.64 and 2.00 mm; (H) protoconch, same shell as (G). Scale bars: 100 μm.

Material examined

Meteor—*Seamount 2* sta. DW136, 7 sh. (1.82 × 1.30 to 2.10 × 1.48 mm); DE140, 10 sh. (1.88 × 1.28 to 2.20 × 1.54 mm); DW143, 70 sh. (1.70 × 1.26 to 2.40 × 1.70 mm); DW152

[includes types], 38 spm. (2.44 × 1.78 to 2.80 × 1.90 mm) and 890 sh. (2.08 × 1.50 to 2.80 × 1.80 mm). Hyères—*Seamount 2* sta. DW182, 12 sh. (1.92 × 1.36 to 2.64 × 1.72 mm); DW188, 1 sh. (jv.); DW 192, 1 sh. (2.08 × 1.38 mm). Irving—*Seamount 2* sta. DW208, 3 sh. (1.70 × 1.24 to 1.90 × 1.30 mm).

Etymology

The name refers to the minute periostracal hairs scattered over the surface of the shell in this species.

Description

Shell with a moderately high spire, solid, up to 2.8 × 1.9 mm. Protoconch of 1.5 convex whorls; surface of larval whorls with six to seven fine spiral threads, with broad interspaces bearing minute granulations. Teleoconch of 3.0–3.75 whorls, with a strong sculpture of elevated, widely separated axial ribs, and spiral cords forming knobs at their intersection with the axial sculpture. Ribs ca 14–16 on the penultimate whorl, with adapical termination not prominent along the suture, extending quite far on the abapical part of the body whorl where they very gradually fade out; ribs on body whorl remaining constant in spacing and size where approaching the outer lip. Spiral cords three to four on spire whorls, the abapical one stronger and separated from the suture by a broader interspace; eight on the body whorl. Spiral microsculpture of indistinct threads, on which can be seen some tiny periostracal hairs. Outer lip orthocline or very slightly prosocline, bordered with a thick rim overrun by the spiral sculpture; smooth inside. Inner lip thick and appressed to the preceding whorl. Shell colour entirely white, a few shells with a very pale brownish blotch adapically on the external surface behind the outer lip. Operculum thin, paucispiral, with eccentric nucleus.

Remarks

This species resembles *Alvania cimicoides* in some shell features, with a broad channel between the suture and a cord of the preceding whorl; it differs nevertheless in having a paucispiral protoconch and a nearly colourless shell. The periostracal hairs are characteristic and were not seen on any of the other species (including *A. cimicoides*) examined at the same magnifications.

This is the commonest rissoid species on Meteor, whereas it is present but extremely rare on Hyères and Irving seamounts.

Alvania elenae n. sp.
(Figure 9)

Type material

Holotype MNHN 9704 (sh., 2.56 × 1.76 mm) and 15 paratypes MNHN 9749 (3 spm. and 12 sh., 2.36 × 1.60 to 2.80 × 1.80 mm) from *Seamount 2* sta. DW152, in MNHN.

Type locality

Meteor seamount (30°02.0′N, 28°22.1′W, 470 m).

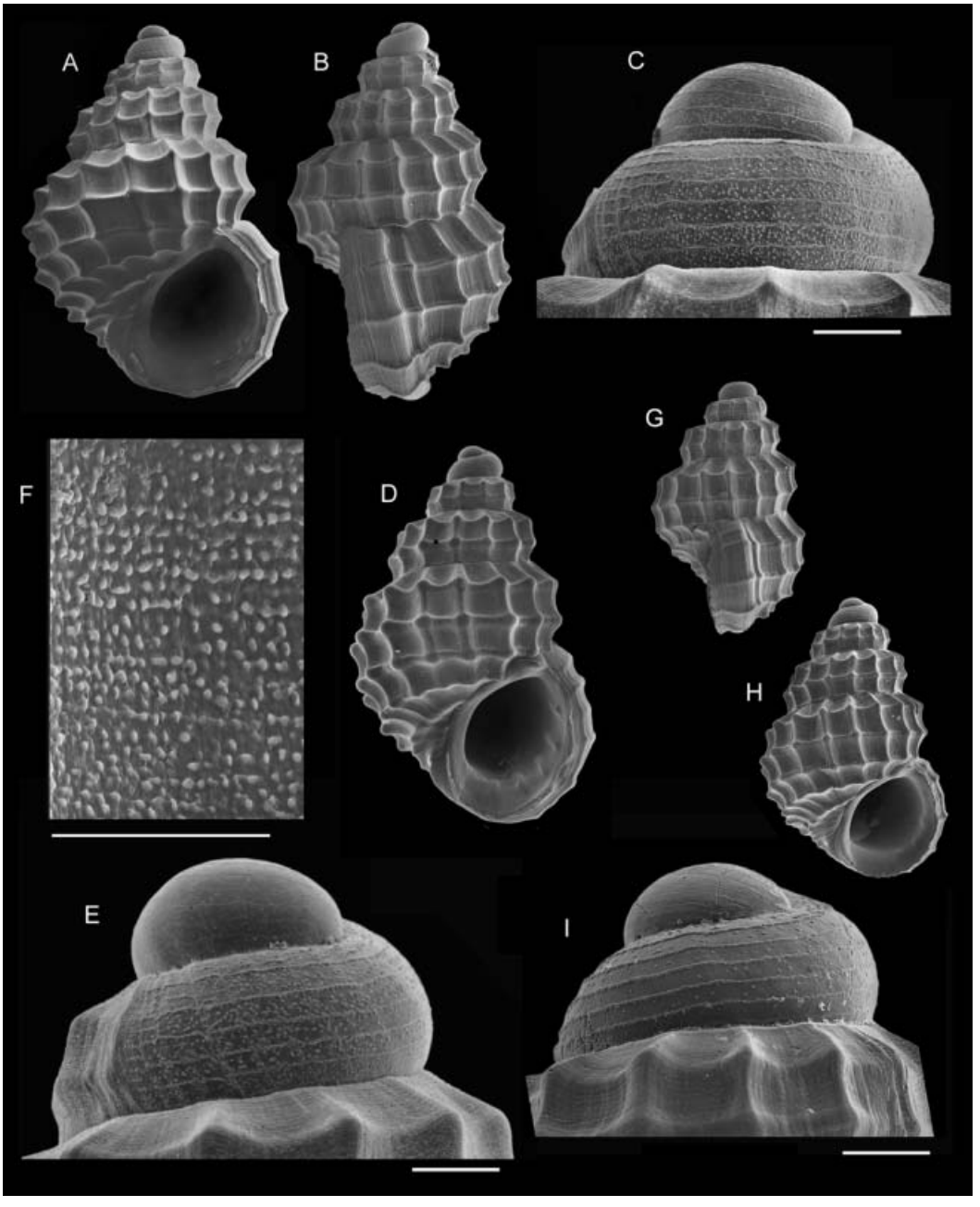

Figure 9. *Alvania elenae* n. sp. (A) Holotype (sh.) from Meteor seamount, DW152 (470 m), actual size 2.56 mm; (B) paratype, same locality, actual size 2.58 mm; (C) protoconch of the holotype; (D) shell from Hyères seamount, DW182 (480 m), actual size 2.60 mm; (E) protoconch, same shell; (F) microsculpture, same shell; (G, H) shells from Irving seamount, DW215 (275 m), actual sizes 1.82 and 2.00 mm; (I) protoconch, same shell as (H). Scale bars: 100 μm.

Material examined

Meteor—*Seamount 2* sta. DW136, 2 sh. (2.10 × 1.36 to 2.30 × 1.40 mm); DE140, 2 sh. (2.16 × 1.40 to 2.26 × 1.46 mm); DW143, 105 sh. (1.52 × 1.12 to 2.26 × 1.52 mm); DW152 [includes types], 3 spm. (2.64 × 1.78 mm and 2 jv.) and 555 sh. (2.00 × 1.34 to 2.80 × 1.90 mm). Hyères—*Seamount 2* sta. DW182, 11 sh. (2.56 × 1.58 to 2.84 × 1.68 mm); DW188, 9 sh. (1.96 × 1.34 to 2.30 × 1.56 mm); DW192, 1 sh. (2.14 × 1.58 mm). Irving—*Seamount 2* sta. DW208, 2 sh. (2.08 × 1.40 mm); DW09, 1 sh. (2.00 × 1.24 mm); DW215, 20 sh. (1.76 × 1.28 to 2.30 × 1.36 mm); DW 217, 1 sh. (2.10 × 1.32 mm).

Etymology

This species is named for my daughter, Elena.

Description

Shell with a moderately high spire, very solid, up to 2.8 × 1.9 mm. Protoconch of 1.5 convex whorls; surface of larval whorls with six to seven fine spiral threads, with broad interspaces bearing minute granulations. Teleoconch of 3.5 whorls, with a very strong sculpture of elevated, widely separated axial folds, and spiral cords forming projecting knobs at their intersection with the axial sculpture. Ribs ca 16 on the penultimate whorl, fading out adapically where they meet the suture, extending quite far on the abapical part of the body whorl where they very gradually fade out; ribs on body whorl remaining constant in spacing and size where approaching the outer lip. Two spiral cords on spire whorls, separated between each other and from the sutures by broad interspaces; five on the body whorl. Spiral microsculpture extremely faint and appreciable only under SEM, consisting of granulose threads, and interspaces covered by minute granules. Outer lip orthocline, bordered with a thick rim overrun by the spiral sculpture; slightly thickened and bearing five or six denticles inside. Inner lip thick and appressed to the preceding whorl. Shell translucent, with one cord (the second one abapically) on spire whorls and two cords (the second and fourth abapically) bearing brownish spots on the nodes intersecting with the ribs. Operculum thin, paucispiral, with eccentric nucleus.

Remarks

Specimens from Hyères seamount differ in having less spinose knobs and thus a less hispid appearance. The few shells from Irving may have a third cord on the spire, and are distinctly smaller and narrower. They nevertheless share the same basic elements of protoconch and teleoconch sculpture and microsculpture and are tentatively considered conspecific. The shallow subtidal species *Alvania sleursi* (Amati, 1987) from the Azores is roughly similar but differs in having a strongly keeled protoconch.

Alvania cancellata has a similar microsculpture of minute granules aligned spirally on the teleoconch, and has the unusual arrangement of spiral threads alternating with granules on its protoconch 1 (homologous to the paucispiral protoconch of non-planktotrophic species). These two characters strongly suggest that these species are related.

Alvania hyerensis n. sp.
(Figure 10)

Type material

Holotype MNHN 9705 (sh., 3.04 × 1.76 mm) and 25 paratypes MNHN 9754 (7 spm. and 18 sh., 2.46 × 1.64 to 3.30 × 1.90 mm) from *Seamount 2* sta. DW182, in MNHN.

Type locality

Hyères seamount (31°23.2′N, 28°53.5′W, 480 m).

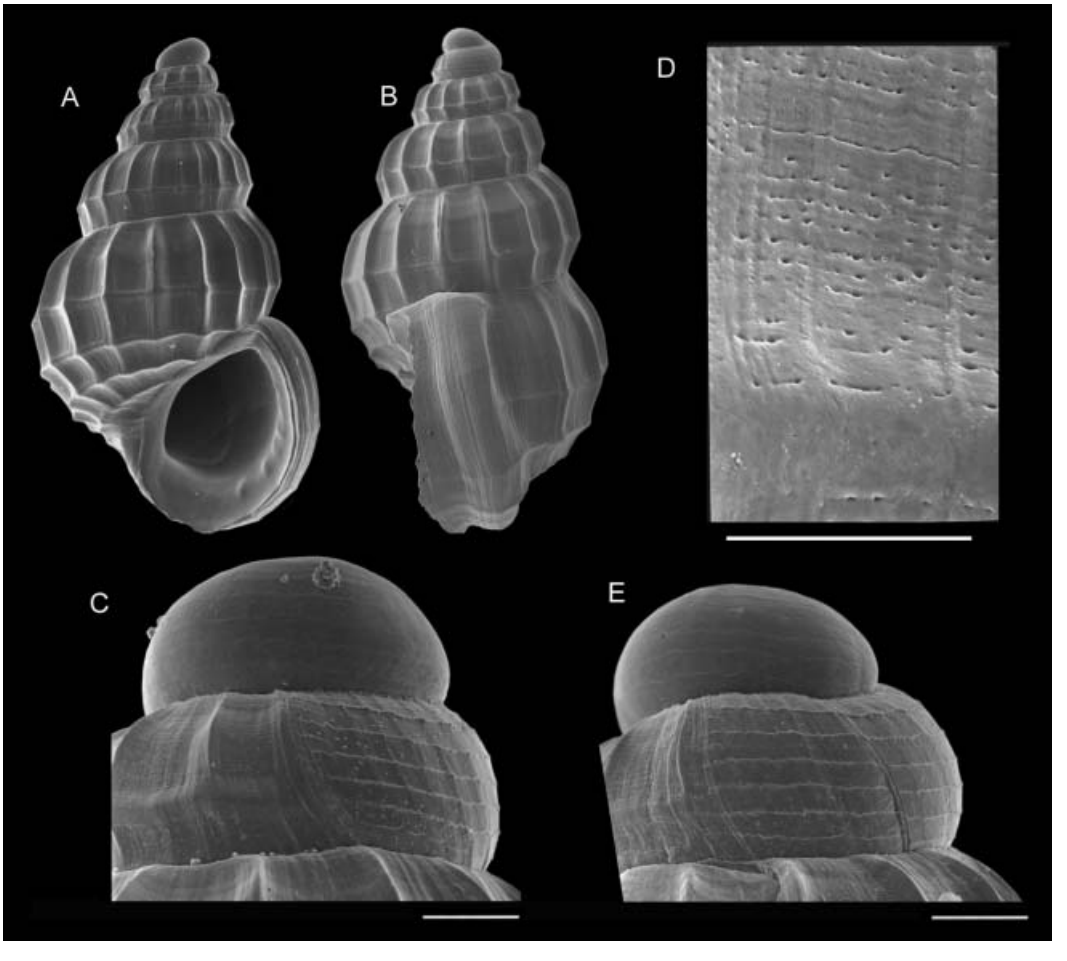

Figure 10. *Alvania hyerensis* n. sp. (A) Holotype (sh.) from Hyères seamount, DW182 (480 m), actual size 3.04 mm; (B) paratype, same locality, actual size 3.10 mm; (C) protoconch of the holotype; (D) microsculpture of the holotype; (E) protoconch of another paratype, same locality. Scale bars: 100 µm.

Material examined

Hyères—*Seamount 2* sta. DW182 [includes types], 7 spm. (2.60 × 1.56 to 2.80 × 1.66 mm) and 350 sh. (2.46 × 1.64 to 3.30 × 1.90 mm); DW188, 35 sh. (1.90 × 1.18 to 2.50 × 1.66 mm); DW 192, 6 sh. (1.98 × 1.34 to 2.68 × 1.76 mm).

Etymology

This species is named after Hyères seamount, of which it is endemic.

Description

Shell with a moderately high spire, quite solid, up to 3.3 × 1.9 mm. Protoconch of 1.5 convex whorls; surface of larval whorls with six to seven fine spiral threads, with broad interspaces bearing a few minute granulations. Teleoconch of 3.75–4.0 whorls, with a strong sculpture of elevated, widely separated axial ribs, and spiral cords forming knobs at their intersection with the axial sculpture. Ribs ca 15–18 on the penultimate whorl, fading out adapically where they meet the suture, extending quite far on the abapical part of the body whorl where they very gradually fade out; ribs on body whorl remaining constant in spacing and size where approaching the outer lip. Spire whorls with one prominent spiral cord, situated at about two-thirds abapically, separated from the suture by a broadly channelled interspace, and at one-third abapically a faint indication of another cord; body whorl with three more spiral cords on the abapical surface. Spiral microsculpture extremely faint and appreciable only under SEM, consisting of minute pits forming irregularly interrupted spiral lines (Figure 10D). Outer lip orthocline or very slightly opisthocline, bordered with a thick rim on which the spiral sculpture is much attenuated; slightly thickened and bearing a few small denticles inside. Inner lip thick and appressed to the preceding whorl. Shell translucent, penultimate spire whorl with one spiral series of very pale brown blotches on the ribs, and body whorl with two such series of blotches, more intense where they arrive behind the outer lip. Operculum thin, paucispiral, with eccentric nucleus.

Remarks

This species resembles *Alvania zoderi* Hoenselaar and Goud, 1998, from the bathyal slopes of the Azores, in having rather smooth ribs on the spire whorls and a strong cord overhanging the suture. The protoconchs are however quite different, rather conical and smooth with a faint keel in *A. zoderi*, bulging and ornamented with spiral threads in *A. hyerensis*; neither the pitted microsculpture nor a colour pattern were mentioned by Hoenselaar and Goud (1998).

There is a superficial resemblance to *A. elenae* in shell size, shape and colour, but the two species are easily separated by the smoother ribs on the spire of *A. hyerensis* and, under SEM, by the pitted microsculpture unusual in *Alvania* species. This species is sympatric with *A. elenae* on Hyères, outnumbering it by far and being the commonest rissoid on the seamount. It was not collected outside Hyères seamount.

Despite the presence of a pitted microsculpture, this species was not placed in *Porosalvania* n. gen. because other characters do not indicate that *A. hyerensis* is related to that group of species. The pits are clearly aligned, as if resulting from the partial closure of spiral grooves, not random as usual in *Porosalvania*; the protoconch has a spiral sculpture

resembling that of *A. elenae* n. sp., and the strong reticulated sculpture departs from the general pattern in *Porosalvania* species.

Alvania suroiti n. sp.
(Figure 11)

Type material

Holotype MNHN 9706 (sh., 2.58 × 1.66 mm) and 20 paratypes MNHN 9757 (4 spm. and 16 sh., 2.40 × 1.48 to 2.80 × 1.60 mm) from *Seamount 2* sta. DW182, in MNHN.

Type locality

Hyères seamount (31°23.2′N, 28°53.5′W, 480 m).

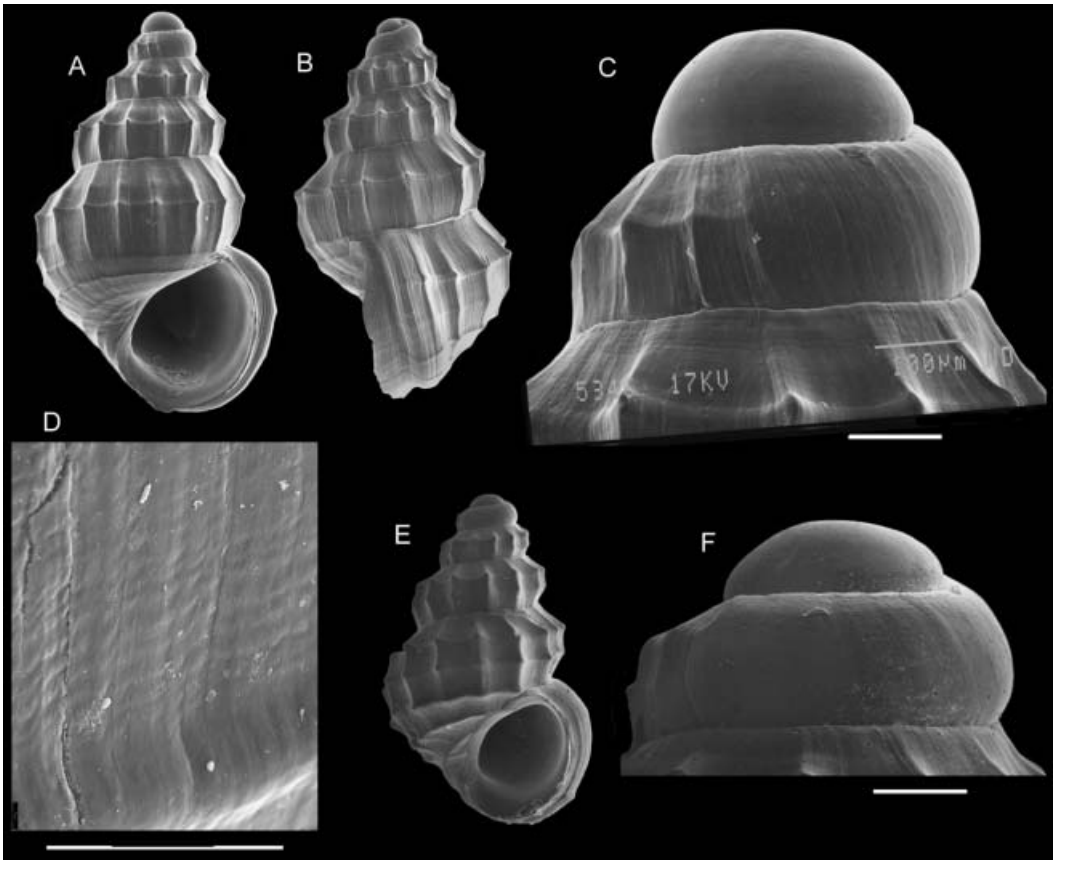

Figure 11. *Alvania suroiti* n. sp. (A) Holotype (sh.) from Hyères seamount, DW182 (480 m), actual size 2.58 mm; (B) paratype, same locality, actual size 2.44 mm; (C) protoconch of the holotype; (D) detail of microsculpture, same shell as (B); (E) shell from Meteor seamount, DW152 (470 m), actual size 2.12 mm; (F) protoconch, same shell as (E). Scale bars: 100 μm (C, F); 50 μm (D).

Material examined

Meteor—*Seamount 2* sta. DW143, 17 sh. (1.74 × 1.18 to 2.10 × 1.34 mm); DW152, 192 sh. (2.12 × 1.34 to 2.40 × 1.38 mm). Hyères—*Seamount 2* sta. DW182 [includes types], 4 spm. (2.62 × 1.48 mm, and jv.) and 120 sh. (2.40 × 1.48 to 2.84 × 1.68 mm).

Etymology

This species is dedicated to R/V 'Le Suroit' on which the *Seamount 2* expedition was carried out.

Description

Shell with a moderately high spire, solid, up to 2.8 × 1.7 mm. Protoconch of 1.25 convex whorls; surface of larval whorls quite smooth. Teleoconch of 3.5 whorls, with a sculpture of acute, widely separated axial ribs, and spiral cords. Ribs ca 16–18 on the penultimate whorl, fading out adapically where they meet the suture and on the abapical part of the body whorl; ribs remaining constant in spacing and size on most of the body whorl, except for the last rib behind the outer lip which is usually reduced. Two spiral cords on spire whorls, the most prominent situated at a little more than one-third abapically from the suture and forming projecting spines at its intersection with the axial ribs; the second one indistinct, situated midway between the stronger cord and the suture; body whorl with four more spiral cords on the abapical surface, narrow with broad, flat interspaces. Spiral microsculpture inconspicuous even under SEM observation, limited to poorly defined spiral microstriae and to the growth lines. Outer lip orthocline, with a thick rim on which the stronger cord of the spire abuts and makes a slight projection, smooth inside; aged specimens with a thin, flaring edge continuing the rim. Inner lip thick and appressed to the preceding whorl. Shell colour entirely white, translucent. Operculum thin, paucispiral, with eccentric nucleus.

Remarks

The description is based on specimens from Hyères. Those from the Meteor seamount are smaller and differ consistently in that the spiral cords on the spire are rather even in size, and there are three cords rather than four on the abapical surface. Both forms lack a distinct microsculpture on both the protoconch and the teleoconch. There are no elements indicating whether this morphological variation represents geographical variation recognizable at the subspecies level, or a species-level differentiation between the two seamounts.

Alvania microtuberculata n. sp.
(Figure 12)

Type material

Holotype MNHN 9707 (sh., 2.40 × 1.60 mm) and 30 paratypes MNHN 9760 (sh., 1.70 × 1.26 to 2.30 × 1.56 mm) from *Seamount 2* sta. DW255, in MNHN.

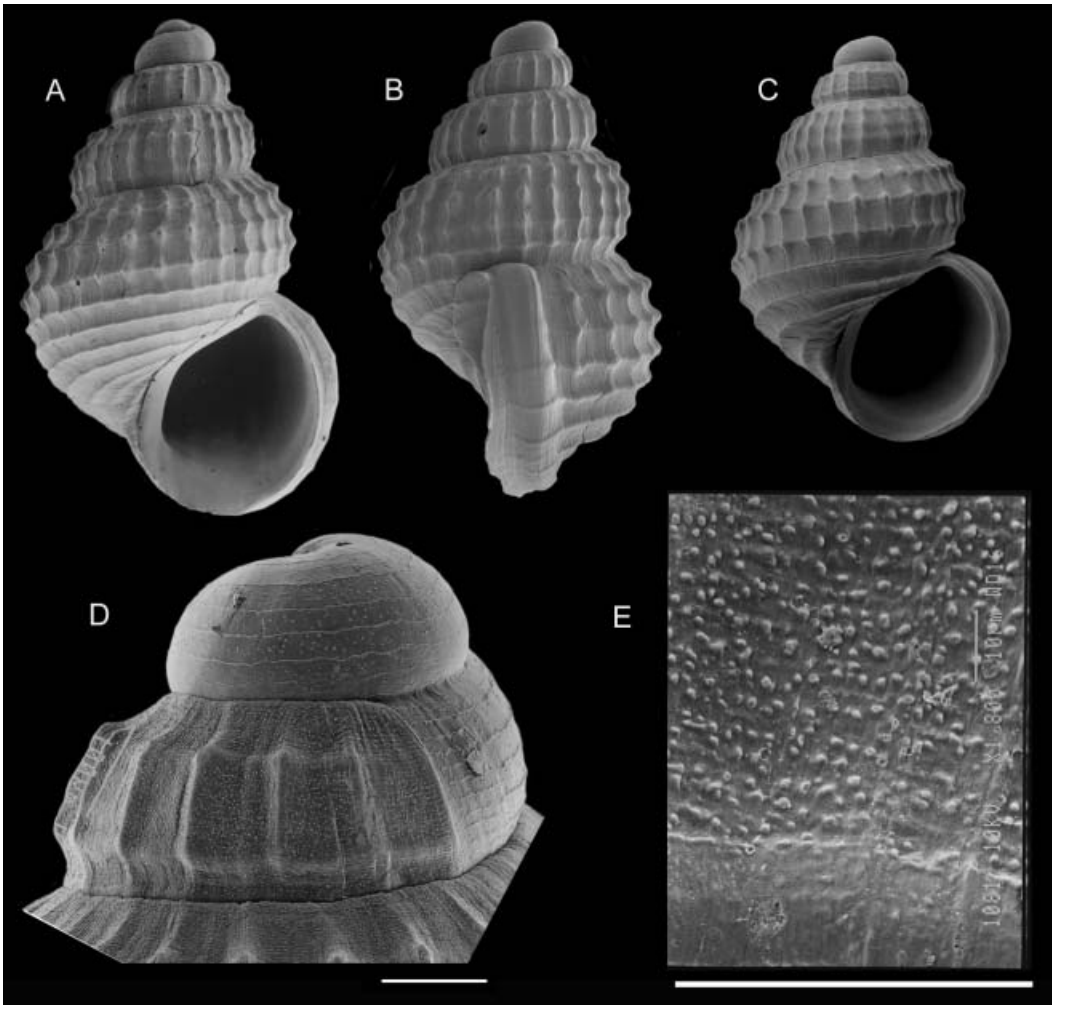

Figure 12. *Alvania microtuberculata* n. sp. (A) Holotype (sh.) from Atlantis seamount, DW255 (340 m), actual size 2.40 mm; (B, C) paratypes, same locality, actual size 2.18 and 1.96 mm; (D) protoconch, same as (C); (E) microsculpture, same as (C). Scale bar: 100 µm (D); 50 µm (E).

Type locality

Atlantis seamount (34°04.9′N, 30°15.3′W, 340 m).

Material examined

Atlantis—*Seamount 2* sta. DW255 [includes types], 106 sh. (1.72 × 1.18 to 2.42 × 1.46 mm); DW258, 4 spm. (1.76 × 1.22 to 2.0 × 1.34 mm) and 475 sh. (1.74 × 1.18 to 2.42 × 1.54 mm); TS270, 1 sh. (2.10 × 1.44 mm); DW274, 2 spm. (1.90 × 1.30 mm, 2.16 × 1.36 mm) and 435 sh. (1.56 × 1.04 to 2.40 × 1.46 mm).

Etymology

The name alludes to the microsculpture of tiny granules which can be seen on the shell.

Description

Shell with a moderately high spire, moderately solid, quite variable in size up to 2.4 × 1.4 mm. Protoconch of 1.5 convex whorls; surface of larval whorls with six to seven fine spiral threads, with broad interspaces bearing scattered minute granulations. Teleoconch of 3.0–3.5 whorls, with a sculpture of rather faint axial folds, and narrow spiral cords forming distinct knobs at their intersection with the axial sculpture. Ribs ca 24–30 on the penultimate whorl, with adapical termination not prominent along the suture, fading out at the periphery of the body whorl and not extending on the abapical part; ribs on body whorl remaining constant in spacing and size where approaching the outer lip. Spiral cords two on the first teleoconch whorl, three to four on next spire whorls; body whorl with four to five more spirals on the abapical surface. Microsculpture detectable only under SEM observation, consisting of minute granules, evenly and densely set.

Outer lip orthocline, bordered at a short distance from the edge with a narrow and high rim on which the cords are continued but very attenuated; smooth inside although the external sculpture seen by transparency may give the impression of denticles. Inner lip appressed to the preceding whorl. Shell translucent, penultimate spire whorl colourless or with a pattern of very pale brown blotches, starting with three to four on penultimate whorl, continued on body whorl, a more intense comma-shaped blotch subsuturally just behind the outer lip, and another blotch on the outer portion of outer lip (covering the head in crawling position). Operculum thin, paucispiral, with eccentric nucleus.

Remarks

This species shares with *Alvania elenae* n. sp. both the peculiar sculpture of the protoconch alternating spiral threads and granules, and the granulose microsculpture of the teleoconch, so that this may indicate that the two species are related although quite different at first glance.

Alvania adiaphoros Bouchet and Warén, 1993
(Figures 13–15, 16H)

Alvania adiaphoros Bouchet and Warén 1993, p 652, 666.

Type material

Holotype and 15 paratypes from 'Monaco' sta. 2214 (coll. H. Fischer), in MNHN.

Type locality

Off Flores, Azores (39°26′N, 31°22′W, 650–914 m).

Material examined

Meteor—*Seamount 2* sta. DW143, 8 sh. (1.70 × 1.24 to 1.93 × 1.30 mm); DW152, 8 spm. (1.76 × 1.19 to 1.96 × 1.34 mm, drawing SM 169 1.82 × 1.20 mm) and 233 sh. (1.72 × 11.4 to 2.12 × 1.42 mm). Hyères—*Seamount 2* sta. DW182, 15 spm. (1.74 × 1.14 to 2.04 × 1.32 mm) and ca 1000 sh. (1.70 × 1.20 to 2.10 × 1.42 mm). Irving—*Seamount 2* sta. DW208, 1 sh. (1.72 × 1.12 mm); DW209, 1 sh. (1.66 × 1.12 mm). Atlantis—*Seamount 2*

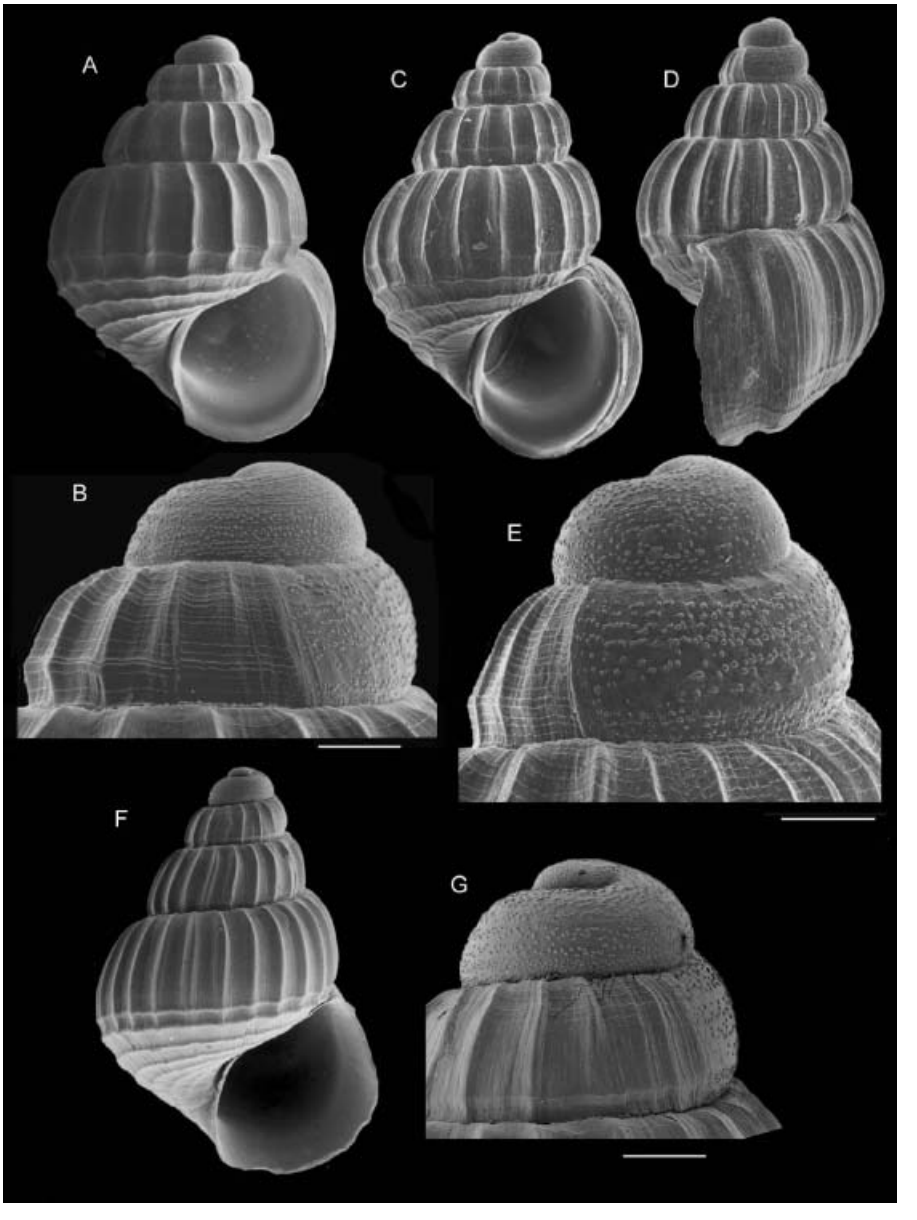

Figure 13. *Alvania adiaphoros* Bouchet and Warén, 1993. (A) Shell from Meteor seamount, DW152 (470 m), actual size 1.86 mm; (B) protoconch, same locality; (C, D) shells from Hyères seamount, DW182 (480 m), actual sizes 1.94 and 1.96 mm; (E) protoconch, same shell as (D); (F) shell from Atlantis seamount, DW255 (340 m), actual size 1.86 mm; (G) protoconch, same shell. Scale bars: 100 µm.

sta. DW255, 3 spm. (1.66 × 1.02 to 1.74 × 1.18 mm) and 760 sh. (1.54 × 1.06 to 2.00 × 1.32 mm); DW258, 7 spm. (1.82 × 0.26 to 2.08 × 1.35 mm) and 530 sh. (1.62 × 1.10 to 2.00 × 1.24 mm); TS270, 7 spm (drawing SM201; 1.56 × 1.10 to 1.74 × 1.24 mm) and 36 sh. (1.64 × 1.10 to 1.98 × 1.30 mm); DW274, 370 sh. (1.46 × 1.00 to 1.88 × 1.26 mm).

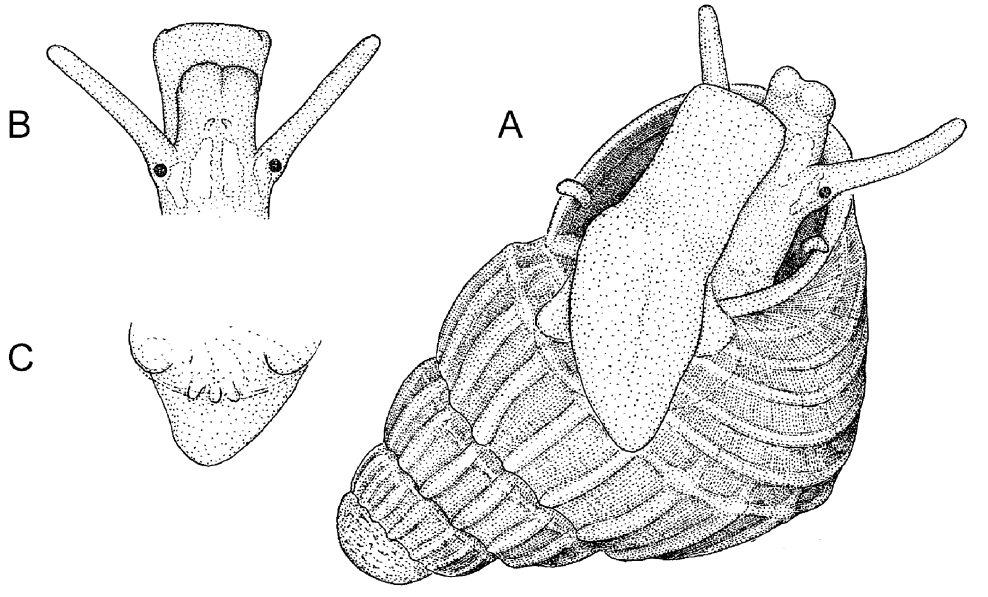

Figure 14. *Alvania adiaphoros* Bouchet and Warén, 1993. (A) Living specimen from Meteor seamount, DW152 (470 m), actual size 1.82 mm; (B) detail of head and propodium; (C) detail of opercular lobes and metapodium.

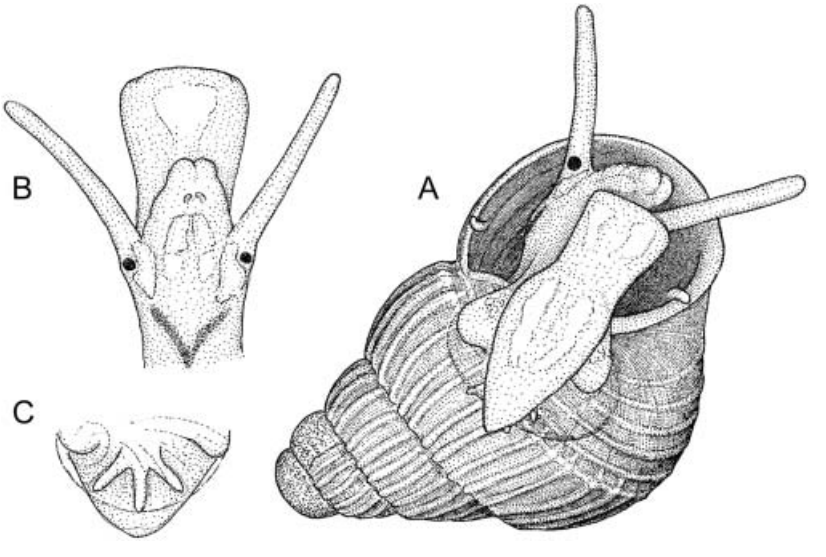

Figure 15. *Alvania adiaphoros* Bouchet and Warén, 1993. (A) Living specimen from Atlantis seamount, TS270 (330 m), actual size 1.74 mm; (B) detail of head and propodium; (C) detail of opercular lobes and metapodium.

Description

Shell with a moderately high spire, quite solid, up to 2.1 × 1.4 mm. Protoconch of 1.75 convex whorls; surface of larval whorls covered by minute granules arranged in broad spiral bands.

Teleoconch of 2.75–3 whorls (Meteor), 3–3.25 whorls (Atlantis), with a sculpture of elevated, widely separated axial ribs, minute spiral threads and distinct spiral cords restricted to the abapical area. Ribs ca 18–20 (Meteor) to 25–30 (Atlantis) on the penultimate whorl, with adapical termination hardly prominent along the suture, fading out at the periphery and not extending on the abapical part of the body whorl; ribs becoming attenuated on the body whorl where approaching the outer lip. A distinct spiral cord overhanging adapically the suture, continued on the body whorl; the periumbilical area of the body whorl with some four to five (Meteor, Hyères) or six to seven (Atlantis) additional cords, narrower than the interspaces, decreasing in size towards the umbilical chink. Spiral threads well expressed on the first teleoconch whorl, then attenuated or disappearing on the later whorls, unequal in size and spacing, overrunning the axial ribs, more conspicuous adapically along the suture. Outer lip orthocline, thickened externally mostly in the adapical part, thickened externally at a distance of the edge by a broad rim, then thinning out to a cutting edge; smooth inside. Inner lip thin, bordering a small umbilical chink. Shell colour entirely white, translucent. Operculum thin, paucispiral, with eccentric nucleus.

Cephalic tentacles cylindrical, with rounded tips. Eyes embedded in a slight swelling at the base of each tentacle. Snout somewhat tapering, truncated and bilobed anteriorly, with tiny bright yellow jaws and large bright yellow buccal mass visible by transparency. Large bright yellow granular masses behind each eye. Dorsal rear part of head with a V-shaped black mark (Atlantis only). Sole of foot colourless (Meteor) or tinged with longitudinal yellow bars (Atlantis), with pedal glands inconspicuous. Metapodial tentacle trifurcate, short (Meteor) or rather large (Atlantis). Right and left pallial tentacles moderately small. Visceral mass visible by transparency in the spire whorls, brownish with very small black granules.

Remarks

The above description is based on specimens from the seamounts, where the species is common. The holotype collected off the Azores has a quite faint axial sculpture but another shell from the type locality illustrated by Bouchet and Warén (1993, Figure 1487) resembles the dominant morphology found on Atlantis seamount.

Specimens from Meteor and Hyères differ from those on Atlantis in having a more solid shell with fewer ribs, and by details in the colour pattern of the head-foot. The species was only found as two shells on Irving (Figure 16H), and those show some features which are transitional to the *Alvania funiculata* n. sp. found in deeper water on Cruiser.

Alvania adiaphoros somewhat resembles the mainland species *A. electa* (Monterosato, 1874) in general shape and in having a strong suprasutural cord separated from the suture by a channelled interspace. It differs in lacking spirals in the adapical part of the whorls, in a lesser extension of the ribs towards the abapical part, and in being less umbilicate. The protoconch is also different, the granules tending to form definite spiral threads in *A. electa*.

Alvania funiculata n. sp.
(Figure 16A–G)

Type material

Holotype MNHN 9708 (sh., 1.84 × 1.22 mm), 50 paratypes MNHN 9763 (3 spm., 1.74 × 1.16 to 1.88 × 1.28 mm), and 47 sh. (1.84 × 1.24 to 2.10 × 1.40 mm) from *Seamount 2* sta. DW203, in MNHN.

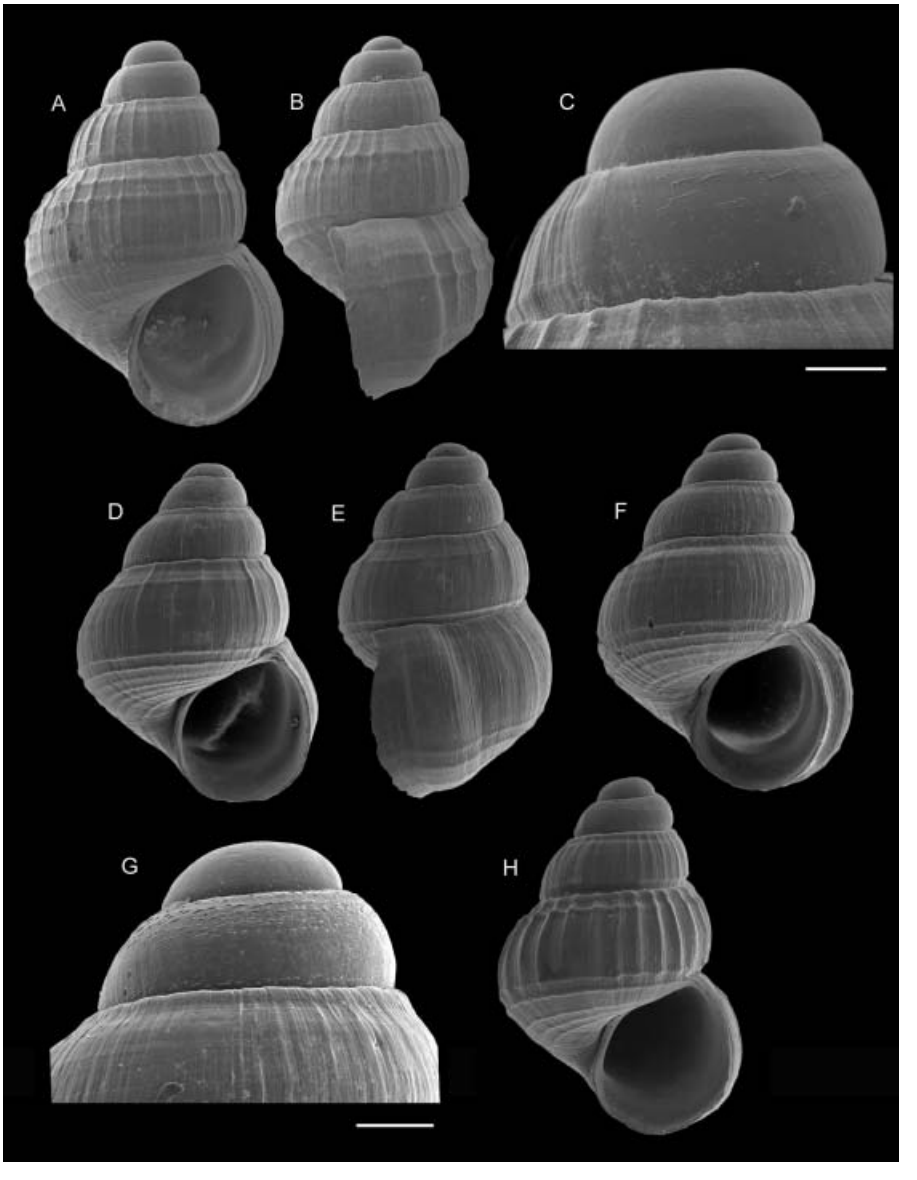

Figure 16. (A) *Alvania funiculata* n. sp. Holotype (sh.) from Hyères seamount, DW203 (845 m), actual size 1.84 mm; (B) paratype (spm.), same locality, actual size 1.76 mm; (C) protoconch of the holotype; (D–F) shells from Cruiser seamount, DW237 (670 m), actual sizes 1.60, 1.70, and 1.60 mm; (G) protoconch, same as (F); (H) shell from Irving seamount, DW208 (790 m) attributed to *A. adiaphoros*, actual size 1.70 mm. Scale bars: 100 µm.

Type locality

Hyères seamount (31°09.5′N, 28°43.5′W, 845 m).

Material examined

Hyères—*Seamount 2* sta. DW200, 46 sh. (1.90 × 1.20 to 2.10 × 1.28 mm); DW203, the type material. Cruiser—*Seamount 2* sta. DW237, 131 sh. (1.52 × 1.02 to 2.04 × 1.26 mm). Atlantis—*Seamount 2* sta. DW261, 14 sh. (1.72 × 1.22 to 2.14 × 1.42 mm). Tyro—*Seamount 2* sta. DW278, 4 spm. (1.60 × 1.12 to 1.86 × 1.30 mm) and 1090 sh. (1.64 × 1.06 to 2.10 × 1.40 mm).

Etymology

The name alludes to the fine spiral threads (Latin, *funicula*, little ropes) on the shell.

Description

Shell with a moderately high spire, quite solid, up to 2.1 × 1.4 mm. Protoconch of 1.75 convex whorls; surface of larval whorls rather smooth, with some minute elongate granules. Teleoconch of 2.75–3 whorls, with a sculpture of faint axial ribs and of spiral cords. Ribs poorly defined, much narrower than the interspaces, fading out at the periphery of the body whorl and not extending on the abapical part. Spiral cords indistinct on the first spire whorls except for one stronger at a short distance abapically from the suture, and a weak cord overhanging adapically the suture, both continued on the body whorl; cords on body whorl becoming more definite and forming small knobs at their intersection with the ribs. Periumbilical area of the body whorl with some six to seven additional cords, narrower than the interspaces, even in size. Outer lip very slightly prosocline, with a thin edge and thickened externally at a distance of the edge by a broad rim, overrun by the spirals; smooth inside. Inner lip thin, bordering a small umbilical chink. Shell colour entirely white, translucent. Operculum thin, paucispiral, with eccentric nucleus.

Remarks

This form is here treated as a distinct species because it is sympatric with *Alvania adiaphoros* on Hyères and on Atlantis seamounts, in discrete depth intervals. It shares with *A. adiaphoros* the general shape and size, and the architecture of the very thick outer lip, but differs in that the spiral sculpture usually dominates over the axial. It most resembles *Alvania tarsodes* (Watson, 1886) from the Azores but has a stouter profile with one whorl less, and with both cords and ribs more delicate. The protoconch is also different, being covered in *A. tarsodes* by much more minute granules (see Bouchet and Warén 1993, p 642–644).

On Cruiser seamount, a small spur culminating ca 600 m deep close to the northeast of Irving, a somewhat different form was the only one found in this species group and is tentatively assigned to *A. funiculata*, whereas on the shallow part of Irving, only two shells (listed under *A. adiaphoros*), with transitional features, were collected.

Alvania stenolopha Bouchet and Warén, 1993
(Figure 17A–D)

Alvania stenolopha Bouchet and Warén 1993, p 644, 653–655.

Type material

Holotype from 'Monaco' sta. 703 (coll. H. Fischer), in MNHN.

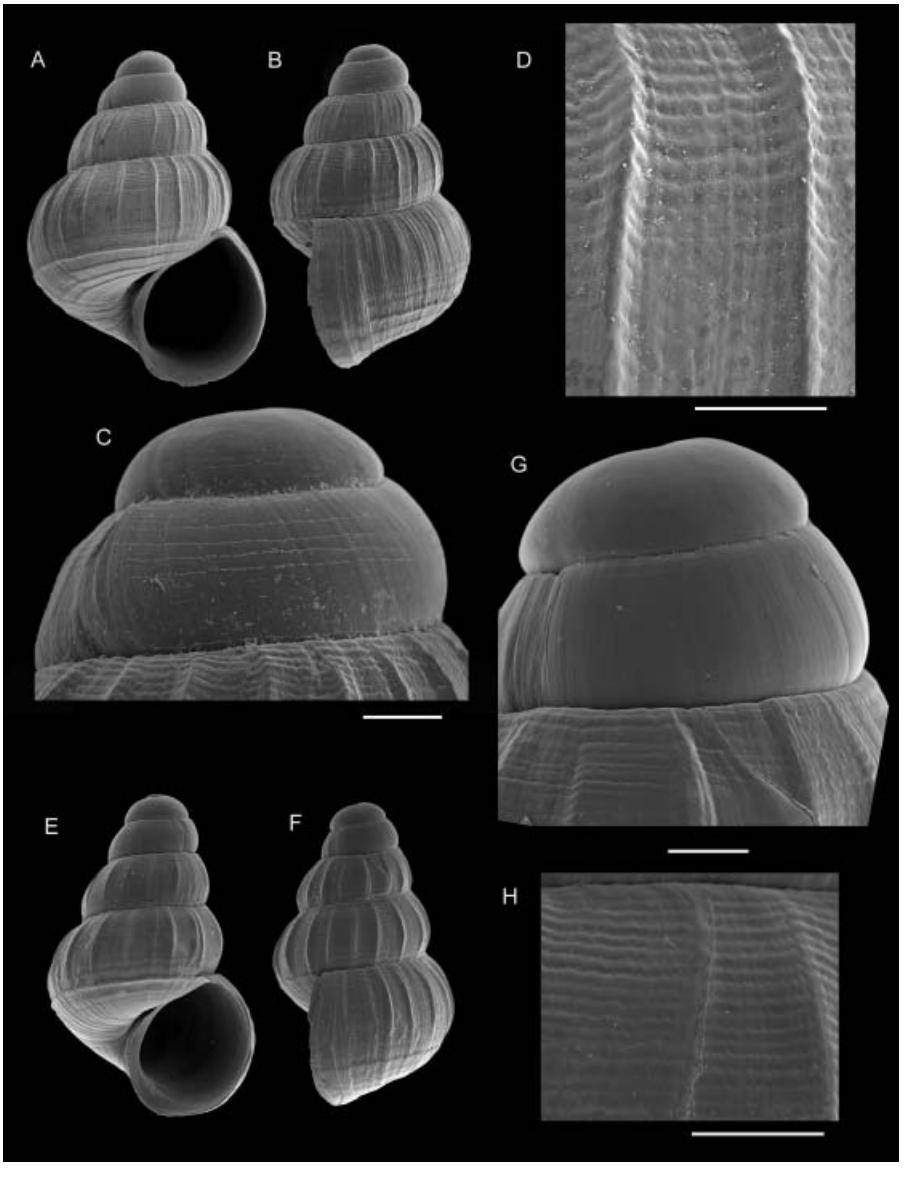

Figure 17. (A, B) *Alvania stenolopha* Bouchet and Warén, 1993, shells from Atlantis seamount, DW261 (1340 m), actual size 2.12 and 2.02 mm; (C) protoconch of a juvenile shell, same locality; (D) detail of microsculpture, same shell as (A); (E) *Alvania macella* n. sp., holotype (sh.) from Atlantis seamount, DW261, actual size 2.04 mm; (F) paratype (sh.), same locality, actual size 2.10 mm; (G) protoconch of the same paratype; (H) detail of microsculpture of the holotype. Scale bars: 100 µm.

Type locality

Off Flores, Azores (39°21′N, 31°06′W, 1360 m).

Material examined

Hyères—*Seamount 2* sta. DW200, 1 sh. (jv.); sta. DW203: 7 sh. (2.00 × 1.32 to 2.08 × 1.48 mm). Atlantis—*Seamount 2* sta. DW 261, 53 sh. (1.76 × 1.24 to 2.12 × 1.50 mm).

Description

Shell with a moderately high spire, quite thin, up to 2.1 × 1.5 mm. Protoconch of 1.3–1.5 convex whorls; surface of larval whorls covered by minute spiral threads. Teleoconch of 2.75–3 whorls, with a sculpture of narrow, widely separated axial ribs, crowded spiral threads and distinct spiral cords restricted to the abapical area. Ribs ca 17–23 on the penultimate whorl, with adapical termination hardly prominent along the suture, interrupted where abutting on the first spiral cord at the periphery and not extending on the abapical part of the body whorl; ribs becoming attenuated or disappearing on the body whorl where approaching the outer lip. Four to eight cords on abapical area of the body whorl, much narrower than the interspaces, decreasing in size towards the umbilical chink. Outer lip slightly prosocline, with a thin edge somewhat flaring but hardly thickened externally, not overrun by the spirals; smooth inside. Inner lip thin, overhanging a distinct umbilical chink. Shell colour white, translucent.

Remarks

Albeit there is a superficial resemblance, this species is easily distinguished from *A. adiaphoros* by having minute spiral threads instead of granules on the protoconch, narrower ribs, a more fragile shell with spiral microsculpture extending on the body whorl and an outer lip expanded outwards rather than thickened.

Warén and Bouchet (2001) reported specimens tentatively assigned to this species at several sites along the North Atlantic ridge in 650–1850 m depth, together with an egg capsule containing a single young in protoconch stage ready to hatch.

Alvania macella n. sp.
(Figure 17E–H)

Type material

Holotype MNHN 9709 (sh., 2.04 × 1.00 mm) and 30 paratypes MNHN 9764 (sh., 2.00 × 1.26 to 2.60 × 1.44 mm) from *Seamount 2* sta. DW261, in MNHN.

Type locality

Atlantis seamount (34°22.4′N, 30°27.8′W, 1340 m).

Material examined

Atlantis—*Seamount 2* sta. DW261 [includes types], 110 sh. (2.00 × 1.26 to 2.60 × 1.44 mm).

Etymology

From Latin *macellus*, skinny, meagre, alluding to the narrow profile compared to *A. stenolopha*.

Description

Shell with a moderately high spire, quite thin, up to 2.6 × 1.4 mm. Protoconch of 1.3–1.5 convex whorls; smooth. Teleoconch of 2.75–3.25 whorls, with a sculpture of narrow, widely separated axial ribs, crowded spiral threads, a distinct spiral cord continuing the suture on the body whorl, and some indistinct cords on the abapical area. Ribs ca 16–18 on the penultimate whorl, with adapical termination hardly prominent along the suture, not extending on the abapical part of the body whorl; ribs becoming attenuated or disappearing on the body whorl where approaching the outer lip. Three to four cords on abapical area of the body whorl, much narrower than the interspaces, decreasing in size towards the umbilical chink. Outer lip orthocline to slightly prosocline, with a thin edge somewhat flaring but not thickened externally, smooth inside. Inner lip thin, overhanging a distinct umbilical chink. Shell colour white, translucent.

Remarks

This species resembles very much *Alvania stenolopha* to the point that these specimens could be considered within intraspecific variability, were it not that both occur sympatrically on Atlantis and could be unambiguously separated in a quite large lot. It differs in being more slender, in having less pronounced spirals abapically and in consistently lacking the spiral threads on the protoconch.

Genus *Pseudosetia* Monterosato, 1884

Type species. *Rissoa turgida* Jeffreys, 1870 (subsequent designation by Crosse, 1885).

Pseudosetia amydralox Bouchet and Warén, 1993

(Figures 18, 19)

Pseudosetia amydralox Bouchet and Warén 1993, p 685–689.

Type material

Holotype from *Seamount 1* sta. CP20, and numerous paratypes from the type locality in MNHN and SMNH.

Type locality

Gorringe seamount (36°34′N, 11°30′W, 305–320 m).

Material examined

Gorringe—*Seamount 1* sta. DW08, 1 spm. (1.32 × 0.92 mm) and 11 sh. (up to 2.10 × 1.32 mm); DW16, 152 sh. (up to 2.10 × 1.28 mm); CP20, 1 spm. (1.72 × 1.20 mm); CP28,

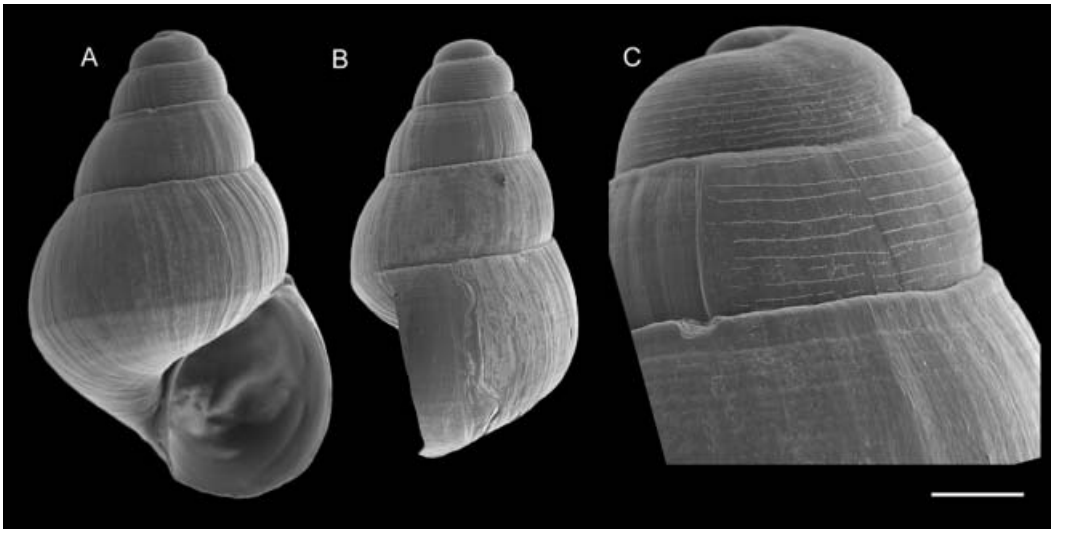

Figure 18. *Pseudosetia amydralox* Bouchet and Warén, 1993. (A) Specimen from Josephine seamount, DW61 (200–205 m), actual size 1.90 mm; (B) shell, same locality, actual size 1.70 mm; (C) protoconch, same specimen as (A). Scale bar: 100 μm.

1 sh. (jv.). Josephine—*Seamount 1* sta. DE39, 6 sh. (up to 2.16 × 1.46 mm); DW43, 28 sh. (2.18 × 1.36 mm); DW60, 5 sh. (1.82 × 1.16 mm); DW61, 1 spm. (1.94 × 1.26 mm) and 132 sh. (up to 2.16 × 1.26 mm). Ampère—*Seamount 1* sta. DE95, 1 spm. (drawing SM65, 1.86 × 1.28 mm) and 3 sh. (up to 1.70 × 1.28 mm); DE98, 138 sh. (up to 2.24 × 1.46 mm); CP 99, 9 spm. (1.68 × 1.10 to 1.82 × 1.25 mm) and jv. spm.; *Victor Hensen* VH97 sta. 94, 5 sh. (jv.); sta. 97, 12 sh. (1.80 × 1.24 to 2.16 × 1.58 mm); sta. 102, 1 sh. (1.70 × 1.10 mm). Seine—*Seamount 1* sta. DE80, 2 sh. (up to 1.84 × 1.20 mm).

Description

Shell with moderately high spire and rounded whorls, up to 2.1 × 1.4 mm. Protoconch of 1.5 convex whorls; surface of larval whorls covered by widely separated, minute spiral threads. Teleoconch of 2.75 moderately convex whorls, with a very faint sculpture of weak axial lines and minute spiral striae. Axial lines irregular, in the form of wrinkles parallel to growth stages, fading out on the abapical part of the body whorl. Body whorl sometimes with an indistinct keel in prolongation of the suture, or rounded. Outer lip orthocline, always with a thin edge even in full-grown specimens, smooth inside. Inner lip thin, bordering a narrow umbilical chink. Shell colour entirely white, translucent. Operculum thin, paucispiral, with eccentric nucleus.

Cephalic tentacles cylindrical, with rounded tips. Eyes rather large, embedded in a very slight swelling at the base of each tentacle. Snout somewhat tapering, truncated and bilobed anteriorly, with tiny whitish jaws visible by transparency, and anterior part tinged with pale brown. No granular masses could be seen behind the eyes. One metapodial tentacle, forming a small, poorly defined flap. Sole of foot colourless with anterior and posterior pedal glands not very conspicuous. Right and left pallial tentacles

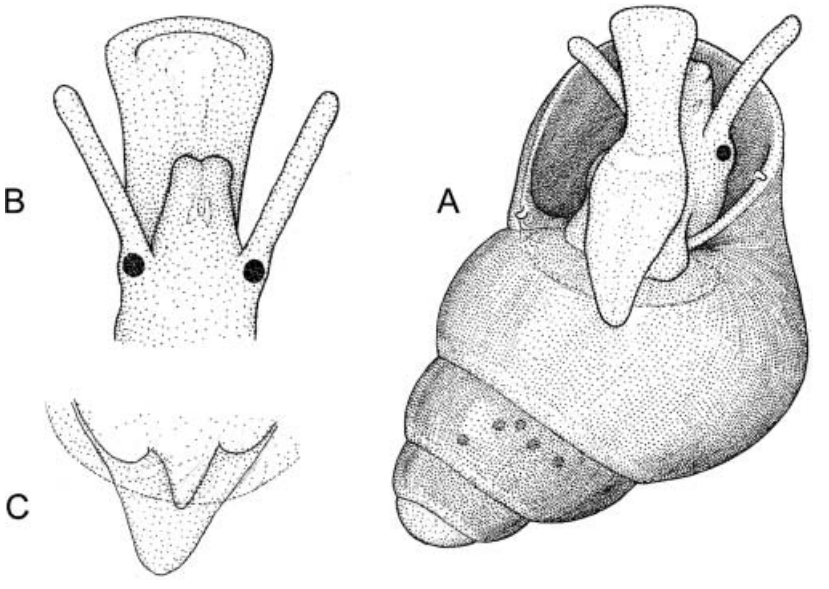

Figure 19. *Pseudosetia amydralox* Bouchet and Warén, 1993. (A) Living specimen from Ampère seamount sta. DE95 (197–210 m), actual size 1.86 mm; (B) detail of head and propodium; (C) detail of opercular lobes and metapodium.

tiny. Visceral mass visible by transparency in the spire whorls and bearing a few black granules.

Remarks

This species is hardly distinct from the North European *P. turgida*, the main difference being the more impressed spiral striae on some specimens and the more solid shell. It is found rather on the uppermost part of the Lusitanian seamounts, whereas *P. turgida* is found in 90–700 m in Norway but has its main bathymetric range between 500 and 1500 m in the Bay of Biscay. In the large material examined from the Lusitanian seamounts, all shells had a thin outer lip and this indicates that apertural thickening does not occur in this species. The specimen from Galicia bank with a varix figured by Bouchet and Warén (1993, p 689, Figure 1619) also has a quite distinct spiral sculpture on the abapical area and may belong to a different species, whereas all other 66 shells in the same lot are 'normal' *P. amydralox* with a thin lip.

Setia spp. have a similar sculpture on the protoconch and also usually lack labial thickening, but the presence of two small pallial tentacles indicates a relationship with *Alvania* s.l. rather than with *Setia*.

Pseudosetia azorica Bouchet and Warén, 1993
(Figure 20)

Pseudosetia azorica Bouchet and Warén 1993, p 686, 689–690.

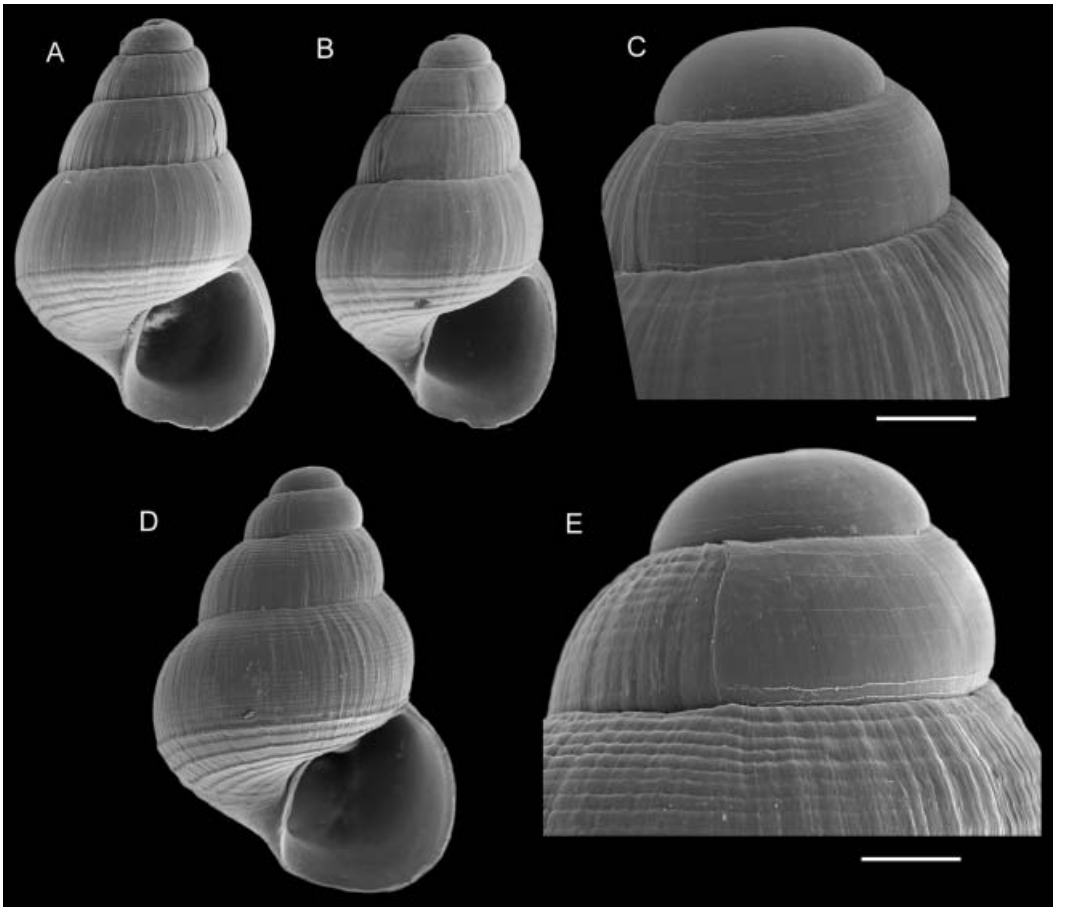

Figure 20. *Pseudosetia azorica* Bouchet and Warén, 1993. (A, B) Shells from Atlantis seamount, DW255 (340 m), actual size 1.57 and 1.50 mm; (C) protoconch, juvenile specimen from Atlantis seamount, TS270 (330 m); (D) shell from Cruiser seamount, DW237 (670 m), actual size 1.62 mm; (E) protoconch, same shell. Scale bars: 100 µm.

Type material

Holotype from *Bartlett* sta. 2, in ZMC (GAS-120), paratype in MNHN.

Type locality

Off Faial/Pico, the Azores (37°13.8′N, 28°44.5′W, 480 m).

Material examined

Meteor—*Seamount 2* DW152, 1 sh. (1.95 × 1.20 mm). Hyères—*Seamount 2* DW182, 4 spm.+122 sh. (1.47 × 1.0 to 2.05 × 1.25 mm). Cruiser—*Seamount 2* sta. DW237, 68 sh. (1.62 × 1.10 to 2.02 × 1.20 mm); DW238, 2 sh. (1.98 × 1.22 to 2.08 × 1.38 mm). Atlantis—*Seamount 2* sta. DW255, 33 sh. (1.30 × 0.85 to 1.77 × 1.07 mm); DW258, 10 sh. (1.42 × 0.96 to 1.60 × 1.00 mm); DW261, 11 sh. (1.70 × 1.20 to 2.10 × 1.36 mm); DW263,

152 sh. (jv. 1.1 × 0.82 mm; 1.45 × 1.00 to 2.15 × 1.30 mm); TS270, 2 spm. (jv. 1.36 × 0.92 and 1.40 × 1.00 mm) and 12 sh. (jv. 0.80 × 0.67 to 1.45 × 0.90 mm); DW274, 13 sh. (1.38 × 0.82 to 1.64 × 1.06 mm).

Description

Shell with moderately high spire, up to 2.15 × 1.30 mm. Protoconch of 1.5 convex whorls; surface of nucleus smooth, then with blurry bands of granules, finally with widely separated, indistinct spiral threads. Teleoconch of two to three moderately convex whorls, with a faint sculpture of weak axial lines, minute spiral striae and spiral cords. Axial lines irregular, in the form of wrinkles parallel to growth stages, fading out on the abapical part of the body whorl. Spiral striae more distinct on the adapical part of the whorl next to the suture. One spiral cord running along the suture or very close to it on the abapical side of the spire whorls; body whorl with this cord continued and with five to six more on the periumbilical area, separated by very broad interspaces, and decreasing in size towards the abapical side. Body whorl with an indistinct keel in prolongation of the suture. Outer lip orthocline, with a thin, flaring edge, thickened externally at a distance of the edge by a broad rim on which the spiral sculpture is attenuated; smooth and not thickened inside. Inner lip thin, quite appressed or leaving an extremely narrow umbilical chink. Shell colour entirely white, translucent. Operculum thin, paucispiral, with eccentric nucleus.

Remarks

Pseudosetia azorica was described from only five shells collected around the Azores, but is not rare on Atlantis seamount. Warén and Bouchet (2001) reported three specimens of *Pseudosetia azorica* on the North Atlantic ridge in 860–870 m depth.

It is distinguished from *Pseudosetia amydralox* and from *Pusullina fuscapex* n. sp. by having strong, definite spirals on the abapical surface. The latter species is found sympatrically on Meteor, Hyères, and Atlantis. Specimens found in deeper water on Cruiser seamount (Figure 20D, E) differ in having more convex whorls and a more distinct sculpture on spire whorls, reminiscent of that seen in *Alvania stenolopha* (see Figure 17A–C). The protoconch sculpture is also very similar, suggesting that this species may be actually related to *A. stenolopha* despite the lack of axial sculpture. This relationship, if verified, would make *Pseudosetia* polyphyletic and call for a reassignment of the species.

Genus *Crisilla* Monterosato, 1917

Type species. Turbo semistriatus Montagu, 1808, by monotypy.

Crisilla ovulum n. sp.
(Figures 21, 22)

Type material

Holotype MNHN 9710 (spm., 1.40 × 0.94 mm) from *Seamount 1* sta. DW60, in MNHN; 34 paratypes MNHN 9765 and SMNH 6742 (2 spm., 1.34 × 0.88 mm and 32 sh.,

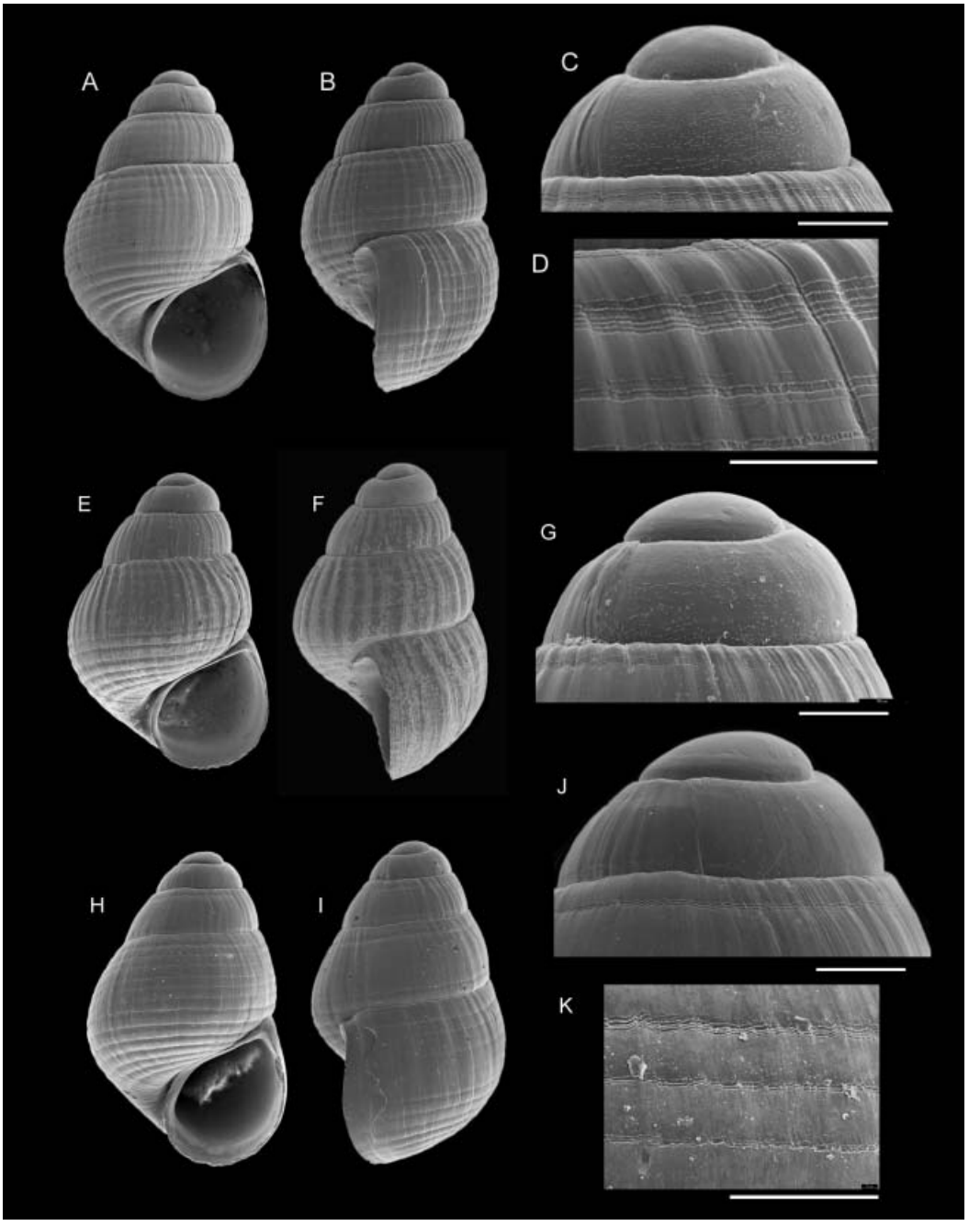

Figure 21. *Crisilla ovulum* n. sp. (A, B) Paratype from Josephine seamount, DW61 (200–205 m), actual size 1.38 mm; (C) protoconch; (D) microsculpture on subsutural area of third whorl; (E, F) shells from Seine seamount, DE80 (250–256 m), actual size 1.24 and 1.34 mm; (G) protoconch, same shell as (E); (H, I) shells from Seine seamount, DE72 (165 m), actual size 1.36 mm; (J) protoconch, same shell as (H); (K) microsculpture, same locality. Scale bars: 100 µm.

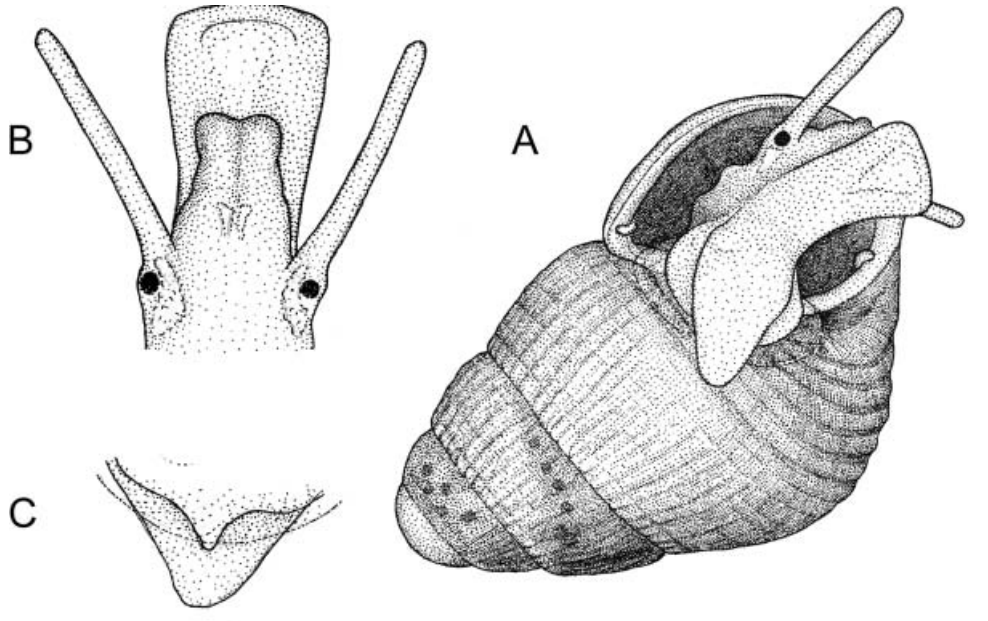

Figure 22. *Crisilla ovulum* n. sp. (A) Holotype (living specimen) from Josephine seamount, DW60 (240–255 m), actual size 1.40 mm; (B) detail of head and propodium; (C) detail of opercular lobes and metapodium.

1.08 × 0.74 to 1.50 × 0.95 mm) from *Seamount 1* sta. DW61 (36°40′N, 14°16′W, 200–205 m) in MNHN and SMNH.

Type locality

Josephine seamount (36°43′N, 14°17′W, 240–255 m).

Material examined

Josephine—*Seamount 1* sta. DW38, 2 spm. (1.16 × 0.76 mm drawing SM32, 1.04 × 0.76 mm) and 12 sh. (1.12 × 0.78 to 1.48 × 0.91 mm); DE39, 15 sh. (1.08 × 0.76 to 1.56 × 1.00 mm); DW41, 4 sh. (1.18 × 0.80 to 1.44 × 0.94 mm); DW43, 19 sh. (1.10 × 0.80 to 1.58 × 0.98 mm); DW45, 32 sh. (1.14 × 0.84 to 1.54 × 1.00 mm); DW58, 1 sh. (1.20 × 0.84 mm); DW60 [holotype], 1 spm. (1.40 × 0.94 mm); DW61, the paratypes. Seine—*Seamount 1* DE72, 2 spm. (1.30 × 0.88 and 1.55 × 0.95 mm) and 600 sh. (1.18 × 0.80 to 1.62 × 1.00 mm); DE 73, 1 spm. (drawing SM51 1.40 × 0.92 mm)+34 sh. (1.42 × 0.88 to 1.68 × 1.04 mm); CP79, 1 sh. (1.30 × 0.88 mm); DE80, 186 sh. (1.40 × 0.93 to 1.82 × 1.08 mm, outstanding large sh. 2.40 × 1.34 mm); DE82, 13 sh. (1.28 × 0.88 to 1.54 × 0.98 mm).

Etymology

Diminutive of Latin *ovum*, an egg; alluding to the shape of the shell.

Description

Shell with moderately high spire, pupoid with blunt apex, adults up to 1.6×1.0 mm. Protoconch of 1.25 whorls, covered with minute, indistinct granules more or less arranged into blurry spiral bands. Teleoconch of 2.5–3.0 whorls, with a sculpture of faint axial wrinkles, and shallow spiral furrows. Axial wrinkles parallel to growth lines, gradually fading out on the abapical part of the body whorl. Spiral furrows either demarcating broad, flat spiral cords, or more scanty and separated by broad flat surfaces; with minute spiral threads running inside; a more well-marked furrow running subsuturally. Intersection of spiral cords and axial wrinkles resulting in a beaded appearance, particularly on the adapical part of whorls. Body whorl rounded, slightly constricted, the abapical part with 18–20 more definite, flat spiral cords. Outer lip orthocline, slightly flexuous, bent forward at its adapical insertion, with a thin edge, not thickened; internally smooth. Inner lip thin, bordering a narrow umbilicus. Shell colour entirely white, translucent. Operculum thin, paucispiral, with eccentric nucleus.

Cephalic tentacles cylindrical, slender with rounded tips. Eyes embedded in a slight swelling at the base of each tentacle. Snout somewhat tapering, truncated and bilobed anteriorly, with tiny bright yellow jaws visible by transparency and anterior part tinged with pale brown. Elongate yellowish granular masses behind each eye; other more irregular yellowish to whitish mass visible by transparency beneath the operculum. Sole of foot colourless with pedal glands inconspicuous; metapodium with a faint longitudinal groove. One metapodial tentacle, forming a triangular flap. Right and left pallial tentacles moderately small. Visceral mass visible by transparency in the spire whorls, reddish brown with conspicuous series of black granules.

Remarks

This species resembles in general aspect *Crisilla marioni* Fasulo and Gaglini, 1987, a shallow-water species living in bioclastic rubble in some parts of the Mediterranean. It also resembles superficially *Gofasia josephinae*, with which it lives sympatrically on Josephine seamount, but differs in having a stouter profile and in the microsculpture of open furrows instead of rows of pores.

The generic placement of this species is tentative. The broad subsutural cord separated by a more marked interspace is very *Crisilla*-like, but the flexuose profile of the aperture is a character state never seen otherwise in other species assigned to *Crisilla*. The shape of the metapodial tentacle is also discrepant, it is a cluster of several tiny cylindrical tentacles in the type species *Crisilla semistriata* (Montagu, 1808) and in the shallow water *C. postrema* Gofas, 1990 from the Azores. The general aspect of the animal and particularly the small, triangular metapodial flap are similar to what is seen in *Gofasia*, e.g. *G. josephinae* and in *Manzonia*, but the shell differs from *Gofasia* in having spiral furrows instead of spiral rows of pits.

This is the commonest rissoid on Seine seamount, specimens there being slightly larger than on Josephine. The specimens from the shallower hauls of Seine (DW72, DE73), sympatric with the fine-ribbed *Alvania seinensis* n. sp. completely lack the axial sculpture. It may be ventured that this results of a character displacement, which would make sense if some tactile features of the shell were implied in mate recognition.

Genus *Manzonia* Brusina, 1870

Type species. *Turbo costatus* J. Adams, 1798, by original designation (=*Turbo crassus* Kanmacher, 1798; non *Turbo costatus* von Salis Marschlins, 1793).

Manzonia lusitanica n. sp.
(Figure 23)

Type material

Holotype MNHN 9711 (sh., 2.16 × 1.34 mm) and 20 paratypes MNHN 9766 (sh., 1.64 × 1.00 to 2.16 × 1.34 mm) from *Seamount 1* sta. DW08, in MNHN.

Type locality

Gorringe seamount (36°28′N, 11°37′W, 470–485 m).

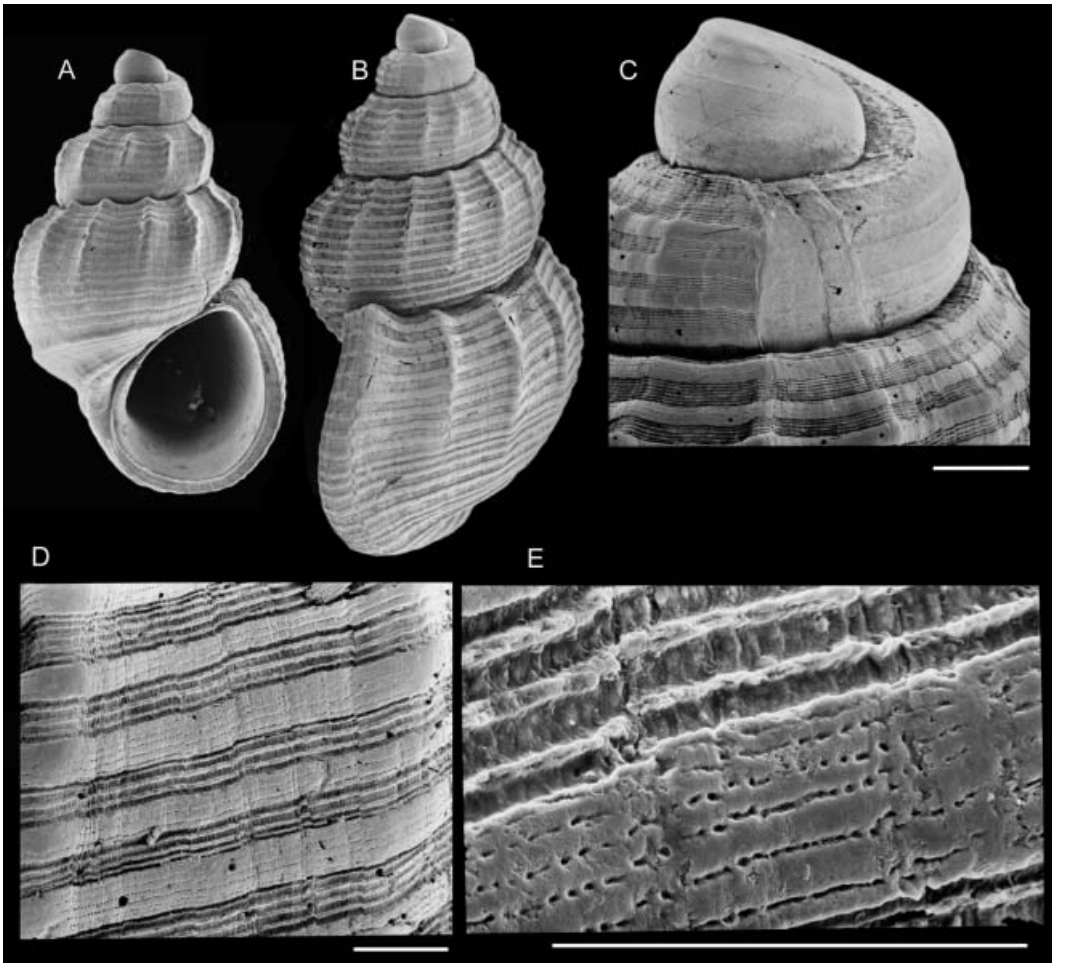

Figure 23. *Manzonia lusitanica* n. sp. (A) Paratype (sh.) from Gorringe seamount, DW08 (470–485 m), actual size 1.78 mm; (B) holotype (sh.), same locality, actual size 2.16 mm; (C) protoconch of the holotype; (D, E) microsculpture of the holotype. Scale bars: 100 µm (C); 50 µm (D, E).

Material examined

Gorringe—*Seamount 1* sta. DW04, 1 spm. (jv.) and 47 sh. (1.48 × 0.97 to 2.10 × 1.24 mm); DW05, 20 sh. (1.60 × 1.02 to 1.97 × 1.23 mm); DW06, 10 sh. (1.52 × 1.15 to 1.86 × 1.16 mm); DW08 [includes types], 24 sh. (1.64 × 1.00 to 2.16 × 1.34 mm); DE09, 5 sh. (1.70 × 1.13 to 2.23 × 1.34 mm); DW16, 4 sh. (1.70 × 1.09 to 1.92 × 1.12 mm); FA18, 1 spm. (2.00 × 1.23 mm); CP20, 1 sh. (1.86 × 1.22 mm).

Etymology

The name alludes to the Lusitanian region and seamounts, where the species is represented.

Description

Shell with a moderately high spire, adults up to 2.4 × 1.4 mm. Protoconch of 1.25 convex whorls, keeled adapically; surface of larval whorls sometimes also bearing some faint spiral cords between the suture and the keel. Teleoconch of ca three convex whorls, faintly angulated at a distance abapically from suture. Axial sculpture of flexuous, narrow and elevated folds, more or less developed on different individuals, fading out on abapical surface of body whorl. Spiral sculpture of flat cords, as broad as interspaces or slightly broader, bearing a characteristic microsculpture of minute pits forming spiral lines; interspaces bearing four to eight raised spiral threads. Abapical area with two stronger spiral cords separated by a broad spiral depression. Outer lip definitely opisthocline, thickened externally by a broad rim sloping gently towards the adjacent surface of body whorl; smooth inside. Inner lip thin, appressed. Shell colour white. Operculum thin, paucispiral, with eccentric nucleus.

Remarks

This species was cited from Gorringe by Ávila and Malaquias (2003, p 148) under the name *Manzonia crispa* (Watson, 1873). The latter species (Figure 24) is stouter with a coarser sculpture of about half as many cords on the spire whorls, and is considered here to be a different species. The specific distinction is supported by the absence of any species of *Manzonia* with a broad periumbilical furrow on Seine and Ampère.

Manzonia taeniata n. sp.
(Figures 25, 26)

Type material

Holotype MNHN 9712 (spm., 1.62 × 1.00 mm) from *Seamount 1* sta. DW15, 10 paratypes MNHN 9767 (sh., 1.64 × 1.00 to 2.16 × 1.34 mm) from *Seamount 1* sta. DW 16 (36°31′N, 11°32′W, 255–265 m), and one paratype MNHN 9768 (sh., 1.82 × 1.13 mm) from *Seamount 1* sta. CP20 (36°34′N, 11°30′W, 305–320 m), in MNHN.

Type locality

Gorringe seamount (36°33′N, 11°29′W, 300–330 m).

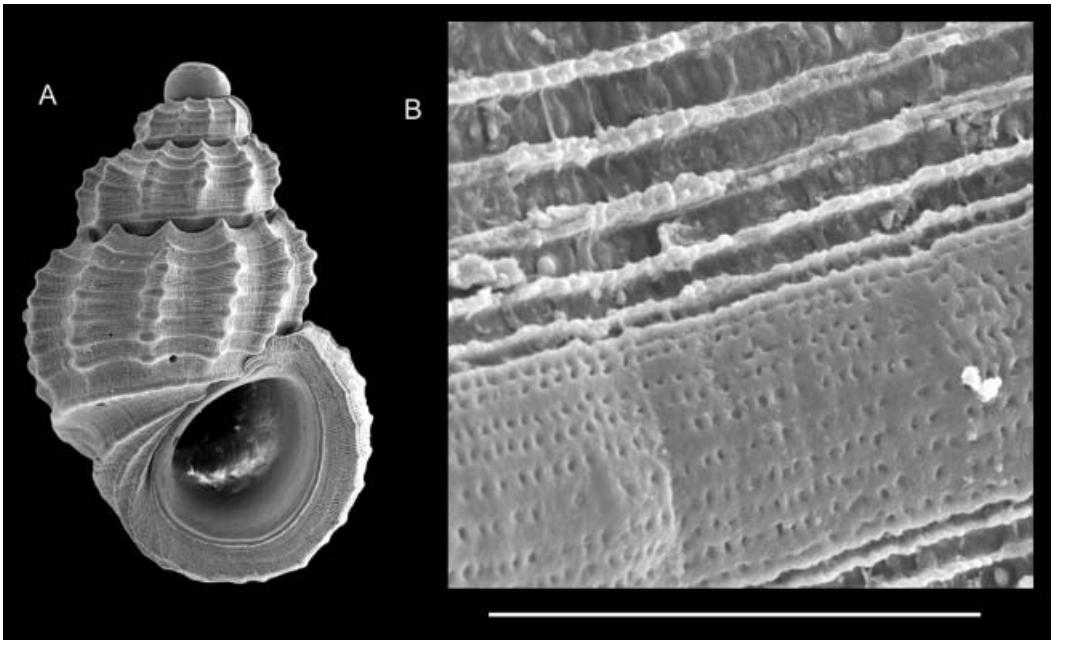

Figure 24. *Manzonia crispa* (Watson, 1873). (A) Shell from Madeira, coll. Jousseaume (MNHN), actual size 2.00 mm; (B) detail of microsculpture, same shell. Scale bar: 50 μm.

Material examined

Gorringe—the type material and *Seamount 1* sta. DW15, 1 sh. (broken); CP20, 3 sh. (broken).

Etymology

From Latin *taeniatus*, banded, alluding to the broad flat cords seen on the shell.

Description

Shell with a moderately high spire, adults up to 2.2 × 1.4 mm. Protoconch of 1.25 convex whorls, with delicate spiral cords and sometimes a very faint adapical keel. Teleoconch of ca 3–3.25 whorls, with a keel at a distance abapically from suture. Axial sculpture of flexuous folds, more or less developed on different individuals, fading out on abapical surface of body whorl. Spiral sculpture of flat cords, much broader than interspaces, bearing a characteristic microsculpture of minute pits forming spiral lines; interspaces bearing two to four raised spiral threads. Abapical area with two somewhat stronger spiral cords. Outer lip opisthocline, thickened externally by a narrow but definite rim, well demarcated from adjacent surface of the body whorl; smooth inside. Inner lip thin, appressed. Shell colour white. Operculum thin, paucispiral, with eccentric nucleus.

Cephalic tentacles cylindrical, with rounded tips. Eyes embedded in a slight swelling at the base of each tentacle. Snout somewhat tapering, deeply bilobed anteriorly, with yellow buccal mass visible by transparency and anterior part tinged reddish. Large yellowish granular masses behind each eye. Metapodial tentacle forming an axial triangular flap and,

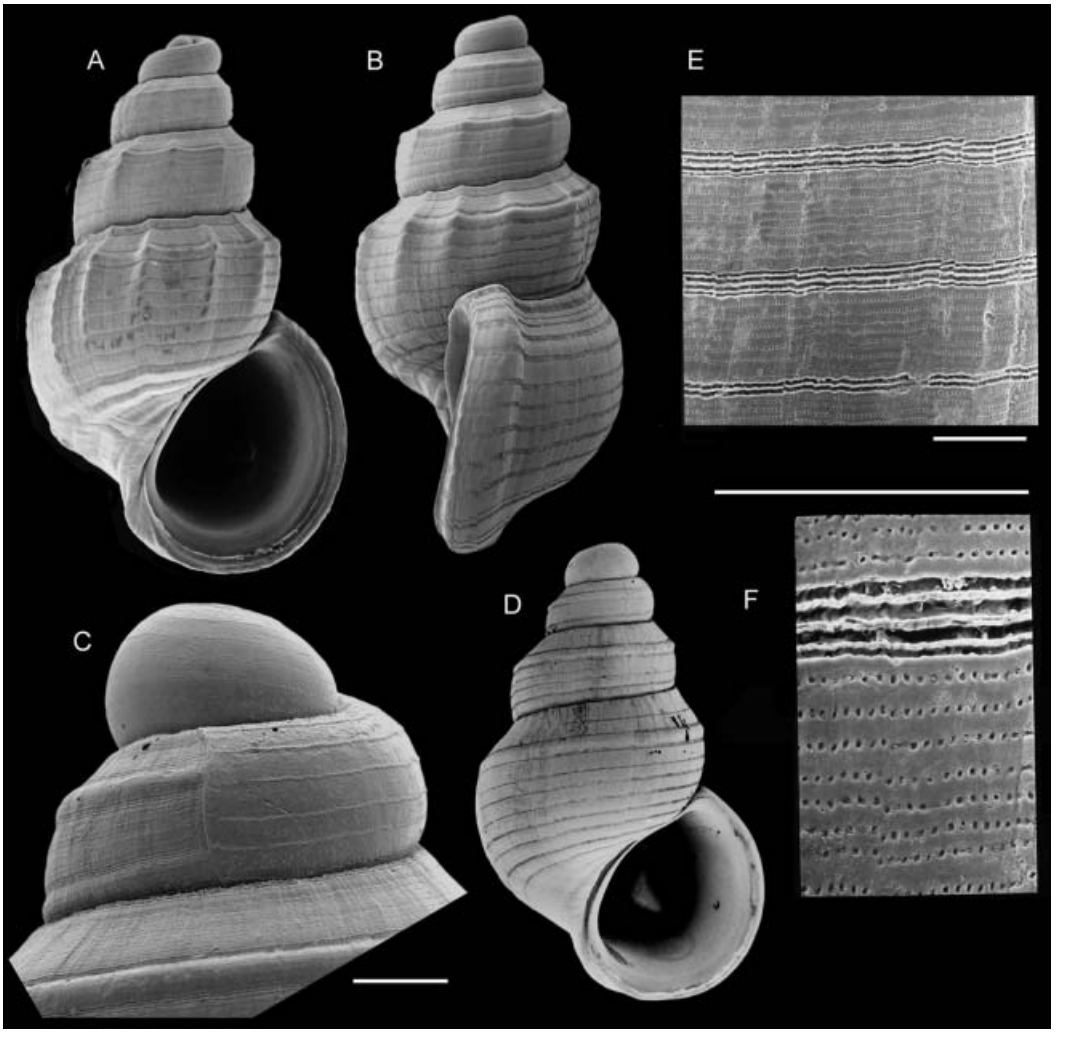

Figure 25. *Manzonia taeniata* n. sp. (A, B) Paratype (sh.) from Gorringe seamount, DW16 (255–265 m), actual size 2.14 mm; (C) protoconch of the same paratype; (D) paratype (sh.) from Gorringe seamount, CP20 (305–320 m), actual size 1.82 mm; (E, F) microsculpture, same as (D). Scale bars: 100 μm (C); 50 μm (E, F).

laterally to it, two small and unequal rounded lobes. Sole of foot colourless; anterior pedal gland opaque white, conspicuous. Right and left pallial tentacles tiny. Visceral mass visible by transparency in the spire whorls, orange brown with very small black granules.

Remarks

This relatively rare species is found sympatrically with *Manzonia lusitanica* n. sp., in smaller numbers but surprisingly was the only *Manzonia* species observed alive in the *Seamount* expeditions. It differs from *M. lusitanica* in the more turriculate outline with a well-defined shoulder on the whorls, and in the sculpture where the flat cords are much broader than the grooves. The protoconchs are also different, strongly keeled adapically in *M. lusitanica* and roundish with distinct spirals in *M. taeniata*.

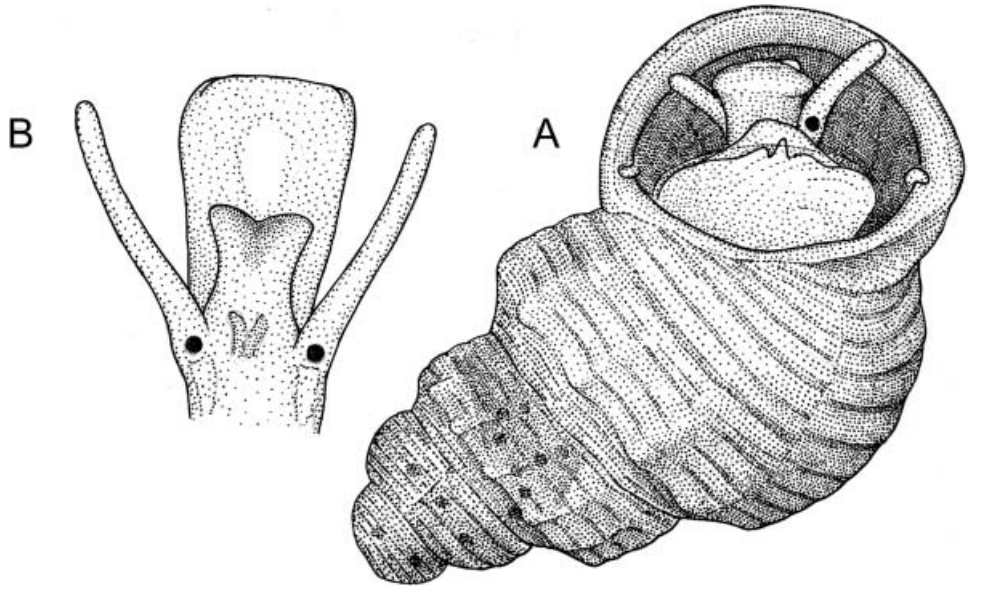

Figure 26. *Manzonia taeniata* n. sp. (A) Holotype (living specimen) from Gorringe seamount, DW15 (300–330 m), actual size 1.62 mm; (B) detail of head and propodium.

Manzonia arata n. sp.
(Figure 27)

Type material

Holotype MNHN 9713 (sh., 1.84 × 1.22 mm) and nine paratypes MNHN 9769 (sh., 1.65 × 1.05 to 2.08 × 1.33 mm) from *Seamount 1* sta. DW92, in MNHN.

Type locality

Ampère seamount (35°03′N, 12°53′W, 117–129 m).

Material examined

Ampère—*Seamount 1* sta. DW92, 1 spm. (jv.) and the type material; DE95, 20 sh. (1.60 × 1.07 to 2.16 × 1.30 mm); DE98, 4 sh. (1.75 × 1.11 to 1.92 × 1.24 mm); CP99, 4 sh. (1.81 × 1.21 to 2.38 × 1.39 mm); VH97 sta. 103, 6 sh. (1.72 × 1.09, and jv.); VH97 sta. 296, 5 sh. (1.84 × 1.6 to 1.90 × 1.18 mm); VH97 sta. 298, 1 spm. (1.76 × 1.04 mm) and 1 sh. (1.78 × 1.14 mm).

Etymology

From Latin *aratus*, plowed, alluding to the regular grooves between spiral cords on the shell.

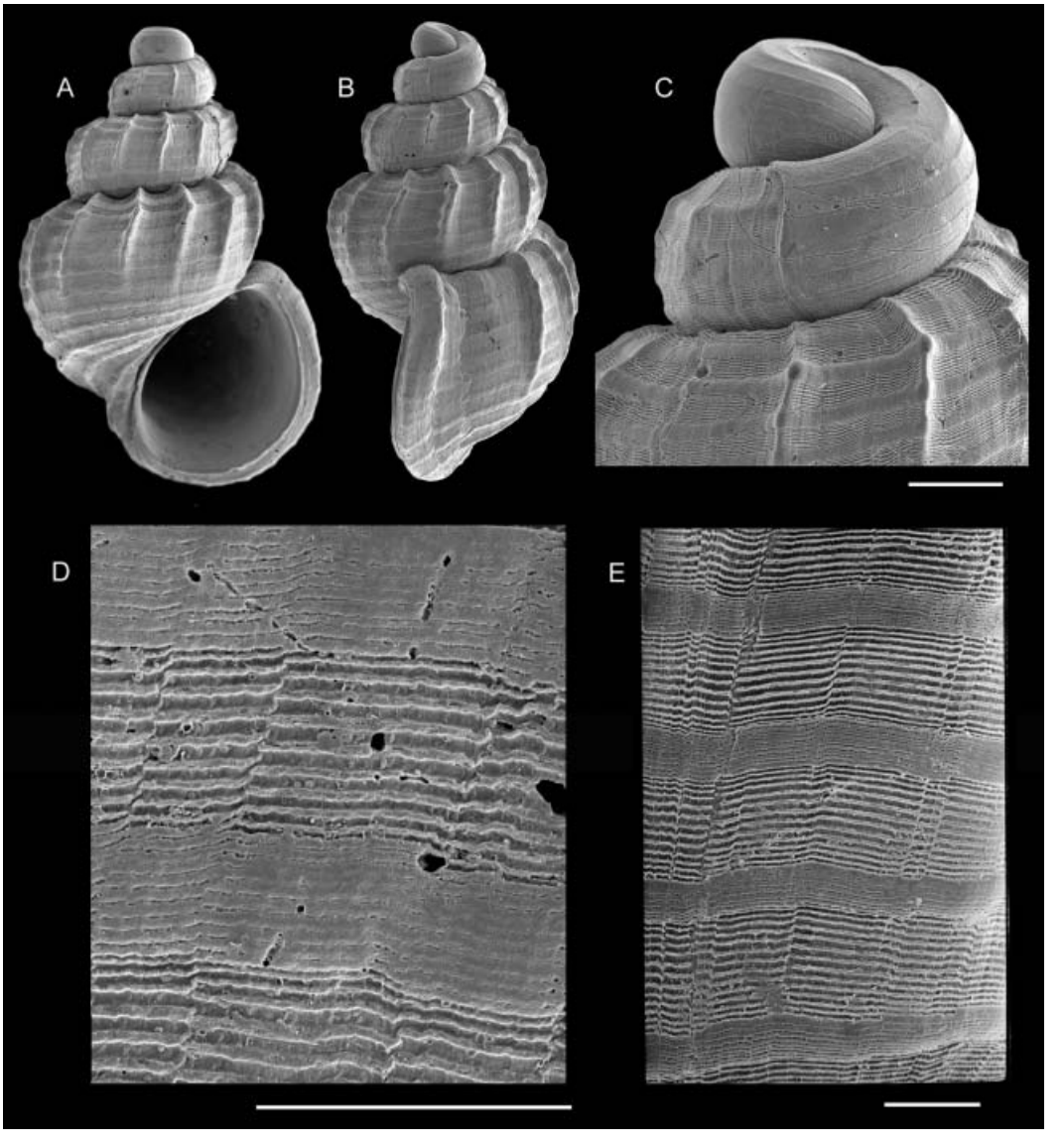

Figure 27. *Manzonia arata* n. sp. (A, B) Holotype (sh.) from Ampère seamount, DW92 (117–129 m), actual size 1.84 mm; (C) protoconch of the holotype; (D) microsculpture of a paratype; (E) microsculpture of the holotype. Scale bars: 100 μm (C); 50 μm (D, E).

Description

Shell with a moderately high spire, adults up to 2.4 × 1.4 mm. Protoconch of 1.25 convex whorls, adapically with a very faint keel, surface of larval whorls with four to five definite spiral cords decreasing in strength towards the suture. Teleoconch of ca three convex whorls with rather rounded profile. Axial sculpture of flexuous, narrow and elevated folds, more or less developed on different individuals, fading out on abapical surface of body whorl. Spiral sculpture of flat cords, narrower than the interspaces, bearing irregular, very faint grooves along spiral lines; interspaces bearing ca 10 raised spiral threads. Spiral cords

on abapical surface slightly larger than those on the periphery, but without any of them markedly larger than the adjacent one. Outer lip definitely opisthocline, thickened externally by a broad rim sloping gently towards the adjacent surface of body whorl; smooth inside. Inner lip thin, appressed. Shell colour white. Operculum thin, paucispiral, with eccentric nucleus.

Remarks

This species was found only on Ampère seamount and differs from *Manzonia lusitanica* in the pattern of microsculpture, where the grooves along cords and interspaces never really close up to form rows of pits as in most *Manzonia* species. Also, this species does not form the '*Manzonia*-keel', i.e. one or two cords distinctly larger and separated by a depression, running on the abapical surface; instead there is a progressive increase in the size of cords towards the abapical end.

Manzonia geometrica Beck and Gofas, n. sp.
(Figure 28)

Type material

Holotype MNHN 9714 (spm., 1.60 × 0.96 mm) from *Victor Hensen* VH97 sta. 103. Paratypes MNHN 9770 (36 sh., 1.35 × 0.85 to 1.70 × 1.02 mm) from *Seamount 1* sta. DW92 (35°03′N, 12°53′W, 117–129 m).

Type locality

Ampère seamount (35°03.19′N, 12°54.42′W, 164 m).

Material examined

Ampère—*Seamount 1* sta. DW92, the paratypes; DE95, 32 sh. (1.28 × 0.91 to 1.78 × 1.12 mm); DE98, 30 sh. (1.36 × 0.97 to 2.28 × 1.32 mm); CP99, 6 sh. (1.32 × 0.87 to 1.80 × 1.15 mm). *Victor Hensen* VH97 sta. 102, 1 sh. (1.52 × 0.96 mm); sta. 103, the holotype and 3 jv. sh.; sta. 296, 23 sh. (1.32 × 0.86 to 1.68 × 1.00 mm); sta. 298, 14 sh. (1.36 × 0.84 to 1.56 × 0.98 mm). Seine—*Seamount 1* sta. DE71, 1 sh. (1.44 × 0.97 mm); DE72, 8 sh. (1.56 × 0.98 to 1.66 × 1.04 mm).

Etymology

From Latin *geometricus*, geometrical, alluding to the angulate profile of the shell.

Descripton

Shell with a moderately high spire, adults up to 2.3 × 1.3 mm. Protoconch of 1.25 convex whorls, with a strong adapical keel and a wrinkled surface texture visible only under high SEM magnification. Teleoconch of ca three whorls, with a strong median keel. Axial sculpture limited to growth lines. Spiral sculpture of flat cords, much broader than

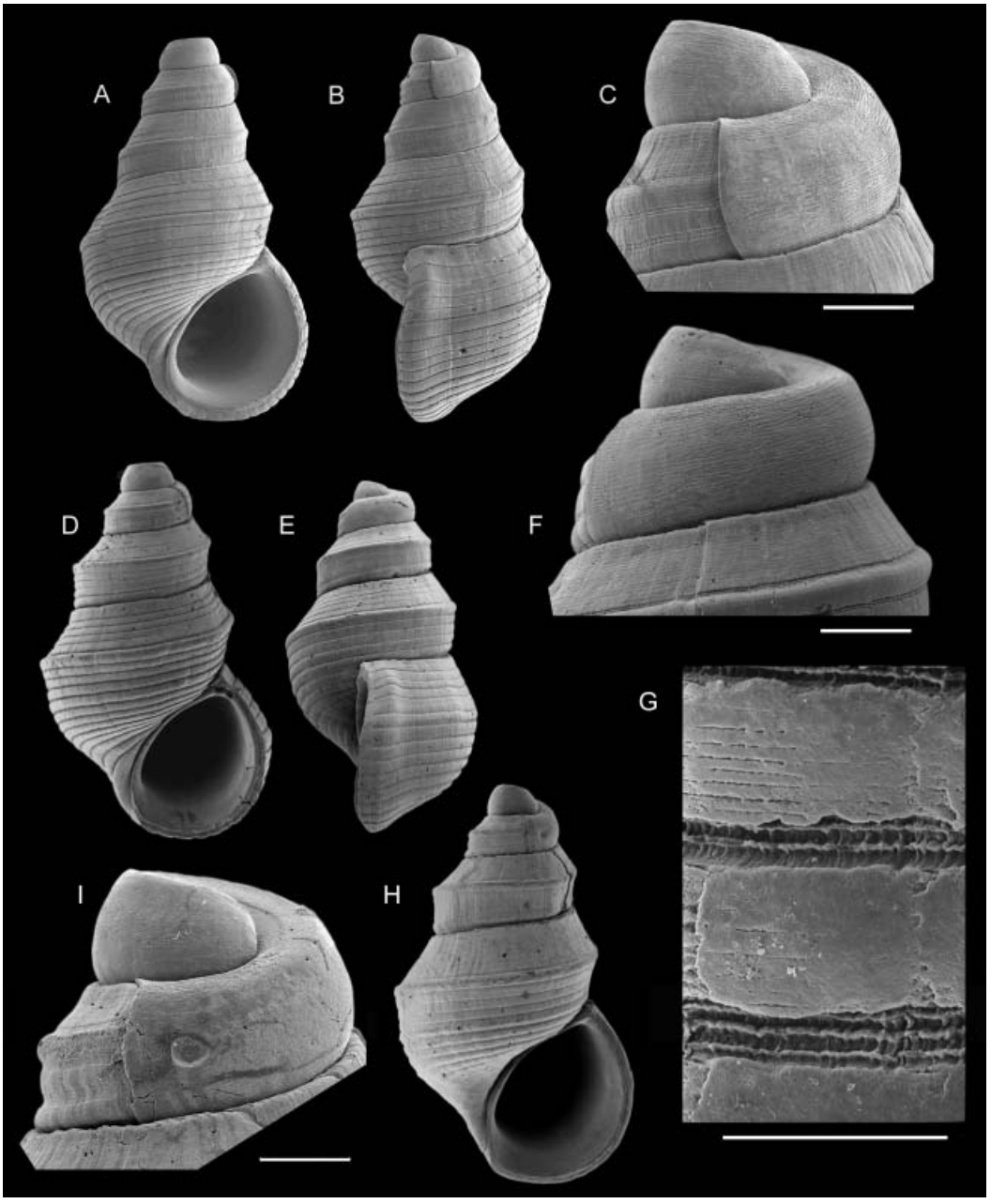

Figure 28. *Manzonia geometrica* Beck and Gofas, n. sp. (A, B) Holotype (spm.) from Ampère seamount, VH97 sta. 103 (164 m), actual size 1.60 mm; (C) protoconch of the holotype; (D) paratype (sh.) from Ampère seamount, DW92 (117–129 m), actual size 1.57 mm; (E) paratype (sh.), same locality, actual size 1.47 mm; (F) protoconch of another paratype, same locality; (G) microsculpture, same shell as (D); (H) shell from Seine seamount, DE72 (165 m), actual size 1.66 mm; (I) protoconch, same as (E). Scale bars: 100 μm (C, F, I); 50 μm (G).

interspaces, bearing a microsculpture (obscured on much of the shell surface) of minute pits forming spiral lines; interspaces bearing two to four raised spiral threads. Abapical area with spiral cords similar in size and shape to those of the periphery. Outer lip opisthocline, thickened externally by a rim sloping gently towards the adjacent surface of body whorl; smooth inside. Inner lip thin, appressed. Shell colour white. Operculum thin, paucispiral, with eccentric nucleus.

Remarks

This species is strikingly different from any described *Manzonia* species in the area, and is characterized by the strong keel, absence of axial sculpture and even size of the cords on the abapical surface.

Manzonia fusulus n. sp.
(Figure 29)

Type material

Holotype MNHN 9715 (sh., 3.18 × 1.26 mm) and two paratypes MNHN 9771 (sh. 2.76 × 1.34, 3.18 × 1.24 mm) from *Seamount 1* sta. DW05, in MNHN.

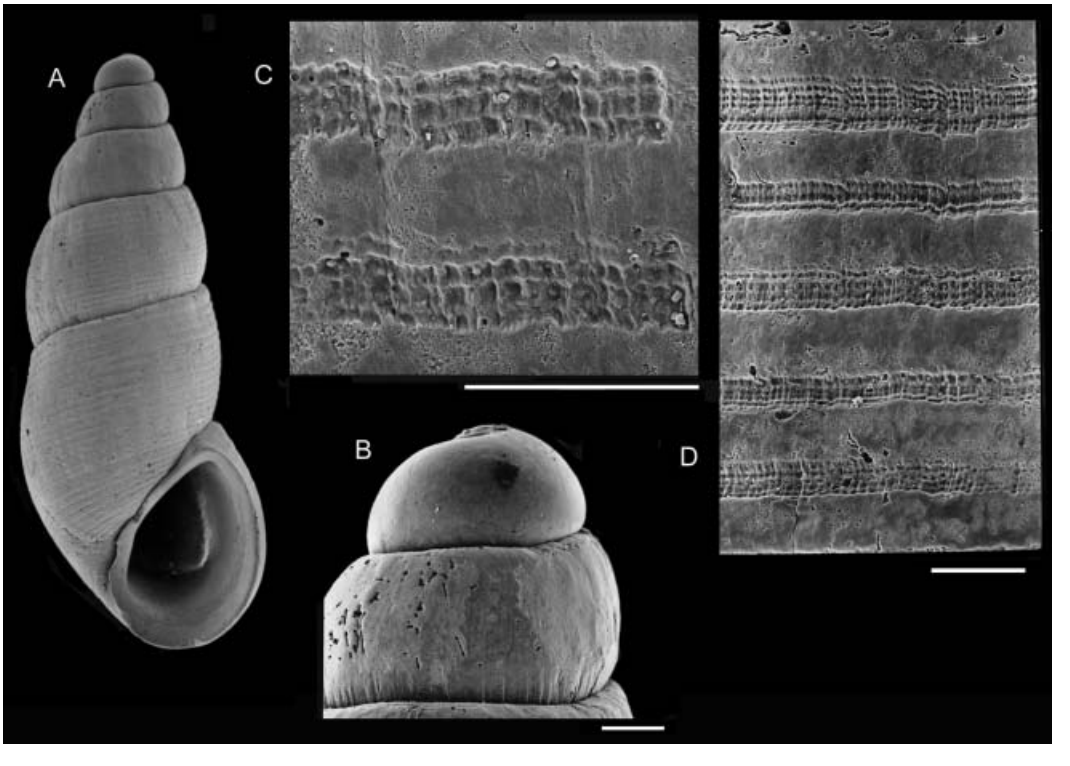

Figure 29. *Manzonia fusulus* n. sp. (A) Holotype (sh.) from Gorringe seamount, DW05 (250 m), actual size 3.18 mm; (B) protoconch of the holotype; (C, D) microsculpture of the holotype. Scale bars: 100 µm (B); 50 µm (C, D).

Type locality

Gorringe seamount (36°32′N, 11°37.9′W, 180 m).

Material examined

Gorringe—*Seamount 1* sta. DW05, the type material; DW06, 5 sh. (2.70 × 1.22 mm, 4 jv.); DE09, 1 sh. (2.46 × 1.20 mm); DW16, 3 old sh. (2.90 × 1.14 to 3.20 × 1.44 mm).

Etymology

Diminutive of Latin *fusus*, a spindle, alluding to the general shape of the shell.

Description

Shell with a high spire fusiform, adults up to 3.2 × 1.4 mm. Protoconch of 1.25 convex whorls, dome shaped, smooth. Teleoconch of ca four whorls, slightly convex, separated by an incised suture. Axial sculpture limited to growth lines. Spiral sculpture of flat cords, slightly broader than interspaces, with smooth surface; interspaces bearing two to four raised spiral threads separating spiral rows of minute pits. Abapical area with spiral cords similar in size and shape to those of the periphery. Outer lip slightly opisthocline, hardly thickened externally, smooth inside. Inner lip thin, not closely appressed. Shell colour white.

Remarks

The material for this species is scanty but it is also strikingly different from any described species in the area. The general shape resembles very much some European species of *Onoba*, such as *O. guzmani* Hoenselaar and Moolenbeck, 1987. The latter do not show, however, the *Manzonia*-like sculpture with distinct lines of pits in the interspaces of cords, and instead have a rough, granulose surface inside the grooves. The fusiform shape, the absence of axial ribs and the *Manzonia*-like sculpture are also seen in *Manzonia manzoniana* (Rolán, 1987) from the Canary Islands, but the present species differs in having a more incised suture, in lacking spirals on the protoconch, and in lacking a rim (the '*Manzonia* keel') on the abapical area of the body whorl which is here evenly curved with subequal spirals.

Genus *Gofasia* Bouchet and Warén, 1993

Type species. *Gofasia galiciae* Bouchet and Warén, 1993, by original designation.

Gofasia josephinae Bouchet and Warén, 1993

(Figures 30–33)

Gofasia josephinae Bouchet and Warén 1993, p 672–674.

Type material

Holotype from *Seamount 1* sta. DW61, in SMNH (cat. no. 4356); 180 paratypes from the type locality in MNHN (no catalogue numbers) and in SMNH (cat. no. 4357).

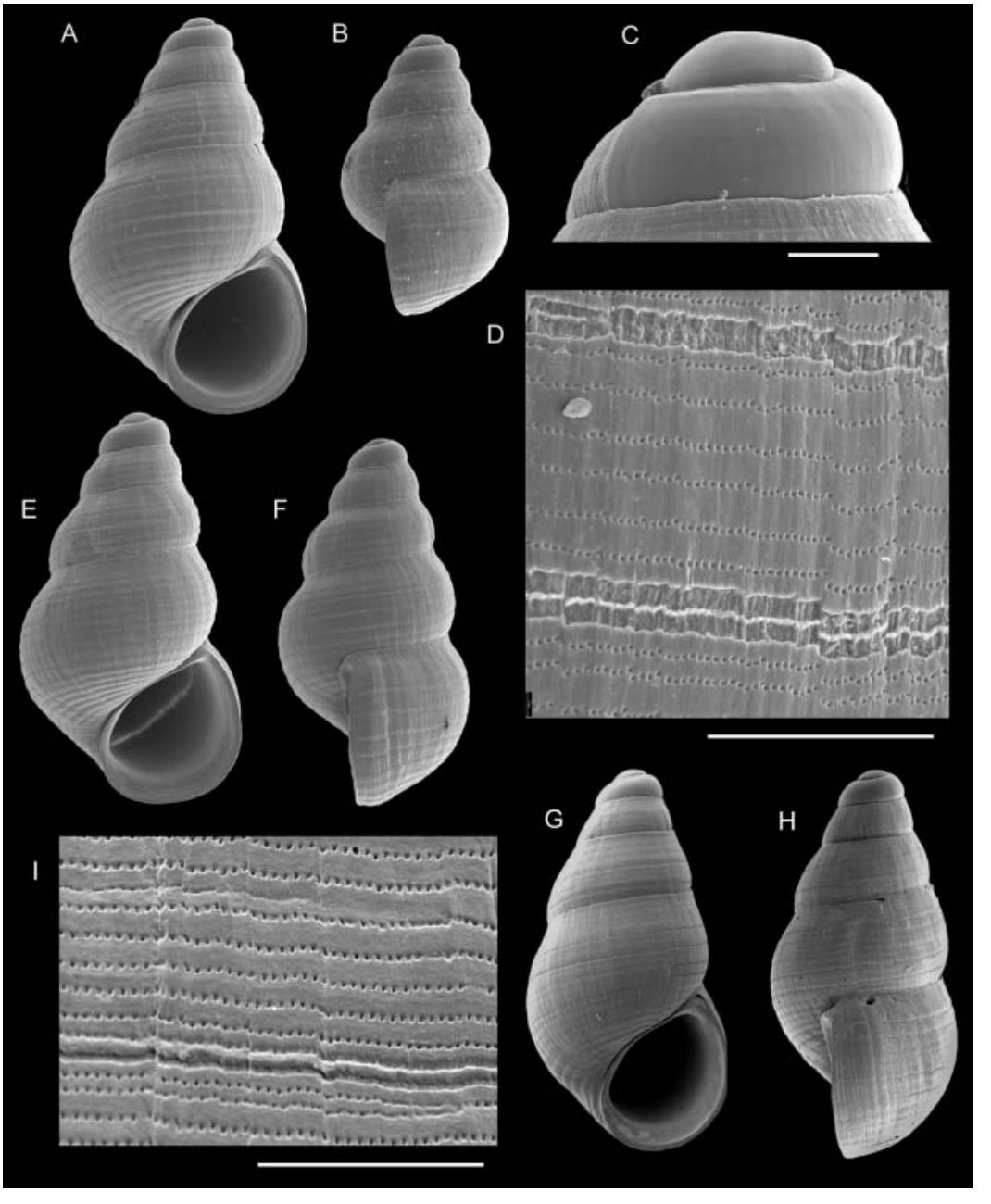

Figure 30. *Gofasia josephinae* Bouchet and Warén, 1993. (A) Specimen from Josephine seamount, DW38 (235–245 m), actual size 2.20 mm; (B) shell, same locality, actual size 1.56 mm; (C) protoconch of the same shell; (D) microsculpture, same specimen as (A); (E, F) shells from Gorringe seamount, CP20 (305–320 m), actual sizes 2.04 and 2.17 mm; (G, H) shells from Gorringe seamount, DW04 (93–96 m) with the shallow morphotype, actual sizes 2.10 and 2.16 mm; (I) microsculpture, same shell as (G). Scale bars: 100 μm (C); 50 μm (D, I).

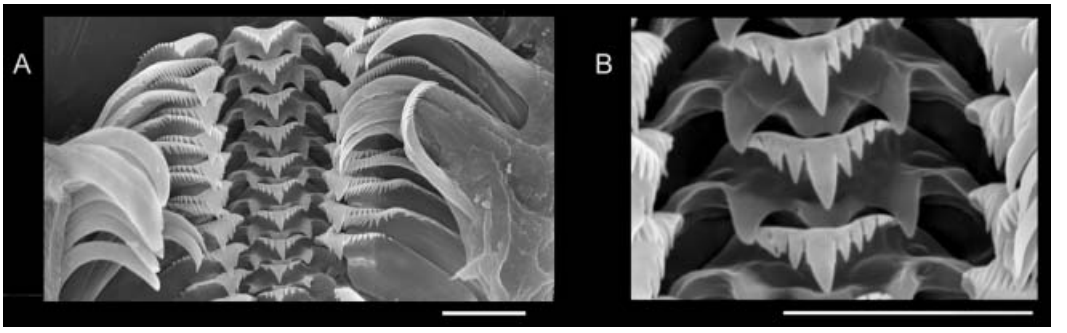

Figure 31. *Gofasia josephinae* Bouchet and Warén, 1993. (A) Partial view of the radula of a specimen from Ampère seamount, DE95 (197–210 m); one of the outer marginals to the right is upturned and shows the denticles normally facing downwards; (B) detail of the central teeth showing paired basal denticles and U-shaped projection. Scale bars: 10 μm.

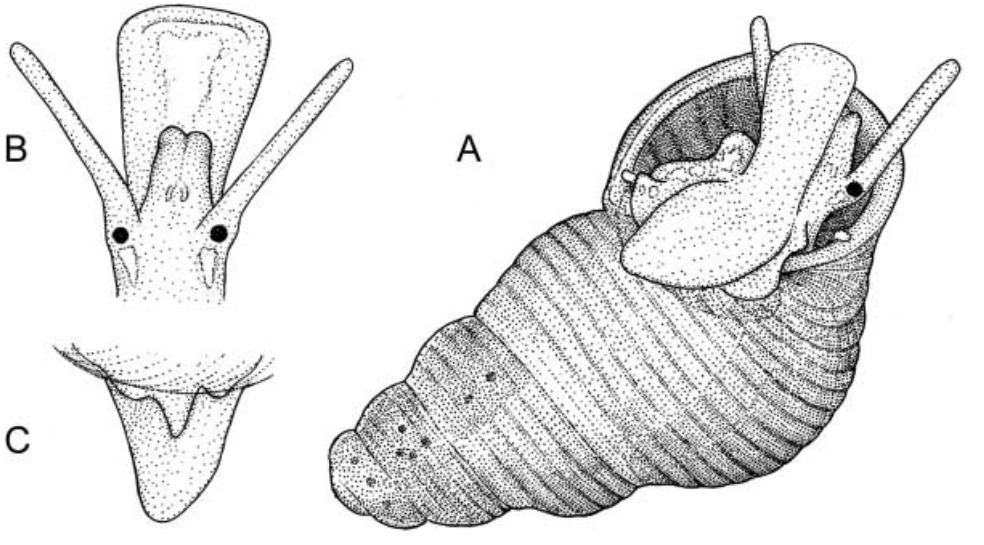

Figure 32. *Gofasia josephinae* Bouchet and Warén, 1993. (A) Living specimen from Gorringe seamount, DW21 (460–480 m), actual size 2.04 mm; (B) detail of head and propodium; (C) detail of opercular lobes and metapodium.

Type locality

Josephine seamount (36°40′N, 14°16′W, 200–205 m).

Material examined

Gorringe—*Seamount 1* sta. DW04, 47 sh. (1.64 × 0.96 to 2.27 × 1.21 mm); DW05, 1 spm. (1.89 × 1.12 mm) and 290 sh. (1.44 × 0.82 to 2.08 × 1.04 mm); DW08, 32 sh. (1.96 × 1.12 to 2.40 × 1.24 mm); DE10, 2 sh. (2.33 × 1.24 mm); CP12, 1 old sh. (jv. 1.80 × 1.04 mm); CP20, 2 spm. (1.98 × 1.14 and 1.94 × 1.08 mm) and 139 sh. (1.65 × 0.93 to 2.24 × 1.20 mm); DW 21, 1 spm. (2.04 × 1.16 mm). Josephine—*Seamount 1* sta. DW38, 2 spm. (2.10 × 1.20 and 1.50 × 0.96 mm); DE39, 41 sh. (1.44 × 0.90 to 2.24 × 1.26 mm); DW43,

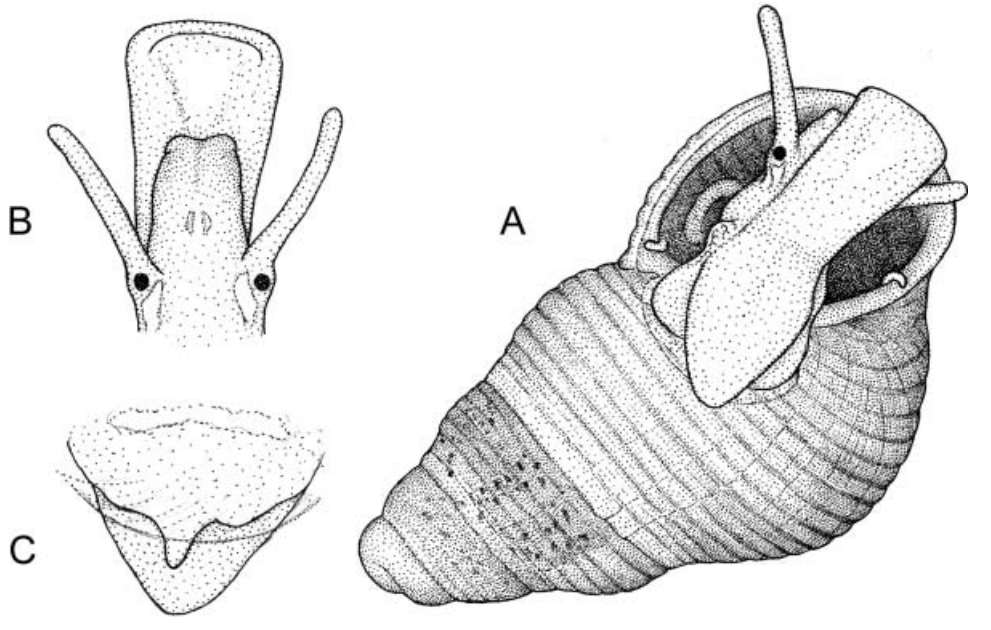

Figure 33. *Gofasia josephinae* Bouchet and Warén, 1993. (A) Living specimen from Ampère seamount, DW95 (197–210 m), actual size 2.06 × 1.20 mm; (B) detail of head and propodium; (C) detail of opercular lobes and metapodium.

44 sh. (1.40 × 0.92 to 2.16 × 1.17 mm); DW45, 40 sh. (1.60 × 1.00 to 2.14 × 1.26 mm); DW60, 3 sh. (1.96 × 1.10 to 2.01 × 1.22 mm); DW61, the type material, and 12 sh. (1.36 × 0.88 to 2.16 × 1.22 mm). Ampère—*Seamount 1* sta. DE95, 60 spm. (1.42 × 0.96 to 2.28 × 1.25 mm) and 292 sh. (1.40 × 0.94 to 2.28 × 1.26 mm); DE98, 12 spm. (1.92 × 1.22 to 2.44 × 1.48 mm) and >1600 sh. (1.88 × 1.24 to 2.70 × 1.48 mm); CP99, 3 spm. (1.76 × 1.04 mm, 2.10 × 1.20 mm and immature 1.29 × 0.86 mm) and 17 sh. (1.96 × 1.18 to × 2.14 × 1.34 mm); *Victor Hensen* VH97 sta. 97, 7 sh. (1.90 × 1.20 to 2.40 × 1.44 mm); sta. 103, 6 sh. (1.50 × 0.94 to 1.98 × 1.18 mm); sta. 296, 12 sh. (1.80 × 1.04 to 1.88 × 1.14 mm, and jv.); sta. 298, 14 sh. (1.56 × 0.98 to 2.10 × 1.30 mm, and jv.).

Description

Shell with a moderately high spire, adults up to 2.7 × 1.5 mm. Protoconch of 1.25 convex whorls, smooth. Teleoconch of 2.75–3.5 whorls, convex except flattened adapical part, with sculpture of flat spiral cords and minute spiral rows of pores. Axial sculpture consisting only of growth lines. Spiral cords flat, much broader than interspaces, three to five on first teleoconch whorl, 7–11 on penultimate, extending over entire shell surface including abapical area. Spiral rows of pores minute (pores ca 0.5 μm) running on the cords visible only at high magnification under SEM observation, replaced by broader grooves between cords. Outer lip orthocline, with a thin edge, slightly thickened externally at a distance of the edge but not forming a distinct rim, smooth and not thickened inside. Inner lip thin, appressed. Shell colour entirely white, translucent. Operculum thin, paucispiral, with eccentric nucleus.

Cephalic tentacles cylindrical, with rounded tips. Eyes embedded in a slight swelling at the base of each tentacle. Snout somewhat tapering, truncated and bilobed anteriorly, with

tiny bright yellow jaws visible by transparency and anterior part tinged with pale brown. Large yellowish granular masses behind each eye; other more irregular yellowish or whitish mass visible by transparency beneath the operculum. Sole of foot colourless with pedal glands inconspicuous; metapodium with a small longitudinal depression. Metapodial tentacles forming an axial triangular flap and, laterally to it, two small and unequal rounded lobes. Right and left pallial tentacles tiny. Visceral mass visible by transparency in the spire whorls, reddish brown with very small black granules.

Radula (Figure 31) taenioglossate, ca 60 µm broad. Central tooth with a well-developed axial cusp flanked on each side by three to four smaller cusps decreasing in size. A single pair of well-developed basal denticles, and moderately developed U-shaped projection. Lateral margins of central teeth thickened, sloping at 45°. Lateral teeth elongate, terminating in a broad triangular cusp which is serrated on the inner side facing the central tooth and smooth on the opposite side; ca 10 small denticulations also present on the inner part of the lateral tooth preceding the main triangular cusp. Marginals elongate and sickle-shaped. Inner marginals with ca 25 denticles on the upper part of the distal half, the first ones broad, abruptly changing to slender, comb-like on the distal part of the tooth. Outer marginals with ca 15 long, comb-like cusps on the distal one-third, facing towards the radular ribbon.

Remarks

This is the commonest rissoid on Gorringe and Ampère seamounts, whereas it shares high numbers with *Crisilla ovulum* and *Gofasia vinyllina* on Josephine. The stouter individuals resemble superficially *C. ovulum* but the latter is more pupoid with less convex whorls, has spiral sculpture forming distinct beads at intersection of the axial folds, and lacks the pitted microsculpture.

Specimens from the shallower part of Gorringe seamount (Figure 30G–I) differ in being more fusiform with less convex whorls. However, there is no clearcut separation between these morphs which are considered conspecific.

Gofasia vanderlandi Bouchet and Warén, 1993
(Figures 34, 35)

Gofasia vanderlandi Bouchet and Warén 1993, p 668–670.

Type material

Holotype (1.68 × 1.09 mm) from CANCAP sta. 3068, in RMNH; seven paratypes in MNHN (1.36 × 0.96 to 1.78 × 1.16 mm) and in SMNH.

Type locality

Off Canary Islands (30°07′N, 15°53′W, 310 m).

Material examined

Ampère—*Seamount 1* sta. CP99, 6 sh. (1.16 × 0.76 to 1.44 × 0.96 mm) examined by Bouchet and Warén (1993); 3 spm. (jv. 1.02 × 0.72 mm; 1.40 × 0.84 mm; 1.45 × 0.86 mm)

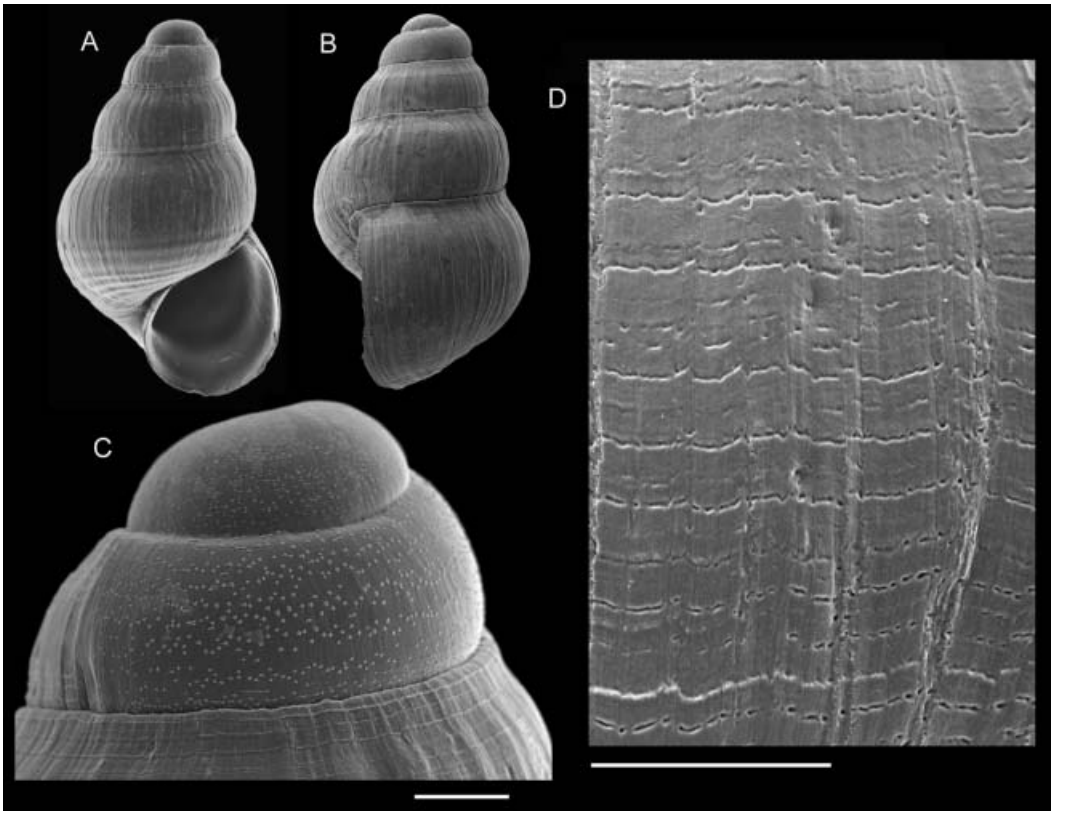

Figure 34. *Gofasia vanderlandi* Bouchet and Warén, 1993. (A, B) Specimen from Ampère seamount, CP99 (225–280 m), actual size 1.45 mm; (C) protoconch of a juvenile shell, same locality; (D) microsculpture, same shell as (C). Scale bars: 100 µm (C); 50 µm (D).

and 5 sh. (1.18 × 0.80 to 1.40 × 0.94 mm); *Victor Hensen* VH97 sta. 97, 5 sh. (1.16 × 0.82 to 1.48 × 0.94 mm).

Description

Shell with a moderately high spire and a blunt apex, rather thin, adults up to 1.5 × 1.0 mm. Protoconch of 1.25 convex whorls; surface of larval whorls covered by minute granules arranged in blurry spiral bands. Teleoconch of 2.25–2.75 convex whorls, with a very faint sculpture of axial lines or poorly defined, fine axial folds, extremely minute spiral lines of pores and very faint spiral cords restricted to the abapical area. Axial lines or folds irregular, parallel to growth stages, too poorly defined to be considered ribs, very gradually fading out on the abapical part of the body whorl. Spiral cords very low and faint, as broad as the interspaces, developed only on the periumbilical area of the body whorl; a very faint depression running subsuturally. Spiral rows of pores visible only at high magnification, accompanied by a few spiral threads in the subsutural area. Outer lip orthocline, with a thin edge and slightly thickened externally at a distance of the edge, smooth and not thickened inside. Inner lip thin, bordering a narrow umbilical chink. Shell colour entirely white, translucent. Operculum thin, paucispiral, with eccentric nucleus.

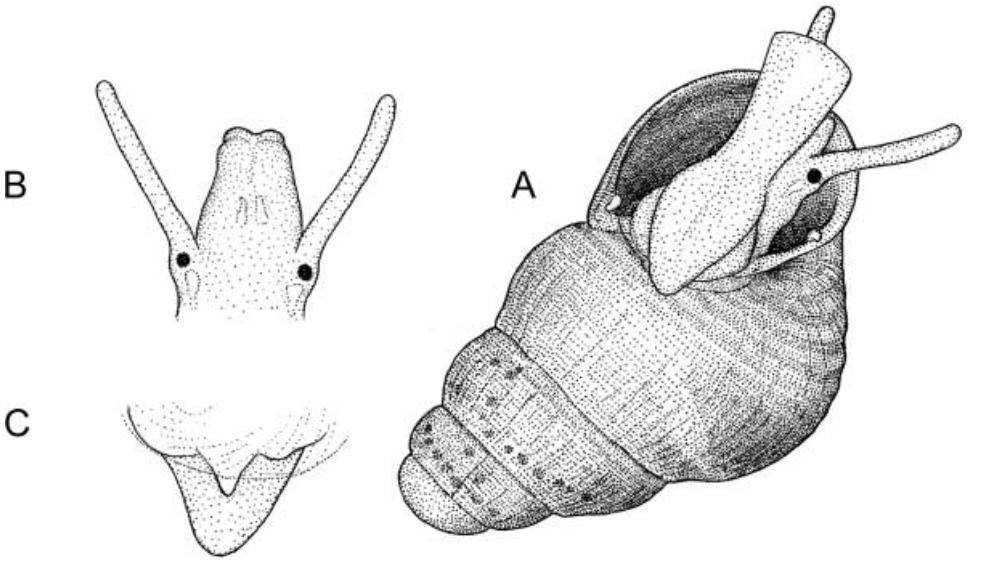

Figure 35. *Gofasia vanderlandi* Bouchet and Warén, 1993. (A) Living specimen from Ampère seamount, CP99 (225–280 m), same as Figure 34A, B, actual size 1.45 mm; (B) detail of head and propodium; (C) detail of opercular lobes and metapodium.

Cephalic tentacles cylindrical, with rounded tips. Eyes embedded in a slight swelling at the base of each tentacle. Snout somewhat tapering, truncated and bilobed anteriorly, with tiny bright yellow jaws visible by transparency and anterior part tinged with pale brown. Small, whitish granular masses behind each eye; other more irregular whitish mass visible by transparency beneath the operculum. Sole of foot colourless with pedal glands inconspicuous; metapodium with a faint longitudinal groove. One metapodial tentacle, forming a triangular flap. Right and left pallial tentacles tiny. Visceral mass visible by transparency in the spire whorls, reddish brown with series of black granules.

Remarks

The above description is based on specimens from Ampère seamount. Part of the material studied here was cited by Bouchet & Warén (1993, p 667–670) as representative of their *Gofasia vanderlandi*, and specimens from Ampère sta. CP99 were figured (their Figures 1533, 1537). The type specimens (Bouchet & Warén, 1993, Figures 1540, 1542–1544) were collected off the Canary Islands and differ in having a lower spire with more conspicuous axial folds. It is not proved that the seamount specimens are conspecific but, in view of the scanty material at hand, I will respect Bouchet and Warén's taxonomic placement.

This species resembles, due to its very faint sculpture, *Pseudosetia amydralox*. However, the microsculpture of the protoconch with spiral threads is definitely different in *Pseudosetia*; furthermore the latter do not have a pitted microsculpture on the teleoconch.

Gofasia galiciae Bouchet and Warén, 1993
(Figure 36)

Gofasia galiciae Bouchet and Warén 1993, p 670–672.

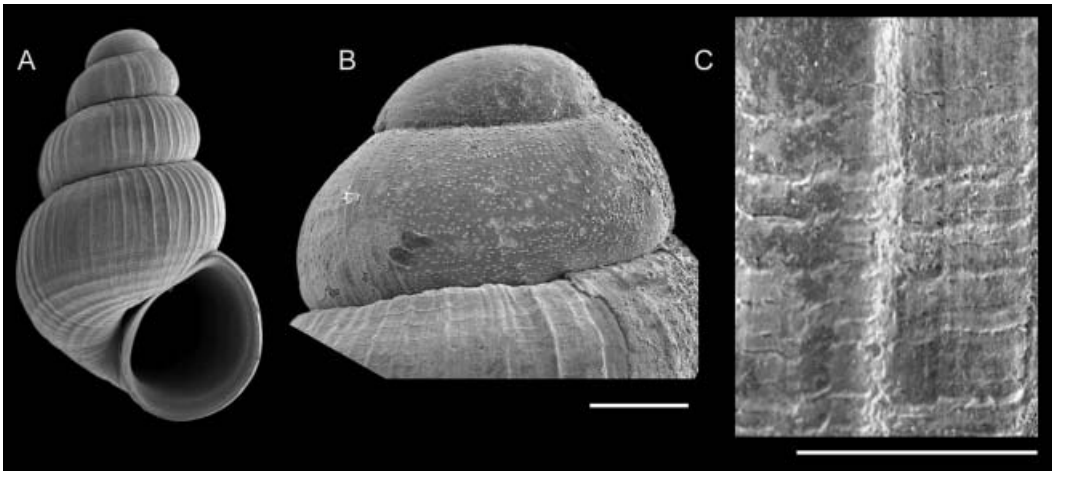

Figure 36. *Gofasia galiciae* Bouchet and Warén, 1993. (A) Shell from Ampère bank, *Victor Hensen* sta. VH97/97 (800 m), actual size 2.00 mm; (B) protoconch of the same shell; (C) detail of microsculpture, same as (A). Scale bars: 100 μm (B); 50 μm (C).

Type material

Holotype (1.6 × 0.9 mm) from *Seamount 1* sta. DW116, in MNHN; numerous paratypes in MNHN and in SMNH.

Type locality

Galicia Bank (42°52′N, 11°51′W, 985–1000 m).

Material examined

Ampère—*Victor Hensen* VH97 sta. 97, 9 sh. (1.48 × 0.96 to 1.80 × 1.06 mm).

Description

Shell with a moderately high spire and a blunt apex, thin, adults up to 1.8 × 1.1 mm. Protoconch of 1.25 convex whorls; surface of larval whorls covered by minute granules arranged irregularly. Teleoconch of about three definitely convex whorls, with a deeply incised suture and a sculpture of fine axial ribs, extremely minute spiral lines of pores and spiral cords. Axial ribs very gradually fading out on the abapical part of the body whorl. Spiral cords very low and faint, as broad as the interspaces, developed only on the periumbilical area of the body whorl. Spiral rows of pores visible only at high magnification, accompanied by a few spiral threads. Outer lip orthocline, with a thin edge and slightly thickened externally, smooth and not thickened inside. Inner lip thin, bordering a distinct umbilical chink. Shell colour entirely white, translucent.

Remarks

The above description is based on shells from Ampère seamount. This species was described from the Galicia bank, off NW Spain, but was also cited by Bouchet & Warén

(1993, p 670) from the two deeper hauls (1350–1380 m) of Josephine seamount. Specimens from Galicia bank are also found in rather deep water (675–1125 m), but differ in having broader, not so acute axial riblets. Although these populations are separated by a large distance and may be isolated, I have favoured the conservative option to threat them as conspecific. The shells from Ampère somewhat resemble *Alvania adinogramma* in their general shape and macroscopic sculpture, but are diagnosed by the microscopic rows of pits. They are clearly separated from the sympatric *Gofasia vanderlandi* by the profile of the whorls, more convex with a deeply incised suture, and by the presence of distinct axial riblets.

Gofasia vinyllina n. sp.
(Figure 37)

Type material

Holotype MNHN 9716 (spm., 1.80 × 1.12 mm) from *Seamount 1* sta. DW61, in MNHN; 30 paratypes MNHN 9772 and SMNH 6742 (sh., 1.24 × 0.80 to 2.06 × 1.12 mm) from the type locality, in MNHN and SMNH.

Type locality

Josephine seamount (36°40′N, 14°16′W, 200–205 m).

Material examined

Josephine—*Seamount 1* sta. DW38, 1 spm. (1.76 × 1.00 mm)+9 sh. (1.32 × 0.86 to 1.96 × 1.16 mm); DW39, 1 spm. (1.82 × 1.04 mm)+14 sh. (1.36 × 0.88 to 2.12 × 1.10 mm); DW43, 10 sh. (1.50 × 0.92 to 2.00 × 1.16 mm); DW45, 110 sh. (1.44 × 0.88 to 2.25 × 1.34 mm); DW61 [includes types], 1 spm.+318 sh. (1.24 × 0.80 to 2.06 × 1.12 mm).

Etymology

The name alludes to the aspect of the microsculpture, similar to the grooves of the old vinyl records.

Description

Shell with a moderately high spire, adults up to 2.2 × 1.3 mm. Protoconch of 1.5 convex whorls; surface of larval whorls covered by minute granules arranged in blurry spiral bands. Teleoconch of 2.5–3.25 convex whorls, with a vague indication of flat spiral cords, and minute spiral rows of pores. Axial sculpture limited to growth lines and some faint wrinkles parallel to these. Spiral sculpture indistinct, if present consisting of 9–10 hardly elevated bands on penultimate whorl, as broad as interspaces and not demarcated from these. Spiral rows of pores ca 5 µm apart from each other, pores extremely minute (ca 0.5 µm), closely set together and almost confluent in the spiral direction, visible only at high magnification under SEM observation. Outer lip definitely opisthocline, with a thin edge and thickened externally at a distance of the edge by a broad rim, smooth and not thickened inside. Inner

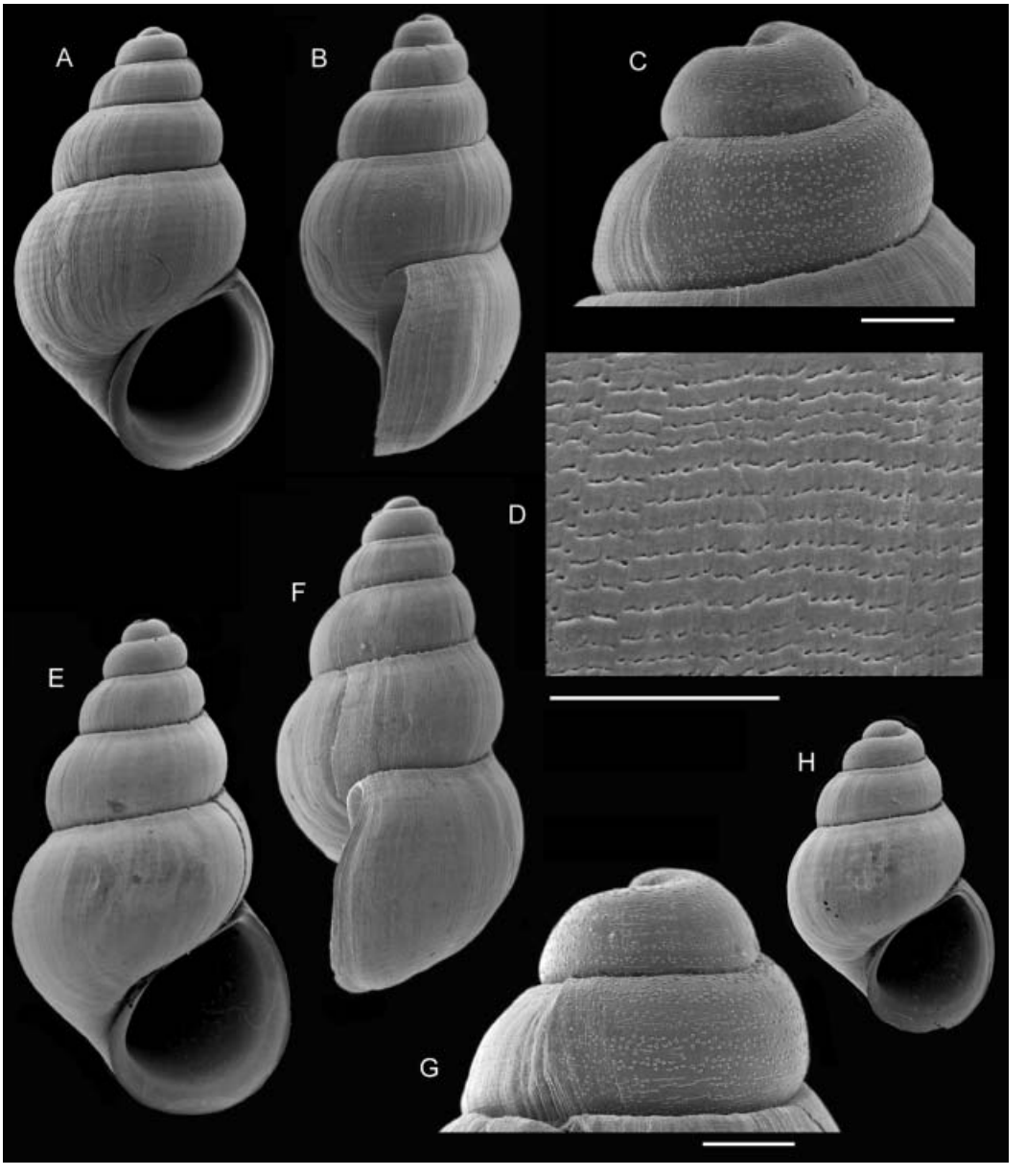

Figure 37. *Gofasia vynillina* n. sp. (A, B) Holotype (spm.) from Josephine seamount, DW61 (200–205 m), actual size 1.80 mm; (C) protoconch of the holotype; (D) microsculpture of the holotype; (E, F) paratype (sh.), same locality, actual size 2.06 mm; (G) protoconch, same shell as (E, F); (H) paratype (sh.), same locality, actual size 1.28 mm. Scale bars: 100 μm (C, G); 50 μm (D).

lip thin, bordering a narrow umbilical chink. Shell colour whitish, some fresh shells with a very faint pattern of pale brown ochre blotches, of which one subsutural spiral row on penultimate and last whorl, and two more spiral rows on last whorl; blotches tending to merge into axial flames in the area preceding the outer lip. Operculum thin, paucispiral, with eccentric nucleus.

Remarks

The microsculpture formed by spiral rows of tiny pores supports the generic placement as *Gofasia* along with *G. josephinae* and *G. vanderlandi*. This species resembles in size and shape the shallow-water European species *Alvania punctura*, from which it differs in having a paucispiral protoconch and in lacking ribs and spiral cords on the teleoconch, among other characters. The microsculpture of the protoconch resembles that of several seamount species including *Gofasia vanderlandi*, *Alvania adinogramma*, and *A. microstriata*. Shells are common on Josephine but only a few specimens were collected alive.

Gofasia tenuicula n. sp.
(Figure 38)

Type material

Holotype MNHN 9717 (spm., 1.40 × 0.80 mm) from *Seamount 1* sta. DW45, in MNHN; one paratype SMNH 6743 from *Seamount 1* sta. DW43 (sh., 1.30 × 0.82 mm), in SMNH, and two paratypes MNHN 9773 from *Seamount 1* sta. DW45 (sh., 1.30 × 0.70, 1.36 × 0.78) in MNHN.

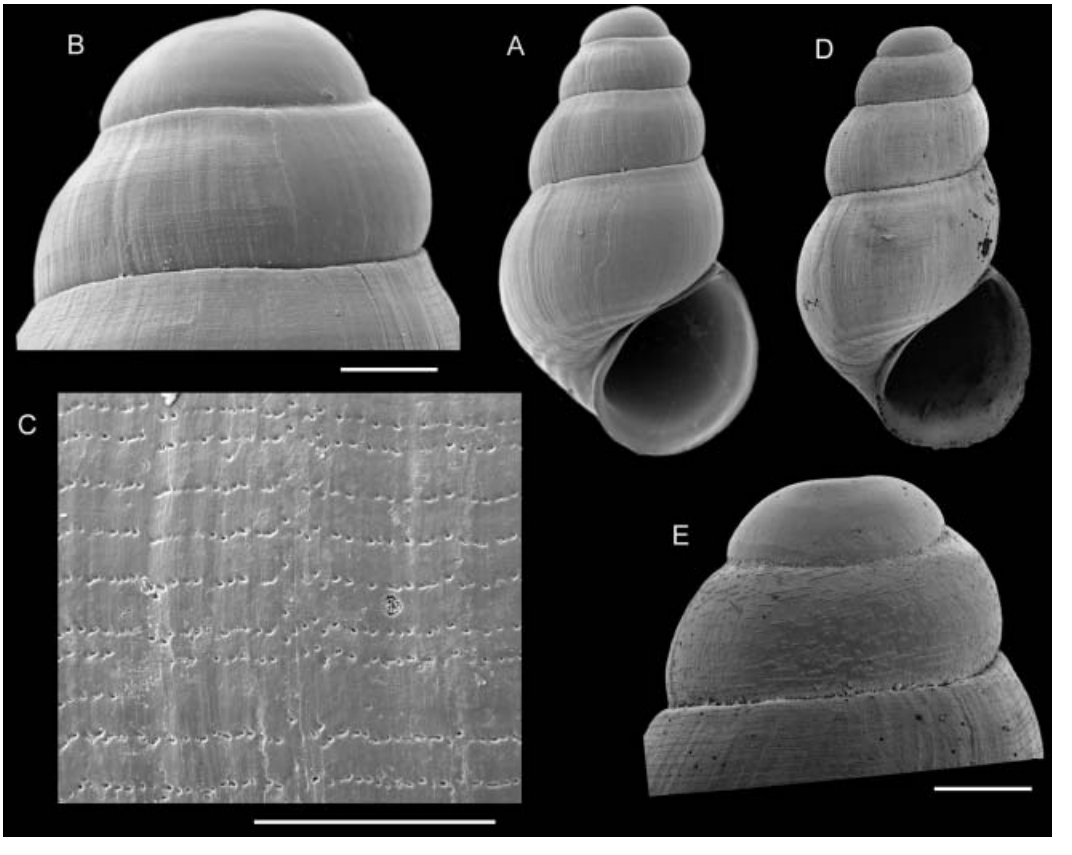

Figure 38. *Gofasia tenuicula* n. sp. (A) Holotype (spm.) from Josephine seamount, DW45 (315–335 m), actual size 1.40 mm; (B) protoconch of the holotype; (C) microsculpture of the holotype; (D) shell from Gorringe seamount, DW16 (255–265 m), actual size 1.32 mm; (E) protoconch, same as (D). Scale bars: 100 µm (B, E); 50 µm (D).

Type locality

Josephine seamount (36°46′N, 14°17′W, 315–335 m).

Material examined

Gorringe—*Seamount 1* sta. DW16, 1 sh. (1.32 × 0.74 mm); CP20, 1 sh. (1.37 × 0.82 mm). Josephine—the type material. Ampère—*Seamount 1* sta. DE95, 3 sh. (1.24 × 0.65 to 1.31 × 0.72 mm); DE98, 7 sh. (1.02 × 1.65 to 1.39 × 0.78 mm); CP99, 2 sh. (1.00 × 0.65 to 1.22 × 0.69 mm); *Victor Hensen* VH97 sta. 94, 3 sh. (1.16 × 0.60 mm, 1.34 × 0.74); sta. 97, 2 sh. (1.12 × 0.64 mm); sta. 99, 1 sh. (jv.).

Etymology

Diminutive of Latin *tenuis*, tenuous.

Description

Shell with a moderately high, blunt spire, adults up to 1.4 × 0.8 mm. Protoconch of 1.25 convex whorls, smooth or with a microsculpture of small granules loosely arranged to form oblique streaks. Teleoconch of 2.75 convex whorls, apparently smooth but microscopically with spiral rows of minute (ca 0.5 µm) pores, rows ca 5 µm apart from each other, visible only at high magnification under SEM observation. Axial sculpture consisting only of faint growth lines. Abapical area with three to four very flattened, very faintly marked spiral cords. Aperture somewhat flaring. Outer lip orthocline, not distinctly thickened, smooth inside. Inner lip forming a narrow rim bordering a small umbilical chink. Shell colour entirely white, translucent. Operculum thin, paucispiral, with eccentric nucleus.

Remarks

This small, rare and macroscopically featureless species is diagnosed as *Gofasia* from the microsculpture of very minute pits. The most similar species is '*Onoba*' *lincta* (Watson, 1873) from the sublittoral zone of Madeira (see Hoenselaar and Moolenbeek 1987, p 20 for SEM illustrations of a possible syntype) but the latter has more pronounced, more crowded and continued spiral striae and its body whorl is proportionally higher. Another species in this group, '*Onoba*' *tarifaensis* Hoenselaar and Moolenbeek, 1987, endemic to the Straits of Gibraltar, has a microsculpture of pits but these are not neatly aligned spirally and their arrangement rather resembles that of *Porosalvania* n. gen. (see e.g. Figure 55D, H).

Gofasia atlantidis n. sp.
(Figures 39, 40)

Type material

Holotype MNHN 9718 (spm., 1.95 × 1.22 mm) from *Seamount 2* sta. TS270, in MNHN; 30 paratypes MNHN 9774 (3 spm., 1.52 × 1.00 to 1.84 × 1.18 mm, and 27 sh., 1.60 × 0.06 to 2.32 × 1.36 mm) from *Seamount 2* sta. DW255 (34°04.9′N, 30°15.3′W, 340 m), in MNHN.

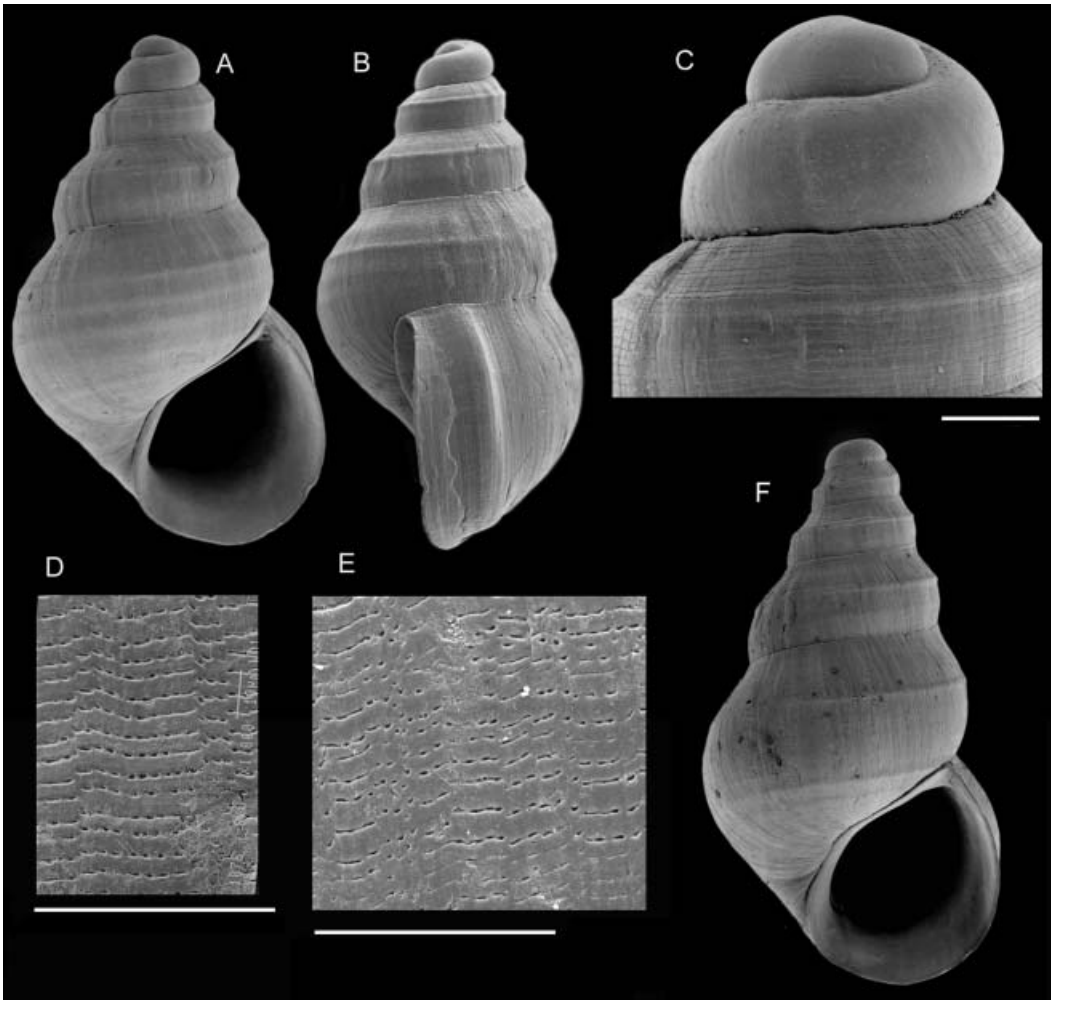

Figure 39. *Gofasia atlantidis* n. sp. (A, B) Paratype (sh.) from Atlantis seamount, DW255 (340 m), actual size 2.00 mm; (C) protoconch of the same paratype; (D, E) microsculpture of the same paratype; (F) paratype, same locality, actual size 2.12 mm. Scale bars: 100 μm (C); 50 μm (D, E).

Type locality

Atlantis seamount (34°04.8′N, 30°14.9′W, 330 m).

Material examined

Atlantis—*Seamount 2* sta. DW255 [includes types], 3 spm., 1790 sh. (1.46 × 0.92 to 2.40 × 1.30 mm); CP157, 1 spm. (1.43 × 0.91 mm); DW258, 1 spm. (1.60 × 1.02 mm) and 574 sh. (1.48 × 0.92 to 2.45 × 1.40 mm); TS270, 25 spm. (mostly jv., adults 1.50 × 0.94 to 2.04 × 1.14 mm) and 122 sh. (1.36 × 0.88 to 2.25 × 1.24 mm); DW 274, 4 spm. (1.64 × 0.92 to 2.00 × 1.14 mm) and 1050 sh. (1.60 × 0.96 to 2.36 × 1.30 mm).

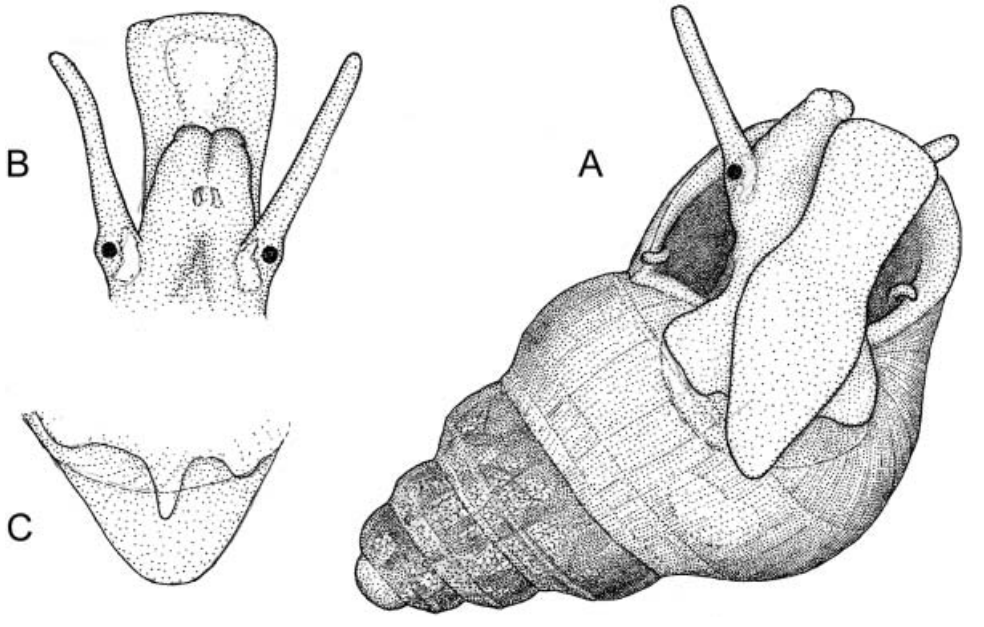

Figure 40. *Gofasia atlantidis* n. sp. (A) Holotype (living specimen) from Atlantis seamount, TS270 (330 m), actual size 1.95mm; (B) detail of head and propodium; (C) detail of opercular lobes and metapodium.

Etymology

Named after Atlantis seamount, to which the species is endemic.

Description

Shell with a moderately high spire, adults up to 2.4 × 1.4 mm. Protoconch of 1.25 convex whorls; surface of larval whorls nearly smooth except for few granules near suture. Teleoconch of three to four convex whorls, the early ones keeled, with minute spiral rows of pores. Axial sculpture limited to growth lines. First teleoconch whorls with one low but well-defined spiral keel, later whorls with this keel attenuated and with several similarly raised lines abapically to it. Spiral rows of pores ca 5 μm apart from each other, pores extremely minute (ca 0.5 μm), closely set together and some of them confluent in the spiral direction to form slits, visible only at high magnification under SEM observation. Outer lip orthocline, with a thin edge and thickened externally at a distance of the edge by a definite, well-demarcated rim, smooth and not thickened inside. Inner lip thin, appressed. Shell colour either whitish or with a very pale colour pattern, a faint brown ochre subsutural spiral band on penultimate and last whorl, and two more on last whorl; colour tending to become more intense and form blotches where abutting on the outer lip. Operculum thin, paucispiral, with eccentric nucleus.

Cephalic tentacles cylindrical, with rounded tips. Eyes embedded in a slight swelling at the base of each tentacle. Snout somewhat tapering, truncated and bilobed anteriorly, with tiny bright yellow jaws visible by transparency and anterior part tinged with pale brown. Large yellowish granular masses behind each eye. Upper part of head also tinged with pale

brown. Sole of foot colourless with pedal glands inconspicuous. Metapodial tentacle forming an axial triangular flap and, laterally to it, two small and unequal rounded lobes. Right and left pallial tentacles tiny. Visceral mass visible by transparency in the spire whorls, brownish with large yellowish granular areas.

Remarks

This species resembles the Lusitanian *G. vinyillina*, in general shape, in the pattern of the pitted microsculpture, and in having a colour pattern on the shell. It differs in having a smooth protoconch, keeled spire whorls, a more conical profile with a broader body whorl and an orthocline rather than opisthocline aperture with a more definite outer rim. It is represented by a large number of shells but very few live-taken specimens, essentially those from the catch of the suprabenthic sled TS270.

Gofasia obtusellaeformis n. sp.
(Figures 41, 42)

Type material

Holotype MNHN 9719 (spm., 1.62 × 1.12 mm) from *Seamount 2* sta. TS270, in MNHN; 30 paratypes MNHN 9775 (20 spm., 1.26 × 0.94 to 1.56 × 1.14 mm and 10 sh., 1.28 × 0.94 to 1.58 × 1.04 mm) from *Seamount 2* sta. DW255 (34°04.9′N, 30°15.3′W, 340 m), in MNHN.

Type locality

Atlantis seamount (34°04.8′N, 30°14.9′W, 330 m).

Material examined

Atlantis—*Seamount 2* sta. DW255 [includes types], 20 spm. and 237 sh. (1.24 × 0.92 to 1.66 × 1.14 mm); DW258, 10 sh. (1.52 × 1.08 to 1.60 × 1.16 mm); TS270, 5 spm. (1.30 × 0.92 to 1.40 × 1.10 mm) and 30 sh. (1.24 × 0.96 to 1.60 × 1.06 mm); DW274, 15 spm. (1.34 × 0.96 to 1.56 × 1.12 mm) and 775 sh. (1.20 × 0.94 to 1.82 × 1.20 mm).

Etymology

The name alludes to the resemblance with the rissoid genus *Obtusella*.

Description

Shell with a moderately high spire and a blunt apex, not very solid, adults up to 1.8 × 1.2 mm. Protoconch of 1.25 convex whorls, quite smooth or with a few wrinkles. Teleoconch of 2.75–3.0 convex whorls, apparently smooth but microscopically with minute spiral rows of pores, ca 5 μm apart from each other, extremely minute (ca 0.5 μm), closely set together and in the spiral direction, visible only at high magnification under SEM observation. Outer lip orthocline with a distinct inwards inflexion near the suture,

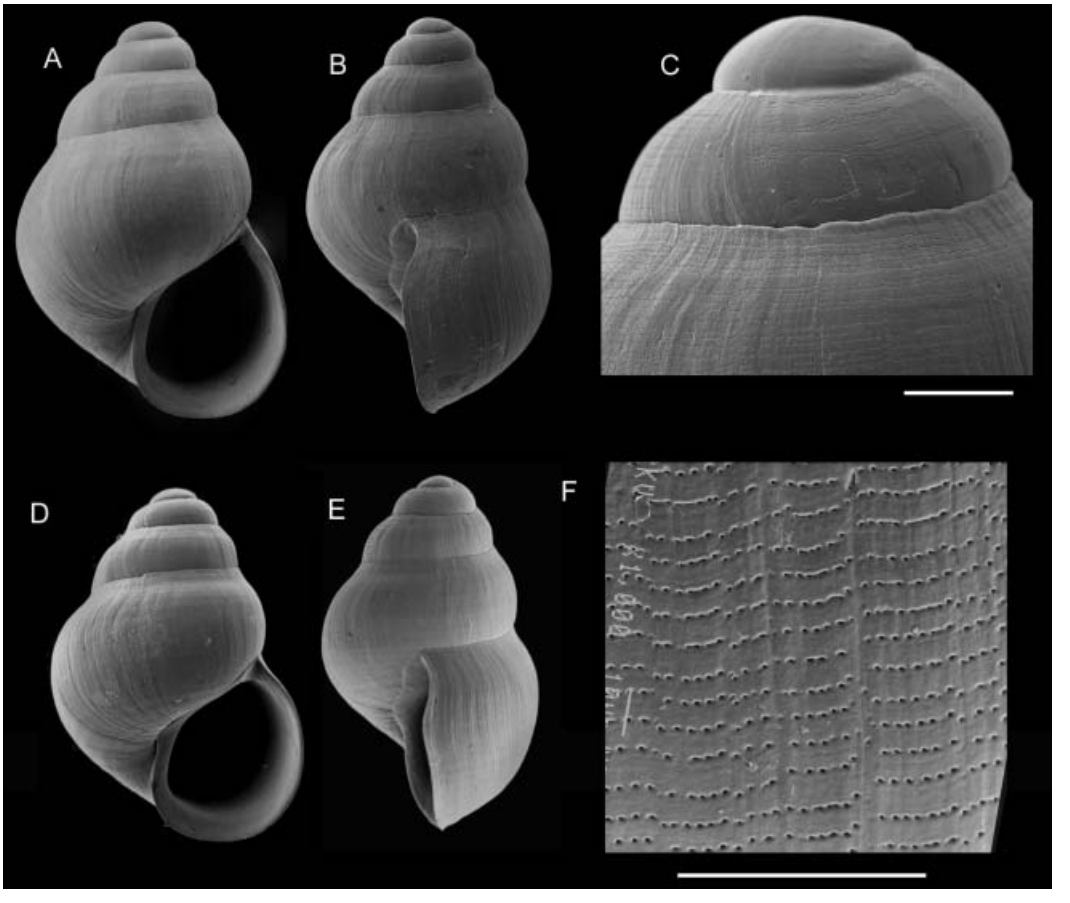

Figure 41. *Gofasia obtusellaeformis* n. sp. (A, B) Paratype (sh.) from Atlantis seamount, DW255 (340 m), actual size 1.50 mm; (C) protoconch of the same paratype; (D, E) paratype, same locality, actual size 1.34 mm; (F) microsculpture of the same paratype as (D, E). Scale bars: 100 μm (C); 50 μm (F).

with a thin edge, not thickened externally. Inner lip thin, not tightly appressed although there is no umbilical chink. Shell colour entirely white, translucent. Operculum thin, paucispiral, with eccentric nucleus.

Cephalic tentacles cylindrical, with rounded tips. Eyes embedded in a slight swelling at the base of each tentacle. Snout somewhat tapering, truncated and bilobed anteriorly, with tiny whitish jaws visible by transparency. Large yellow granular masses behind each eye; other yellow mass visible by transparency beneath the operculum. Sole of foot colourless with pedal glands inconspicuous. Metapodial tentacle forming an axial triangular flap and, laterally to it, two small and unequal rounded lobes. Right and left pallial tentacles tiny. Visceral mass visible by transparency in the spire whorls, brownish with large yellowish granular areas.

Remarks

This species superficially resembles shallow-water species of the genus *Obtusella*; however, the latter have plain cords as spiral microsculpture and not the pitted pattern which supports the generic assignment.

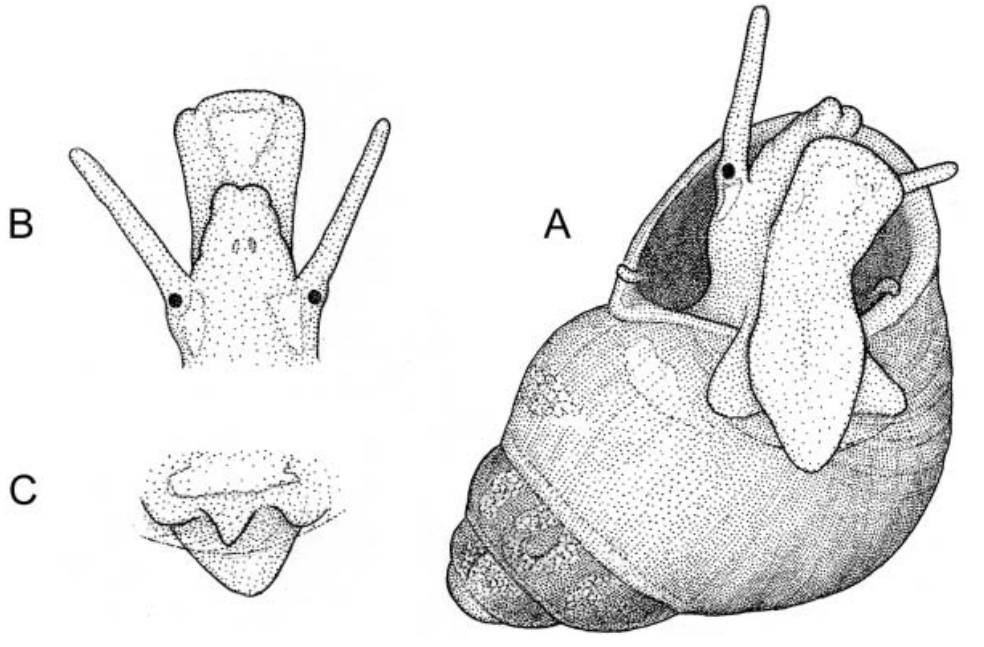

Figure 42. *Gofasia obtusellaeformis* n. sp. (A) Holotype (living specimen) from Atlantis seamount, TS270 (330 m), actual size 1.62 mm; (B) detail of head and propodium; (C) detail of opercular lobes and metapodium.

Genus *Porosalvania* n. gen.

Type species. Porosalvania solidula n. sp.

Diagnosis

Shell with a moderately high to quite high spire and a blunt apex, adults in size range 2–4 mm. Protoconch of paucispiral type, a little more than 1.25 whorls, nearly smooth. Teleoconch of three to five whorls, quite solid, with sculpture of variably developed axial folds and spiral cords, usually not sharply defined, sometimes lacking. Teleoconch microsculpture visible only under high SEM magnification, consisting of minute pits, about 1 μm in diameter and ca 5–10 μm apart, usually distributed at random, sometimes loosely aligned parallel to growth lines or spirally. Outer lip orthocline or very slightly prosocline; thickened externally mostly in the adapical part, at some distance from the edge, then thinning out to a cutting edge; smooth inside.

Head-foot with cephalic tentacles slender and tapering, and relatively small eyes at the base of each tentacle. Snout somewhat tapering, bilobed anteriorly. Anterior pedal gland distinct in propodium. Metapodial tentacle forming an axial triangular flap and, laterally to it, two small and unequal rounded lobes. Right and left pallial tentacles present. Operculum thin, paucispiral, with eccentric nucleus.

Radula taenioglossate. Central teeth with a well-developed axial cusp flanked on each side by smaller denticles, a single pair of well-developed basal denticles, and moderately developed U-shaped projection. Lateral teeth elongate, terminating in a broad triangular cusp. Marginals elongate and sickle-shaped, denticulated on their distal part.

Remarks

A new genus *Porosalvania* is here installed to accommodate several of the rissoid species found on the Meteor group seamounts, which share among other shell characters a microsculpture of minute pits not aligned along spiral lines, an attenuated or very attenuated spiral macrosculpture, and an axial sculpture either absent or constituted of broad axial folds. Some of these species resemble several deep-water rissoids placed in *Benthonellania* Lozouet, 1990 by Bouchet and Warén (1993). However, the West African type species *Benthonellania gofasi* Lozouet, 1990 has strongly unequal pallial tentacles, a well-developed neck lobe, a cylindrical rather than bilobed snout, and a large and conspicuous metapodial gland (Gofas 1999). All these features are very peculiar among the Rissoidae and were not found in *Porosalvania solidula* which could be observed alive. Characters of the head-foot and tentacle array in the latter resemble *Manzonia*, *Gofasia*, or some *Alvania* s.l., with small, symmetrical pallial tentacles, a small metapodial flap, and the anterior pedal gland more conspicuous than the posterior. The radula resembles that found in *Manzonia*, *Gofasia*, and in some species of *Alvania* s. l. (see Ponder 1985, and Figure 31 herein).

Whether the presence of the pitted microsculpture actually indicates a relationship with *Gofasia* and *Manzonia* must be considered with caution. A pitted microsculpture is also found in unrelated species of the subfamily Rissoininae (e.g. Figure 57 herein) and in the protoconch of the Barleeidae (see Gofas 1995). Nevertheless the congruence with the shape of the metapodial tentacle as a triangular flap, and the consistency with a distribution in the North Atlantic seamounts and in Macaronesia, suggest that there is really a relationship. A broader geographic scope is nevertheless needed to test this in the framework of a phylogenetic hypothesis.

Some of the species placed in *Benthonellania* by Bouchet and Warén (1993) may belong here. *Benthonellania fayalensis* was examined under SEM for microsculpture, but the shells were too corroded to ascertain whether the *Porosalvania* microsculpture was present.

Porosalvania solidula n. sp.
(Figures 43–46)

Type material

Holotype MNHN 9720 (spm., 2.40 × 1.38 mm) from *Seamount 2* sta. DW140, in MNHN; 30 paratypes MNHN 9776 (spm., 2.76 × 1.76 to 3.20 × 2.10/3.30 × 1.86 mm) from *Seamount 2* sta. DW152, in MNHN.

Type locality

Meteor seamount (30°01.1′N, 28°27.7′W, 308 m).

Material examined

Meteor—*Seamount 2* sta. DW136, 1 spm. (2.60 × 1.48 mm) and 3 sh. (2.28 × 1.36 to 2.68 × 1.40 mm); DE140, the holotype and 6 sh. (2.64 × 1.36 to 2.76 × 1.52 mm); DW143, 60 sh. (2.32 × 1.28 to 2.80 × 1.56 mm); DW152, 305 spm. (2.50 × 1.46 to3.12 × 1.70/

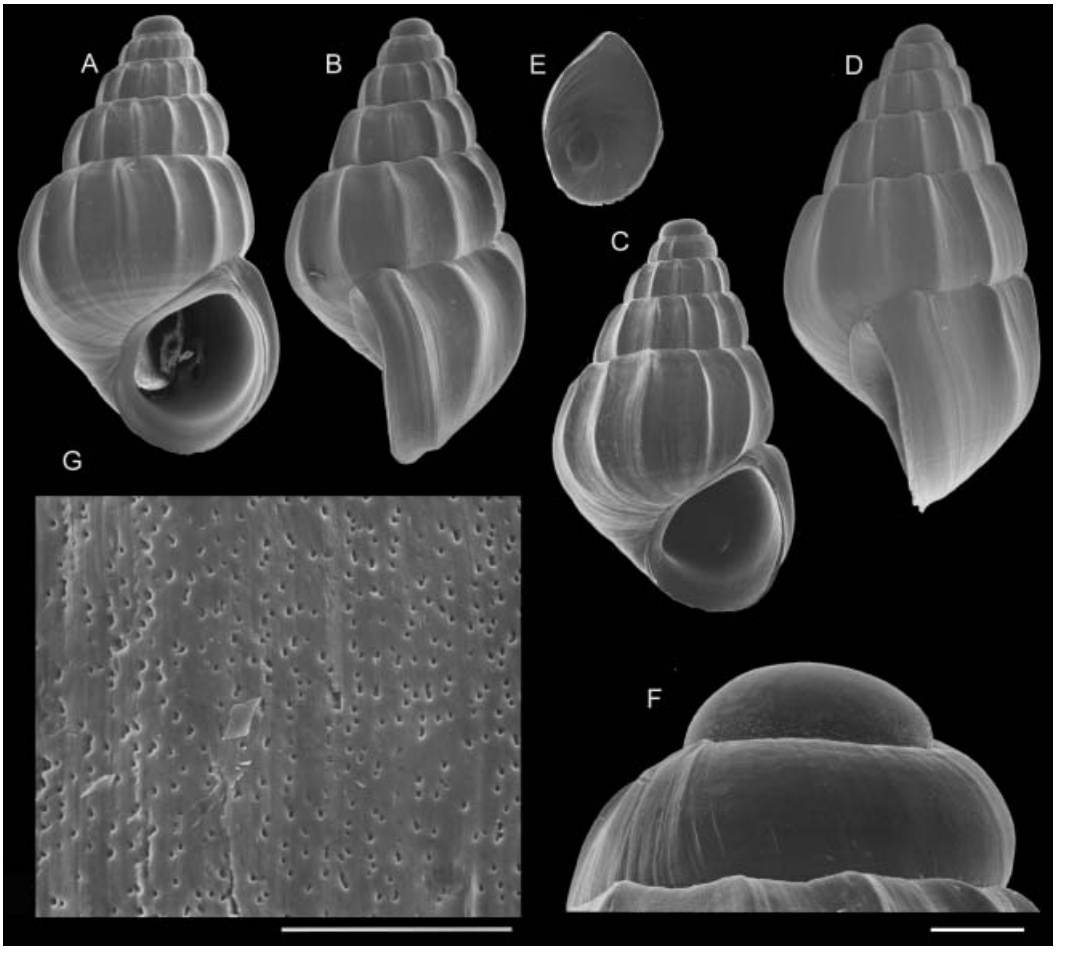

Figure 43. *Porosalvania solidula* n. sp. from Meteor seamount, DW152 (470 m). (A) Paratype (spm.), actual size 2.82 mm; (B–D) paratypes (sh.), same locality, actual sizes 2.84, 2.50, and 3.10 mm; (E) operculum of another paratype, actual size 0.95 mm; (F) protoconch of another paratype; (G) microsculpture. Scale bars: 100 μm (F); 50 μm (G).

3.16 × 1.88 mm; includes paratypes) and 1300 sh. (2.24 × 1.30 to 3.30 × 1.84/ 3.04 × 2.00 mm); DE174, 3 spm. (2.80 × 1.90 to 2.84 × 1.92)+4 sh. (3.20 × 1.90 mm, and jv.); DW179, 16 sh. (2.98 × 1.76 to 3.50 × 2.08 mm). Hyères—*Seamount 2* sta. DW182, 64 spm. (2.86 × 1.64 to 3.12 × 1.90/3.12 × 2.06 mm) and 635 sh. (2.44 × 1.48 to 3.24 × 2.04/3.60 × 2.00 mm); DW188, 3 spm. (2.44 × 1.42 to 2.74 × 1.48 mm) and 26 sh. (2.40 × 1.40 to 2.78 × 1.54 mm); DW 192, 9 (old) sh. (2.10 × 1.30 to 2.66 × 1.44 mm). Irving—*Seamount 2* sta. DW208, 2 sh. (2.16 × 1.46 to 2.48 × 1.70 mm); DW209, 7 sh. (2.26 × 1.42 to 2.64 × 1.58 mm); DW215, 24 sh. (2.00 × 1.30 to 2.44 × 1.54 mm).

Etymology

Diminutive of Latin *solidus*, solid, alluding to the comparatively thick shell.

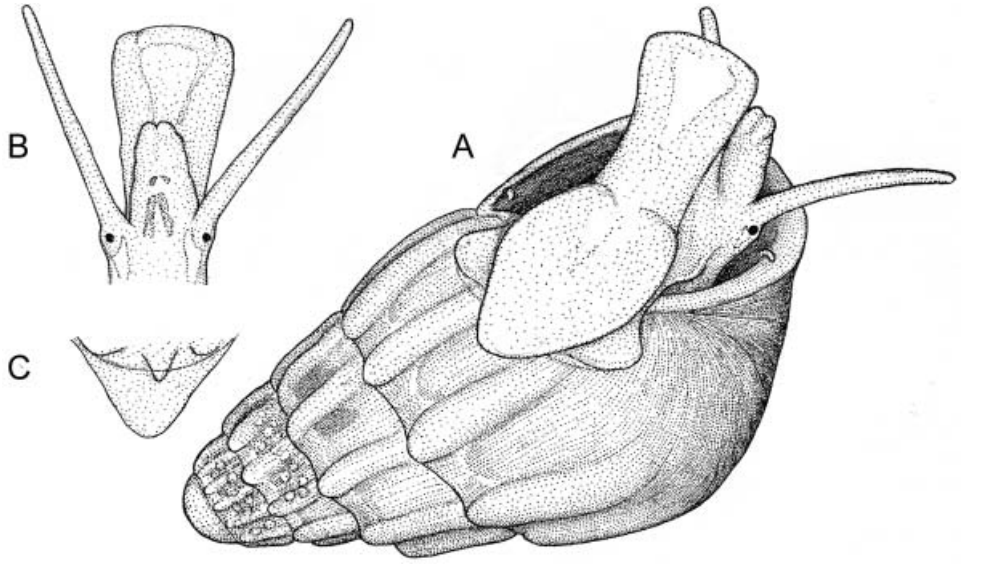

Figure 44. *Porosalvania solidula* n. sp. (A) Holotype (living specimen) from Meteor seamount, DE140 (308 m), actual size 2.34 mm; (B) detail of head and propodium; (C) detail of opercular lobes and metapodium.

Description

Shell with a moderately high spire and a blunt apex, adults up to 3.6×2.0 mm. Protoconch of a little more than 1.25 whorls, nearly smooth. Teleoconch of four whorls; spire whorls moderately convex to rather flat, somewhat swollen subsuturally, with strong, slightly flexuous axial ribs (ca 14–15 on the penultimate whorl; ribs on body whorl becoming broader and more attenuated where approaching the outer lip). Ribs on some specimens slightly protruding adapically along the suture. Body whorl rounded, with the axial folds fading towards the periumbilical area which is quite smooth except for a very vague

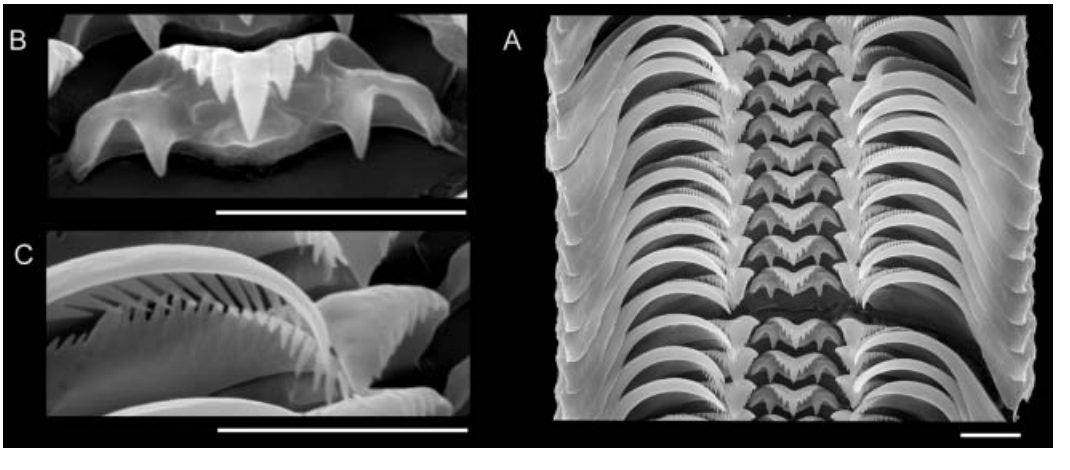

Figure 45. *Porosalvania solidula* n. sp. (A) Partial view of the radula of a paratype from Meteor seamount, DW152 (470 m); (B) detail of the central teeth, tilted 30° with respect to (A), showing paired basal denticles and poorly developed U-shaped projection; (C) detail of the distal part of laterals and marginals, tilted likewise to show the denticles on the outer marginals, which are concealed in (A). Scale bars: 10 µm.

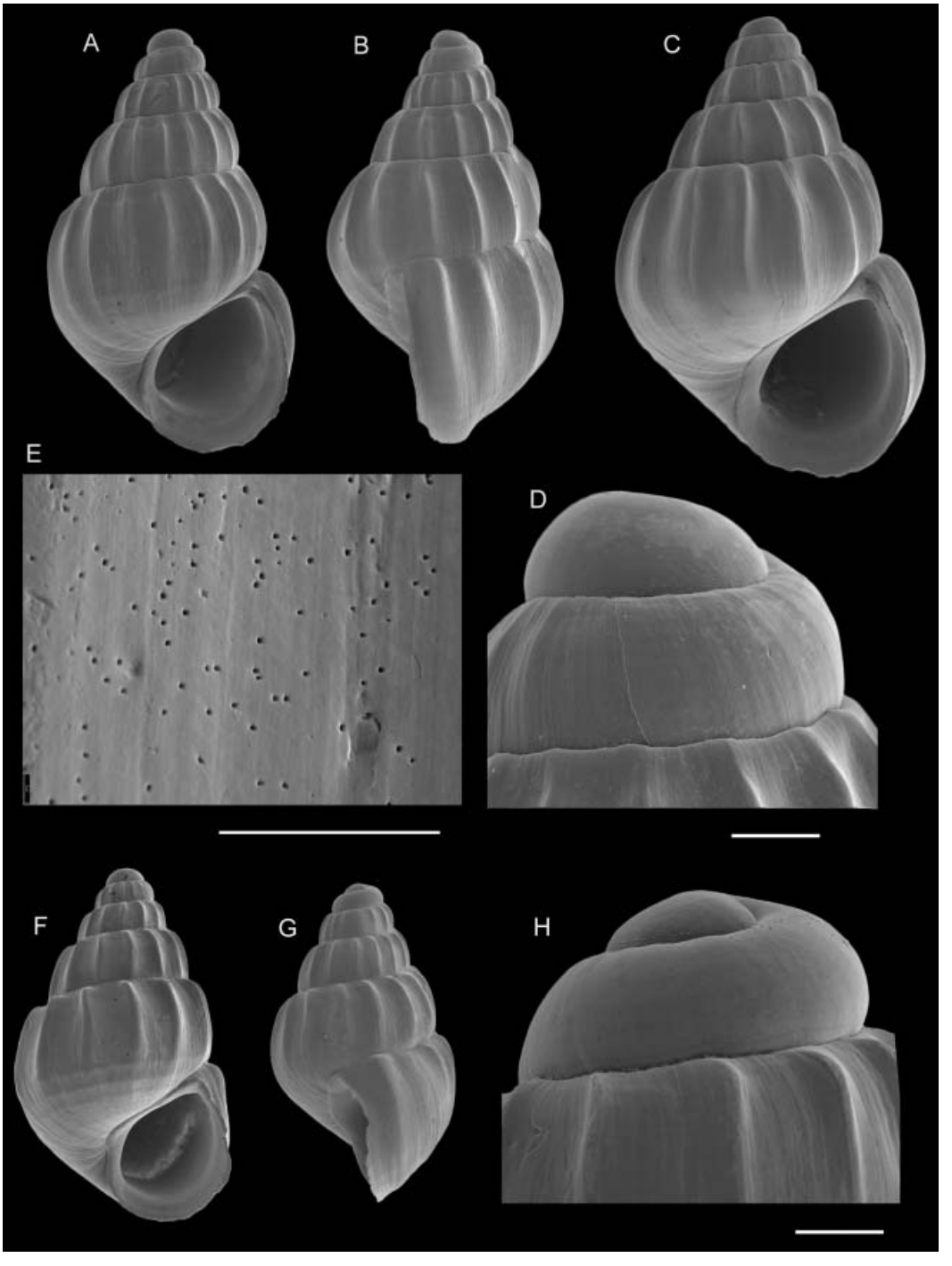

Figure 46. *Porosalvania solidula* n. sp. (A–C) Shells from Hyères seamount, DW182 (480 m), actual sizes 2.88, 2.80, and 3.16 mm; (D) protoconch, same shell as (B); (F, G) shells from Irving seamount, DW215 (275 m), actual sizes 2.36 and 2.10 mm; (H) protoconch of another shell, same locality. Scale bars: 100 μm (D, H); 50 μm (E).

indication of spiral cords. Teleoconch microsculpture visible only under high SEM magnification, consisting of minute pits, about 1 μm in diameter and ca 5–10 μm apart, randomly distributed or loosely aligned parallel to growth lines. Outer lip orthocline or very slightly prosocline; thickened externally mostly in the adapical part, at some distance from the edge, then thinning out to a cutting edge; smooth inside. Inner lip tightly appressed to the abapical area of the whorl, not leaving any umbilical chink. Shell colour white. Operculum thin, paucispiral, with eccentric nucleus.

Cephalic tentacles slender and tapering, with rounded tips. Eyes relatively small, embedded in a slight swelling at the base of each tentacle. Snout somewhat tapering, bilobed anteriorly, with tiny jaws and a brownish buccal mass visible by transparency, and anterior part tinged with pale brown. Large yellowish granular masses behind each eye. Sole of foot colourless with distinct triangular anterior pedal gland. Metapodial tentacle forming an axial triangular flap and, laterally to it, two small and unequal rounded lobes. Right and left pallial tentacles tiny. Visceral mass visible by transparency in the spire whorls, brownish with adapically a bright orange and yellow mass corresponding to the gonad.

Radula taenioglossate, ca 80 μm broad. Central teeth with a well-developed axial cusp flanked on each side by three to four smaller cusps decreasing in size. A single pair of well-developed basal denticles, and poorly developed U-shaped projection. Lateral margins of central teeth thickened, sloping at 45°. Lateral teeth elongate, terminating in a broad triangular cusp which is finely serrated on the inner side facing the central tooth and smooth on the opposite side; small denticulations also present on the inner part of the lateral tooth preceding the main triangular cusp. Marginals elongate and sickle-shaped. Inner marginals with ca 30 delicate cusps on the upper part of the distal half, increasing in size towards the distal part of the tooth. Outer marginals with ca 20 long, comb-like cusps on the distal one-third, facing towards the radular ribbon.

Remarks

This species most resembles '*Benthonellania*' *fayalensis* (Watson, 1886), with which it shares the paucispiral protoconch and general aspect. The latter differs, however, in having a suprasutural thread on the protoconch, in having distinct spirals on the periumbilical area and in having a less tightly appressed inner lip.

This is one of the commonest rissoids on the upper portion of Meteor and Hyères seamounts, and also has an unusually high representation of living specimens. In the large lot from DW152 on Meteor, nearly one of every five individuals recorded was collected alive.

The population from Meteor consistently shows a higher density of the micropores (about twice as many per surface unit) although the size of pores and the shortest distance between adjacent pores is similar. The few shells collected on Irving are smaller and ambiguous, the faint indication of a few spirals on the abapical surface being reminiscent of *P. decipiens* (see 'Remarks' for that species).

Porosalvania angulifera n. sp.
(Figure 47)

Type material

Holotype MNHN 9721 (sh., 1.96 × 1.32 mm) and 40 paratypes MNHN 9777 (sh., 1.48 × 1.00 to 2.02 × 1.20 mm) from *Seamount 2* sta. DW143, in MNHN.

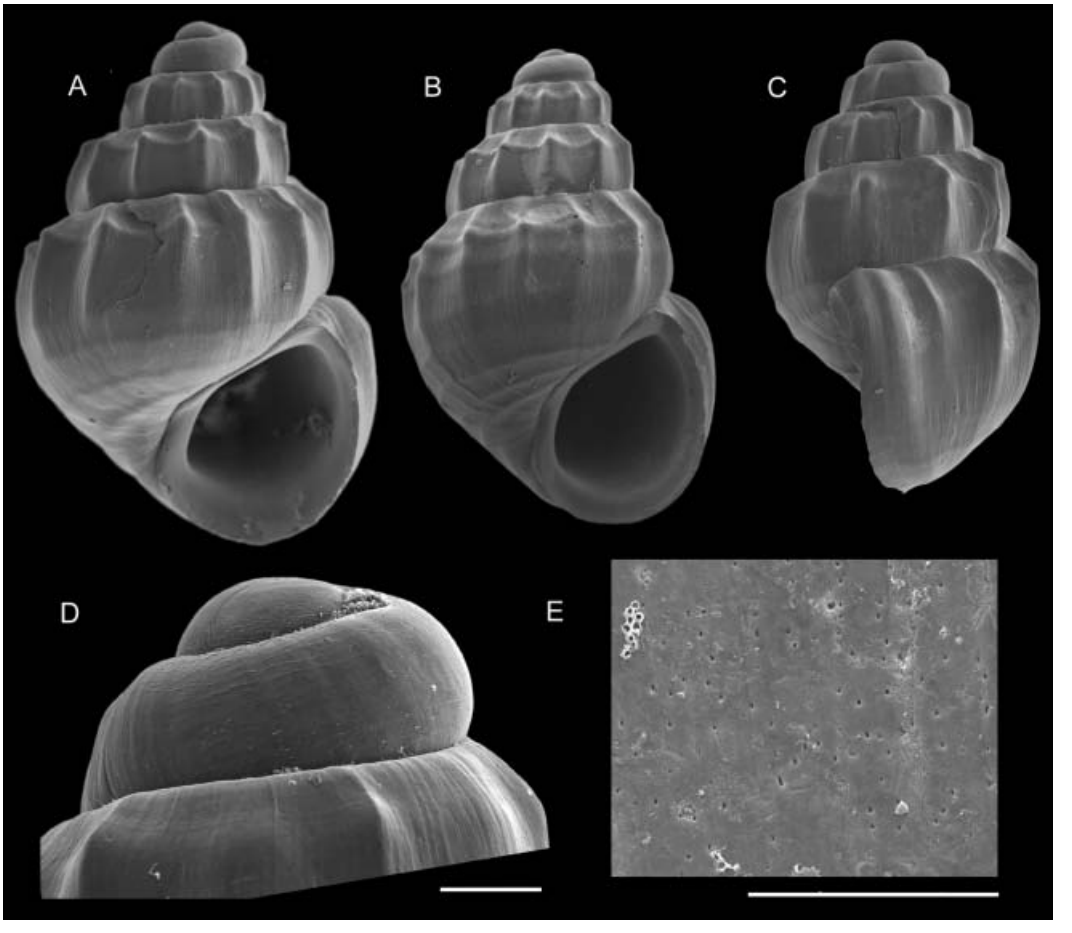

Figure 47. *Porosalvania angulifera* n. sp. (A) Holotype (sh.) from Meteor seamount, DW143 (330 m), actual size 1.96 mm; (B, C) paratypes, same locality; (D) protoconch of another paratype; (E) microsculpture, same shell as (B). Scale bars: 100 μm (B); 50 μm (C).

Type locality

Meteor seamount (30°09.9′N, 28°28.1′W, 330 m).

Material examined

Meteor—*Seamount 2* sta. DW143, the type material; DW152, 6 sh. (1.66 × 1.16 to 2.04 × 1.24 mm). Hyères—*Seamount 2* sta. DW188, 1 sh. (1.70 × 1.20 mm).

Etymology

From Latin *angulifer*, angle-bearing, alluding to the profile of the spire whorls.

Description

Shell with a rather low spire and a blunt apex, adults up to 2.0 × 1.2 mm. Protoconch of a little more than 1.25 whorls, with spirally oriented wrinkles. Teleoconch of 3.25–3.75 whorls; spire whorls angulated, with strong axial folds (in quite constant number, ca 11–14 on spire whorls and on body whorl), each bearing a distinct projection at the angle. Body whorl rounded abapically, with the axial folds fading towards the periumbilical area. A few (three to four) hardly distinct spiral cords on the periumbilical area, sometimes also a still more vague indication of spiral cords on the penultimate whorl on each side of the angle. Teleoconch microsculpture visible only under high SEM magnification, consisting of minute pits, about 1 μm in diameter and ca 5–10 μm apart, randomly distributed. Outer lip orthocline or very slightly prosocline; thickened externally, mostly in the adapical part at a short distance from the edge; smooth inside. Inner lip tightly appressed to the abapical area of the whorl, not leaving any umbilical chink.

Remarks

This small species is found sympatrically with *P. solidula* on the shallowest part of Meteor seamount, without the occurrence of any transitional form. It is distinguished by being smaller, stouter, in having a pronounced shoulder on all teleoconch whorls with a marked angle on the axial folds, and in having a wrinkled protoconch whereas all the other species of *Porosalvania* have a smooth one. A single shell was found in sample DW188 from the shallow part of Hyères. Considering the caution taken with the cleaning of the gear and the fact that this is an uncommon species, this occurrence is probably not an artifact but would be better demonstrated if more specimens were found.

Porosalvania decipiens n. sp.
(Figure 48)

Type material

Holotype MNHN 9721 (sh., 2.50 × 1.75 mm) and 30 paratypes MNHN 9778 (sh., 2.28 × 1.44 to 2.76 × 1.70 mm) from *Seamount 2* sta. DW200, in MNHN.

Type locality

Hyères seamount (31°19.1′N, 28°36.0′W, 1060 m).

Material examined

Hyères—*Seamount 2* sta. DW200 [includes types], 136 sh. (2.24 × 1.42 to 2.72 × 1.60 mm); DW203, 40 sh. (1.98 × 1.38 to 2.54 × 1.72 mm).

Etymology

From Latin *decipiens*, deceptive or elusive, alluding to the broad variability which makes this species difficult to separate from some congeners.

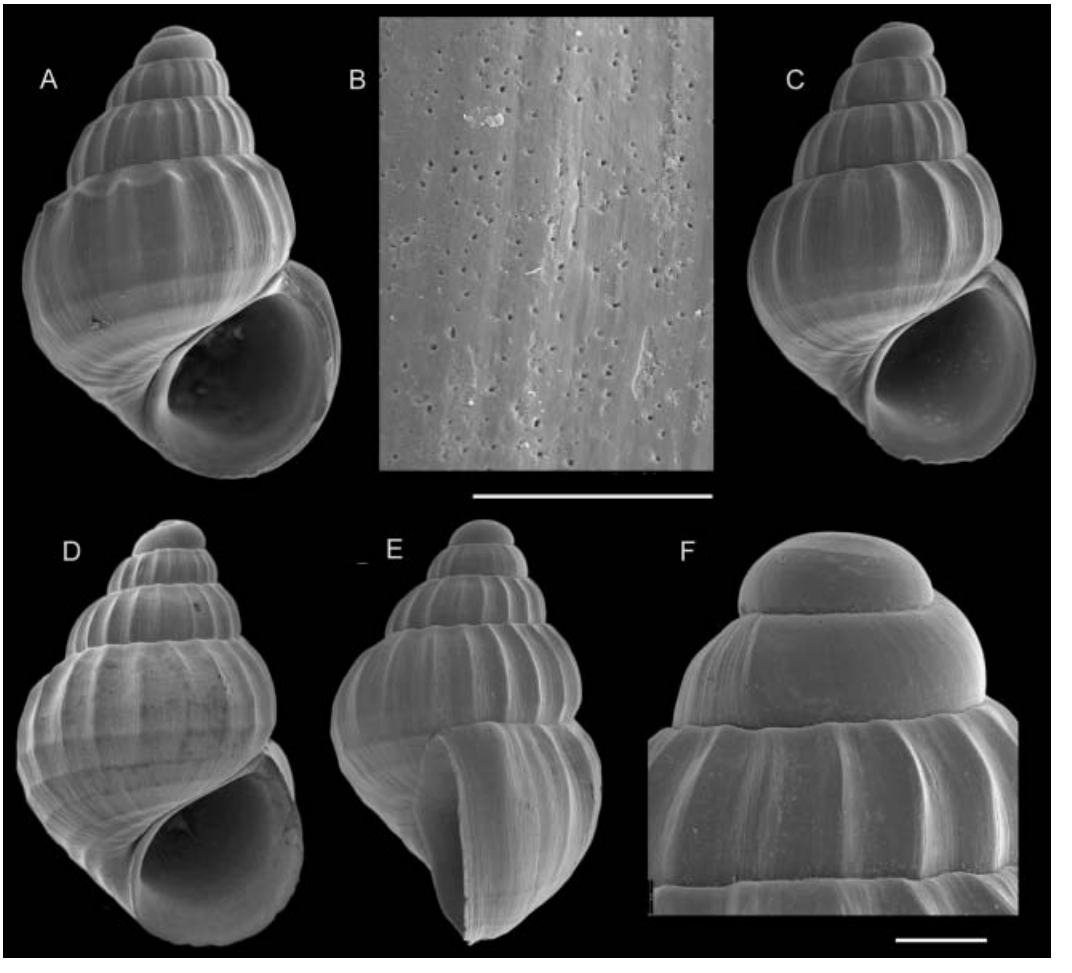

Figure 48. *Porosalvania decipiens* n. sp. (A) Holotype (sh.) from Hyères seamount, DW200 (1060 m), actual size 2.50 mm; (B) microsculpture of the holotype; (C) paratype (sh.), same locality, actual size 2.36 mm; (D, E) paratype (sh.), same locality, actual size 2.30 mm; (F) protoconch of the same paratype. Scale bars: 50 μm (B); 100 μm (F).

Description

Shell with a rather low spire and a blunt apex, adults up to 2.7 × 1.6 mm. Protoconch of a little more than 1.25 whorls, quite smooth. Teleoconch of 3–3.5 whorls; spire whorls rather rounded, with variably developed axial ribs (ca 16–22 on the penultimate whorl; ribs on body whorl becoming broader and more attenuated where approaching the outer lip). Ribs on the body whorl sometimes projecting with an angle at a short distance from the suture. Body whorl rounded abapically, with the axial folds fading towards the periumbilical area. A few (three to four) hardly distinct spiral cords on the periumbilical area, sometimes also a still more vague indication of spiral cords on the penultimate whorl. Teleoconch microsculpture visible only under high SEM magnification, consisting of minute pits, about 1 μm in diameter and ca 5–10 μm apart, randomly distributed. Outer lip orthocline or very slightly prosocline; thickened externally, mostly in the adapical part at a short

distance from the edge, then thinning out to a cutting edge; smooth inside. Inner lip tightly appressed to the abapical area of the whorl, not leaving any umbilical chink.

Remarks

The population collected on the deeper part of Hyères seamount is treated as a distinct species despite resemblance with both *P. solidula* and *P. angulifera*. Compared to *P. solidula*, this form is stouter, with more ribs on the spire whorls, more instances of an angle at some distance from the suture (in this respect resembling *P. angulifera*), fewer and more distinct spirals on the abapical surface and sometimes even on the whorls. It differs from *P. angulifera* in being larger with more ribs, in lacking an angle on the early spire whorls and in having a smooth protoconch. However, the lot from DW200 shows an extensive variability in spire height, number of ribs, expression of the subsutural angle, and some specimens even have attenuated ribs thus resembling *P. vixcostata*.

In the rich haul of DW203 at an intermediate depth (845 m), *P. decipiens* was less abundant than at 1060 m, and the very different *Porosalvania profundior* was the most abundant. Thus, the discrete bathymetric distribution (Figure 49) is best explained by the differentiation of a third species, distinct from both *P. angulifera* and *P. solidula*. The alternative would be that *P. decipiens* morphs are the extreme expression of a clinal variation starting from *P. solidula* morphs in the shallow part of the seamounts.

Porosalvania vixplicata n. sp.
(Figure 50)

Type material

Holotype MNHN 9722 (sh., 2.42 × 1.40 mm) and 30 paratypes MNHN 9779 (sh., 1.82 × 1.18 to 2.62 × 1.52 mm) from *Seamount 2* sta. DW263, in MNHN.

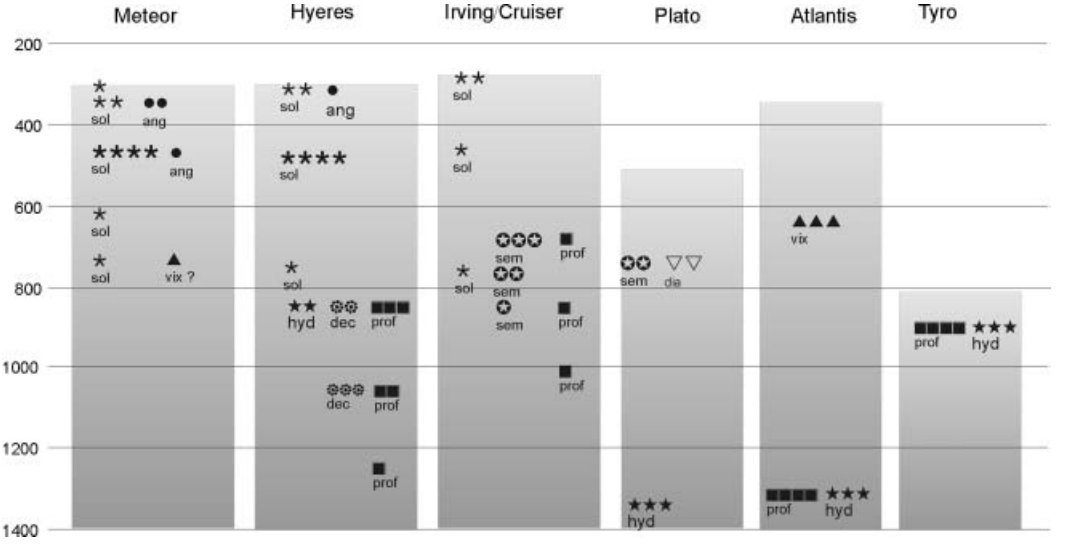

Figure 49. Bathymetric distribution of the *Porosalvania* species on the Meteor group seamounts. Number of symbols (1–4) for each species reflects abundance classes 1–10, 10–99, 100–500, >500 respectively.

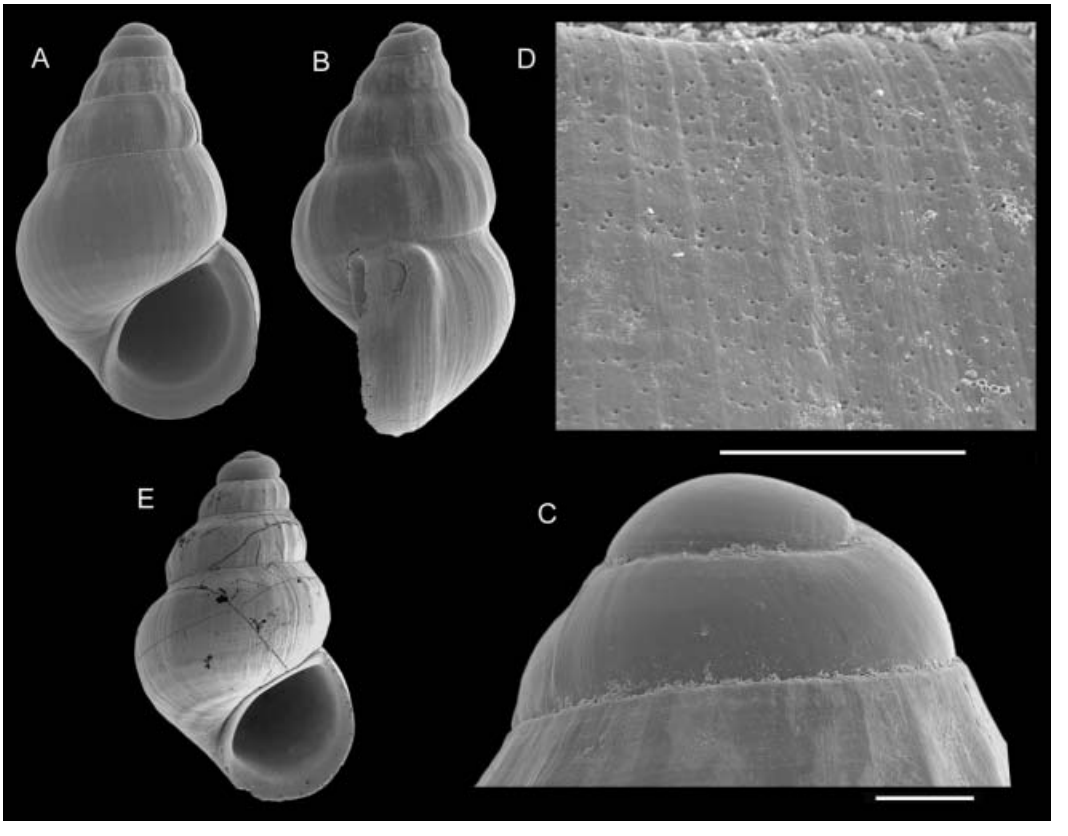

Figure 50. *Porosalvania vixcostata* n. sp. (A) Holotype (sh.) from Atlantis seamount, DW263 (610 m), actual size 2.42 mm; (B) paratype (sh.), same locality, actual size 2.52 mm; (C) protoconch of the holotype; (D) microsculpture of the holotype; (E) shell resembling *P. vixcostata* from Meteor seamount, DW179 (730 m), actual size 2.30 mm. Scale bars: 100 µm (C); 50 µm (D).

Type locality

Atlantis seamount (34°25.9′N, 30°32.5′W, 610 m).

Material examined

Atlantis—*Seamount 2* sta. DW263 [includes types], 70 sh. (1.68 × 1.12 to 2.66 × 1.52 mm).

Etymology

From Latin *vix*, hardly, and *plicatus*, folded, alluding to the faint folds of the spire whorls.

Description

Shell with a moderately high spire and a blunt apex, adults up to 2.6 × 1.5 mm. Protoconch of a little more than 1.25 whorls, nearly smooth. Teleoconch of 3–3.5 whorls; spire whorls convex, with faint axial folds on the first teleoconch whorl, disappearing gradually on the next one. Body whorl rounded, nearly smooth macroscopically. Teleoconch microsculpture visible only under high SEM magnification, consisting of minute pits, about 0.5 µm in

diameter and ca 2–10 µm apart, loosely aligned in a spiral direction. Outer lip smooth inside, distinctly thickened externally at some distance from the edge, then thinning out to a cutting edge. Inner lip tightly appressed to the abapical area of the whorl, not leaving any umbilical chink.

Remarks

This species, together with *P. semisculpta* and *P. profundior*, are the only ones of this group represented on Atlantis seamount; no species resembling *P. solidula* was found on the shallower part of the seamount despite a very thorough sampling. The shell of *P. vixcostata* is distinguished from congeners by the disappearance of the ribs on the body whorl, the regularly convex whorls, and the microsculpture where the microscopic pits are loosely organized in a spiral direction. A few shells resembling *P. vixcostata* were found at a comparable depth on Hyères and Meteor, but differ in being more distinctly ribbed on the spire whorls and in having the pits randomly distributed as in the other species. Therefore they probably do not represent the same species and may more likely be extreme variants of *P. decipiens*.

Porosalvania semisculpta n. sp.
(Figure 51)

Type material

Holotype MNHN 9723 (sh., 2.14 × 1.32 mm) and 30 paratypes MNHN 9780 (sh., 1.54 × 1.04 to 2.14 × 1.34 mm) from *Seamount 2* sta. DW237; one paratype MNHN 9781 (jv. spm., 1.74 × 1.10 mm) from *Seamount 2* sta. DW238, in MNHN.

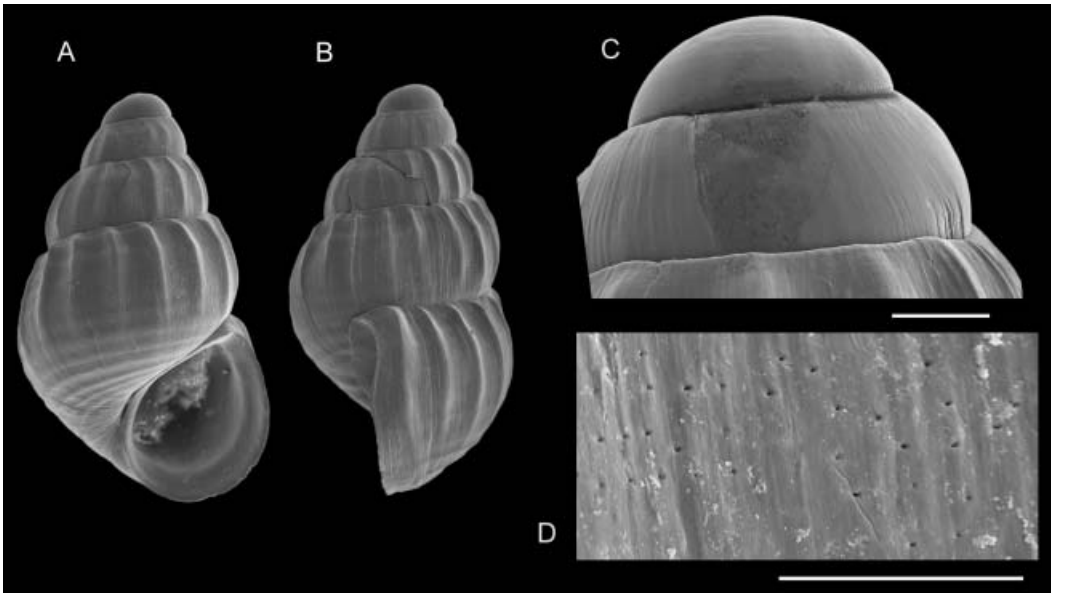

Figure 51. *Porosalvania semisculpta* n. sp. (A) Holotype (sh.) from Cruiser seamount, DW237 (670 m), actual size 2.14 mm; (B) paratype (sh.), same locality, actual size 2.14 mm; (C) protoconch of another paratype (spm.) from DW238; (D) microsculpture of the holotype. Scale bars: 100 µm (C); 50 µm (D).

Type locality

Cruiser seamount (32°15.9′N, 27°31.8′W, 670 m).

Material examined

Irving—*Seamount 2* sta. DW208, 23 sh. (1.58 × 1.06 to 2.08 × 1.30/2.38 × 1.30 mm). Cruiser—*Seamount 2* sta. DW237 [includes types], 205 sh. (1.52 × 0.92 to 2.24 × 1.32 mm); DW238, 1 spm. [paratype] and 9 sh. (1.52 × 1.04 to 2.18 × 1.36 mm); Plato—*Seamount 2* sta. DW242, 36 sh. (2.06 × 1.22 to 2.44 × 1.36 mm). Atlantis—*Seamount 2* sta. DW263, 4 sh. (2.20 × 1.44 to 2.46 × 1.46 mm).

Etymology

From Latin prefix *semi*, half, and *sculptus*, sculptured, alluding to the sculpture which fades out on the body whorl.

Description

Shell with a quite high spire and a blunt apex, adults up to 2.4 × 1.3 mm. Protoconch of a little more than 1.25 whorls, nearly smooth. Teleoconch of 3–3.25 whorls; spire whorls convex, with strong axial folds equivalent in size to the interspaces (ca 17–22 on penultimate whorl; becoming more attenuated or restricted to the subsutural zone where approaching the outer lip) and a very faint indication of spiral cords. Body whorl rounded, with the axial folds very gradually fading towards the periumbilical area, at the time they are replaced by seven to eight well-marked spiral cords. Teleoconch microsculpture visible only under high SEM magnification, consisting of minute pits, about 0.5 µm in diameter and ca 2–10 µm apart, randomly distributed. Outer lip orthocline, smooth inside, thickened externally at a short distance from the edge by a faint rim hardly more prominent than the axial folds, then thinning out to a cutting edge. Inner lip appressed to the abapical area of the whorl. Shell colour white. Operculum thin, paucispiral, with eccentric nucleus.

Remarks

This species is restricted to the deeper part of Cruiser, Atlantis and Plato seamounts, and on the latter is sympatric with the similar *P. diaphana*. It differs from *P. decipiens* in being distinctly more slender yet maintaining a similar number of ribs per whorl, and in always lacking a subsutural projection or shoulder on the ribs. *Porosalvania vixplicata* from Atlantis seamount differs in having the body whorl macroscopically nearly smooth and a strongly thickened outer lip, and *P. diaphana* from Plato seamount is still more slender with the axial folds very faint.

Porosalvania diaphana n. sp.
(Figure 52)

Type material

Holotype MNHN 9724 (sh., 2.30 × 1.36 mm) and 37 paratypes MNHN 9782 (sh., 2.00 × 1.14 to 2.40 × 1.30 mm) from *Seamount 2* sta. DW242, in MNHN.

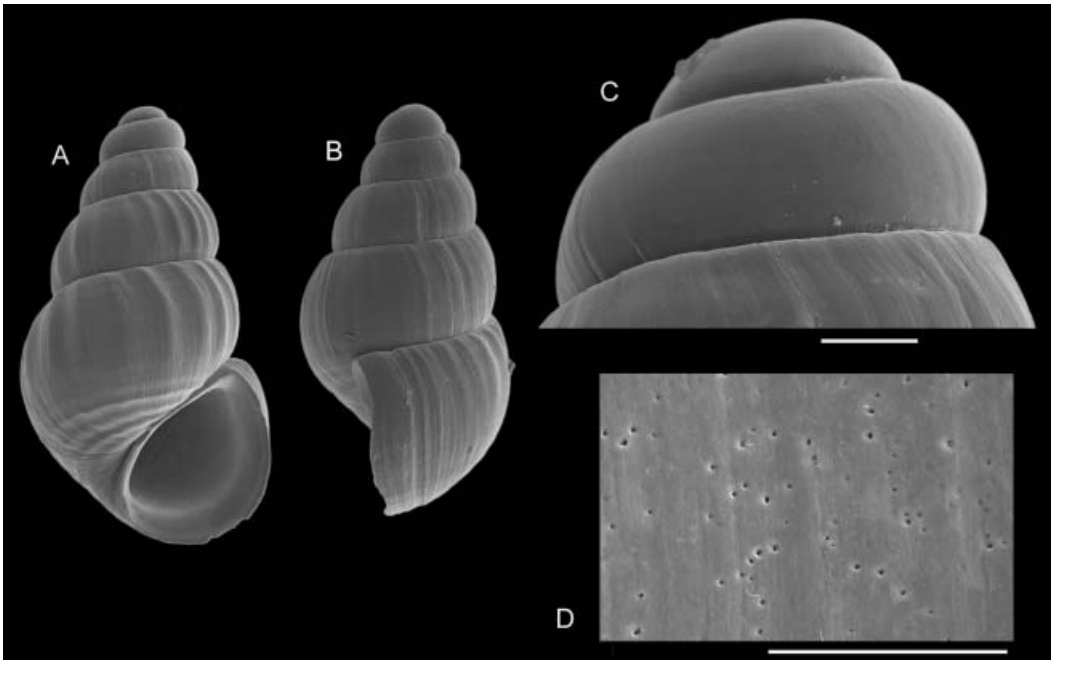

Figure 52. *Porosalvania diaphana* n. sp. (A) Holotype (sh.) from Plato seamount, DW242 (710 m), actual size 2.30 mm; (B) paratype (sh.), same locality, actual size 2.16 mm; (C) protoconch of the holotype; (D) microsculpture. Scale bars: 100 μm (C); 50 μm (D).

Type locality

Plato seamount (33°11.8′N, 28°57.0′W, 710 m).

Material examined

The type material.

Etymology

From Latin *diaphanus*, transparent.

Description

Shell with a quite high spire and a blunt apex, adults up to 2.4 × 1.3 mm. Protoconch of a little more than 1.25 whorls, nearly smooth. Teleoconch of 3.25–3.5 whorls; spire whorls moderately convex, with very poorly defined axial folds. Body whorl rounded, with the axial folds fading towards the periumbilical area, on which there are four to five well-marked spiral cords. Teleoconch microsculpture visible only under high SEM magnification, consisting of minute pits, about 0.5 μm in diameter and ca 2–10 μm apart, randomly distributed. Outer lip orthocline, smooth inside, thickened externally at a short distance from the edge by a faint rim, then thinning out to a cutting edge. Inner lip appressed to the abapical area of the whorl. Shell colourless, translucent.

Remarks

This species most resembles *P. semisculpta*, from which it differs in having a still more slender, more translucent shell and in lacking the strong, definite axial folds. It is found sympatrically on Plato seamount and the two species could be separated unambiguously in the material examined.

Porosalvania profundior n. sp.
(Figures 53, 54)

Type material

Holotype MNHN 9725 (sh., 3.20 × 1.66 mm) and 30 paratypes MNHN 9783 (sh., 2.60 × 1.56 to 3.42 × 1.72 mm) from *Seamount 2* sta. DW203, in MNHN.

Type locality

Hyères seamount (31°09.5′N, 28°43.5′W, 845 m).

Material examined

Hyères—*Seamount 2* sta. DW185, 3 sh. (2.62 × 1.54 to 3.22 × 1.72 mm); DW200, 59 sh. (2.92 × 1.70 to 3.54 × 1.70 mm); DW 203 [includes types], 246 sh. (2.40 × 1.52 to 3.34 × 1.78 mm). Irving—*Seamount 2* sta. DW225, 6 sh. (2.14 × 1.34 to 3.06 × 1.62 mm). Cruiser—*Seamount 2* sta. DW237, 1 jv. sh.; DW 238, 14 sh. (2.48 × 1.52 to 2.90 × 1.66 mm). Atlantis—*Seamount 2* sta. DW261, 1120 sh. (2.36 × 1.38 to 3.48 × 1.96 mm). Tyro—*Seamount 2* sta. DW 278, 5 spm.+1845 sh. (2.64 × 1.46 to 3.28 × 1.70 mm)+320 jv. sh.

Etymology

From Latin *profundus*, deep, alluding to the bathymetric distribution, deeper than congeners.

Description

Shell with a rather high spire, quite solid, up to 3.5 × 2.0 mm. Protoconch of 1.5 convex whorls; surface of larval whorls smooth.

Teleoconch of 3.5–4.25 whorls, with a sculpture of rather strong axial ribs, and faint spiral cords overrunning the ribs. Ribs ca 18–20 on the penultimate whorl, fading out adapically where they meet the suture, also fading out at the periphery and not extending on the abapical part of the body whorl. Ribs attenuated and/or more crowded on the part of the body whorl preceding the outer lip. One spiral cord at some distance abapically from the suture marking a shoulder on the whorls; the periumbilical area of the body whorl with some four to five additional blunt cords. Teleoconch microsculpture visible only under high SEM magnification, consisting of minute pits, about 0.5 µm in diameter and ca 2–10 µm apart, lacking along the spiral cords. Outer lip orthocline to opisthocline, with a thin edge and thickened externally at a distance of the edge by a thick, elevated rim, usually not overrun by the spirals; smooth inside. Inner lip thin, appressed. Shell colour white. Operculum thin, paucispiral, with eccentric nucleus.

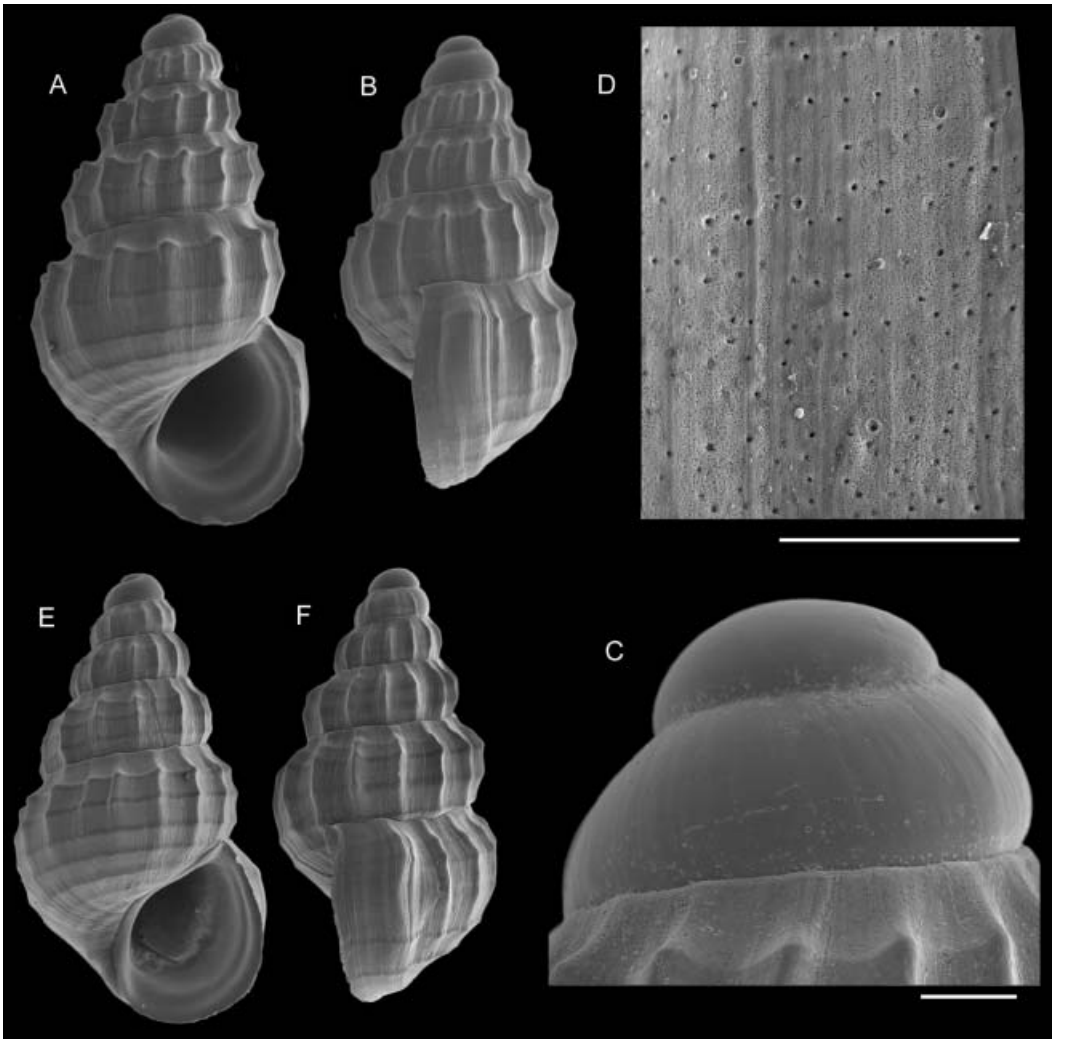

Figure 53. *Porosalvania profundior* n. sp. (A) Holotype (sh.) from Hyères seamount, DW203 (845 m), actual size 3.20 mm; (B) paratype (sh.), same locality, actual size 2.84 mm; (C) protoconch of the same paratype; (D) microsculpture of the holotype; (E, F) shells from Tyro seamount, DW278 (890 m), actual sizes 2.82 and 2.78 mm. Scale bars: 100 µm (C); 50 µm (E).

Remarks

This is the commonest species in the deep samples around the seamounts. The high spire with elevated ribs and opisthocline lip makes this species resemble *Frigidoalvania thalassae* Bouchet and Warén, 1993. However, the latter lacks the pitted microsculpture, has broad flat cord with narrow grooved interspaces, and a more conical protoconch with spiral grooves; all these differences indicate that they are not particularly related. The microsculpture links this species with others here assigned to *Porosalvania*, although this would not have been expected from the general shape.

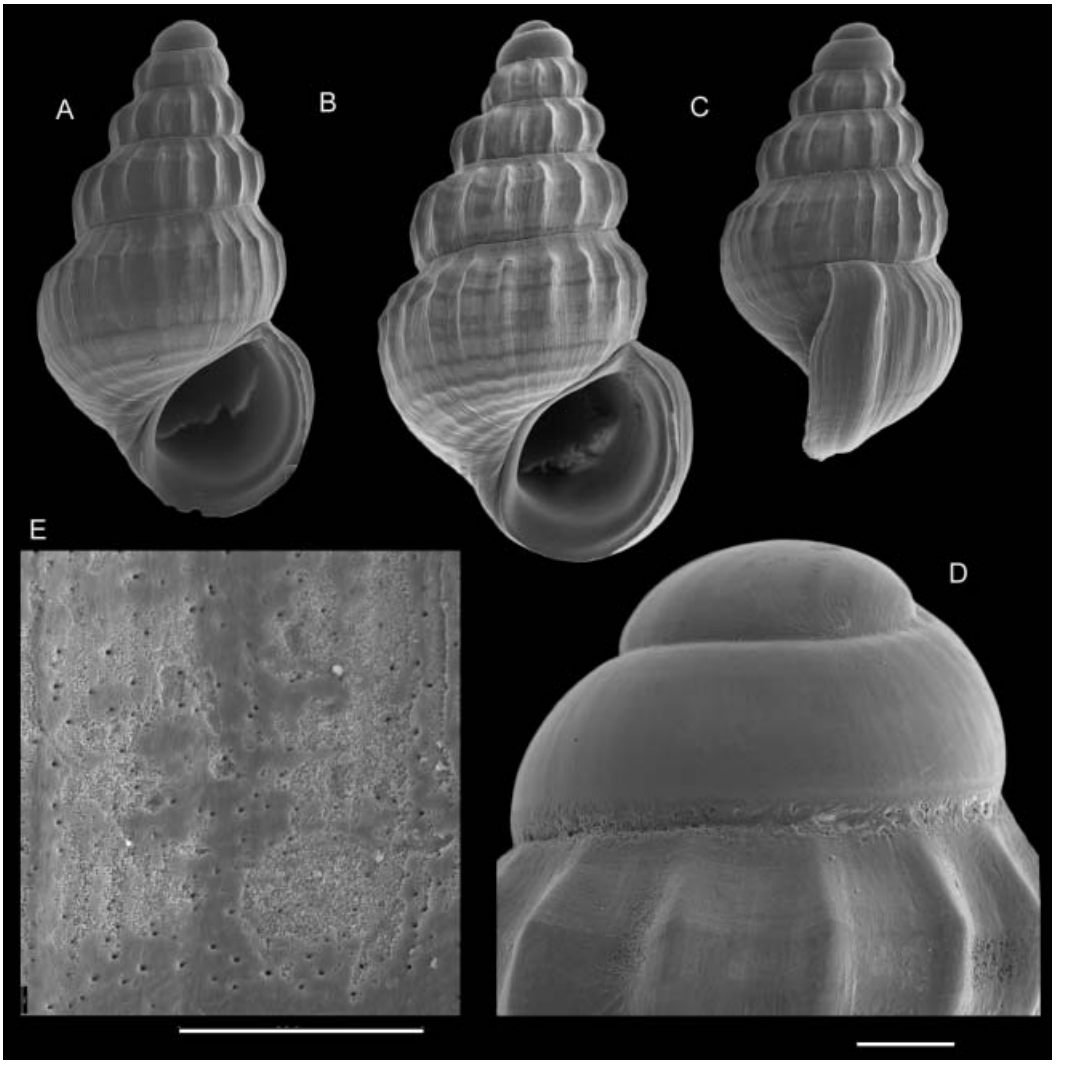

Figure 54. *Porosalvania profundior* n. sp. (A, B) Shells from Atlantis seamount, DW261 (1340 m), actual sizes 3.04 and 3.34 mm; (C) shell with very low spire for this species, same locality, actual size 2.70 mm; (D) protoconch, same as (C); (E) microsculpture, same as (B). Scale bars: 100 µm (D); 50 µm (E).

Porosalvania hydrobiaeformis n. sp.
(Figure 55)

Type material

Holotype MNHN 9726 (sh., 2.26 × 1.12 mm) and 30 paratypes MNHN 9784 (2.00 × 1.00 to 2.64 × 1.22 mm) from *Seamount 2* sta. DW261, in MNHN.

Type locality

Atlantis seamount (34°22.4′N, 30°27.8′W, 1340 m).

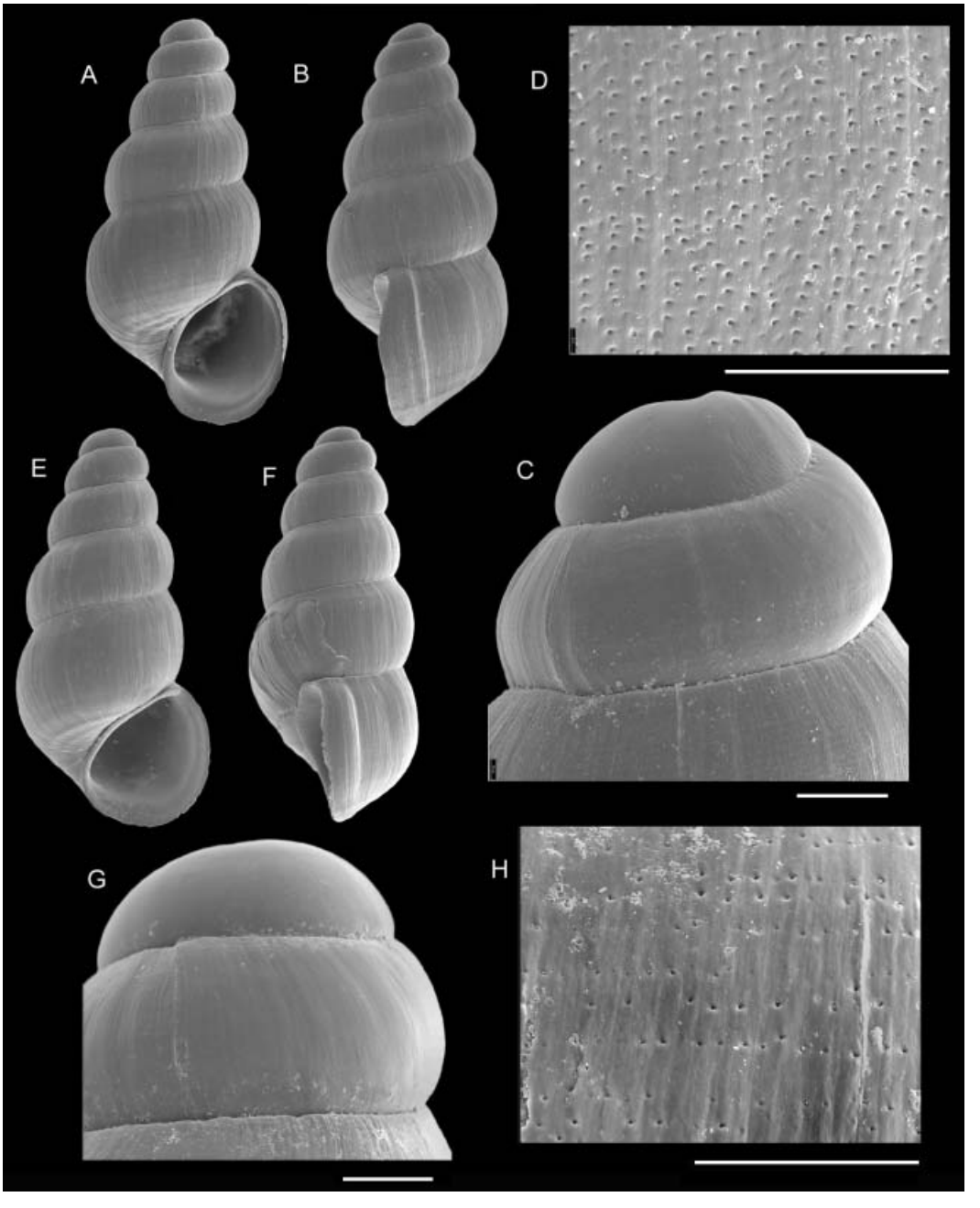

Figure 55. *Porosalvania hydrobiaeformis* n. sp. (A) Holotype from Atlantis seamount, DW261 (1340 m), actual size 2.26 mm; (B) paratype, same locality, actual size 2.15 mm; (C) protoconch of another paratype, same locality; (D) microsculpture, same as (B); (E, F) shells from Hyères seamount, DW203 (845 m), actual size 2.22 mm; (G) protoconch, same shell as (E); (H) microsculpture, same shell as (E). Scale bars: 100 µm (C, G); 50 µm (D, H).

Material examined

Hyères—*Seamount 2* sta. DW203, 37 sh. (1.90 × 0.94 to 2.36 × 1.12 mm). Plato—*Seamount 2* sta. DW250, 185 sh. (1.82 × 0.90 to 2.60 × 1.12 mm). Atlantis—*Seamount 2* sta. DW261 [includes types], 300 sh. (1.86 × 1.00 to 2.78 × 1.20 mm). Tyro—*Seamount 2* sta. DW278, 114 sh. (2.00 × 1.10 to 2.76 × 1.38 mm).

Etymology

The name alludes to the general aspect of the shell, recalling the freshwater genus *Hydrobia*.

Description

Shell with a high, blunt spire, adults up to 2.8 × 1.2 mm. Protoconch of 1.25 convex whorls, smooth. Teleoconch of three to four convex whorls, apparently smooth but microscopically with minute pores (ca 0.5 μm) loosely arranged spirally. Axial sculpture consisting only of faint growth lines. Abapical area with three to four very flattened, very faintly marked spiral cords. Aperture somewhat flaring. Outer lip orthocline, with a thin edge, distinctly thickened externally by a rim at a distance of the edge, smooth and not thickened inside. Inner lip forming a narrow rim in continuity with the peristome. Shell colour entirely white, translucent.

Remarks

This species is found in rather deep water around the seamounts, in large numbers, but was not collected alive. It is assigned to *Porosalvania* considering the microsculpture of minute pits aligned spirally and the orthocline outer lip, although the really smooth macroscopic appearance is also reminiscent of some *Gofasia* species. The most similar species is *P. diaphana* from Plato seamount, which differs in being definitely stouter and having some kind of axial sculpture. The name alludes to its superficial resemblance with many continental ground-water hydrobiids.

Genus ***Benthonella*** Dall, 1889

Type species. *Benthonella gaza* Dall, 1889, by original designation.

Benthonella tenella (Jeffreys, 1869)

Lacuna tenella Jeffreys 1869, p 204–205, Plate 101 Figure 7.

Type material

Holotype (sh.) cat. no. 185475 and two paratypes (sh.) cat. no. 186455, in the United States National Museum.

Type locality

North of the Hebrides, Great Britain.

Material examined

Gorringe—*Seamount 1* sta. CP30, 83 sh. (2.90 × 2.18 to 4.60 × 3.20 mm; figured in Bouchet and Warén 1993, p 699). Josephine—*Seamount 1* sta. CP50, 2 sh. (jv.). Meteor—*Seamount 2* sta. DW173, 1 sh. (4.10 × 2.52 mm). Hyères—*Seamount 2* sta. DW185, 368 sh. (3.20 × 2.20 to 4.68 × 2.90 mm); DW186, 36 sh. (3.56 × 2.26 to 4.22 × 2.64 mm); DW200, 5 sh. (2.96 × 2.12 to 4.60 × 3.40 mm); DW203, 12 sh. (9.94 × 1.90 to 4.06 × 2.68 mm). Irving—*Seamount 2* sta. DW208, 1 sh.; DW225, 4 spm. (3.90 × 2.35 to 4.50 × 2.95 mm) and 7 sh. Cruiser—*Seamount 2* sta. DW238, 1 sh.; Plato—*Seamount 2* sta. DW244, 14 sh. (3.54 × 2.32 to 4.06 × 2.78 mm); DW250, 42 sh. (2.30 × 1.64 to 4.14 × 2.90 mm). Tyro—*Seamount 2* sta. DW275, 4 sh. (3.70 × 2.30 to 4.56 × 2.70 mm).

Remarks

This is possibly the most widespread and common gastropod in the bathyal North Atlantic and the Mediterranean (Rex et al. 1979; Rex & Etter 1990; Bouchet & Warén 1993). Most specimens from the seamounts, like those collected around the Azores, are thin-shelled and ribbed and would correspond to subspecies *B. t. fischeri* Dall, 1889 if taxonomic recognition is given to this variation (see discussion in Bouchet & Warén 1993). In the lot from Plato seamount DW250 (1500 m), the smooth form (23 sh.) coexists with the ribbed one (19 sh.) without intermediates; there the smooth form is also smaller (maximum height 3.0 mm) and has more convex whorls, but has a similar protoconch. However, in this species where development is planktotrophic, the coexistence in sympatry of discrete morphs may be caused by the contribution of batches of larvae from different geographic origins, rather than reflect the existence of two different species. Therefore, this falls very short of invalidating the conclusion of Bouchet and Warén (1993) that a single species of *Benthonella* is involved in the North Atlantic.

Genus ***Benthonellania*** Lozouet, 1990

Type species. Benthonellania gofasi Lozouet, 1990, by original designation.

Benthonellania fayalensis (Watson, 1886)

(Figure 56)

Rissoa fayalensis Watson 1886, p 589, Plate 44 Figure 7.

Type material

Holotype (sh., 1.60 × 0.93 mm) from Challenger sta. 75, in BMNH (1897.2.9.1896).

Type locality

Off Fayal, Azores (38°38′N, 28°28.5′W, 819–910 m).

Material examined

Ampère—*Victor Hensen* VH97 sta. 97, 5 sh. (1.44 × 1.00 to 1.90 × 1.14 mm); sta. 104, 2 sh. (1.48 × 0.94 to 1.70 × 1.04 mm).

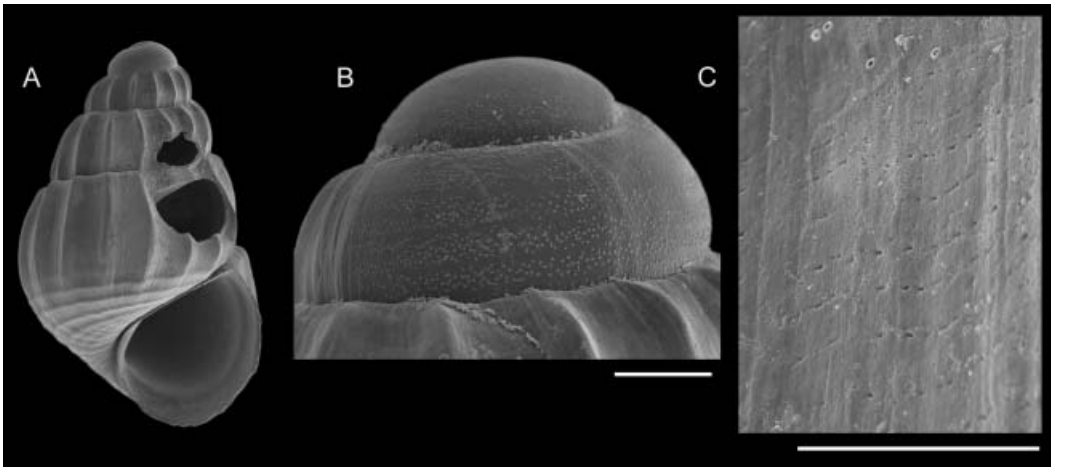

Figure 56. *Benthonellania fayalensis* (Watson, 1886). (A) Shell from Ampère bank, *Victor Hensen* sta. VH97/97 (800 m), actual size 1.90 mm; (B) protoconch of another shell, same locality; (C) detail of microsculpture, same as (A). Scale bars: 100 μm (B); 50 μm (C).

Remarks

The specimens collected on Ampère seamount agree well with the specimens from the type locality and nearby (see Bouchet and Warén 1993, p 680–681), so that this is the first unambiguous report of the species outside the Azores. The reservations expressed previously regarding the assignment to *Benthonellania* also apply here but, in the absence of data on the living animal the generic placement by Bouchet and Warén (1993) will be respected. The specimens from Ampère seamount and those from the Monaco station cited in Bouchet and Warén were examined under SEM for microsculpture. The former do not show a *Porosalvania* microsculpture, only very tenuous spiral lines of slit-like pores on some parts of the shells (Figure 56C), and the latter are too corroded by acidic glass to conserve any kind of microsculpture.

Genus *Amphirissoa* Dautzenberg and Fischer, 1897

Type species. Amphirissoa cyclostomoides Dautzenberg and Fischer, 1897.

Amphirissoa cyclostomoides Dautzenberg and Fischer, 1897

Amphirissoa cyclostomoides Dautzenberg and Fischer 1897, p 161, Plate 3 Figures 6–8.

Type material

Lectotype (Ponder 1985, p 72) in MOM, reported as destroyed by acidic glass tube (Bouchet and Warén 1993, p 696). Paralectotypes in MNHN (coll. H. Fischer), IRSN (coll. Dautzenberg) and BMNH.

Type locality

The Azores, off central group (39°11′N, 29°06′W, 1600 m).

Material examined

Cruiser—*Seamount 2* sta. DW237, 9 sh. (0.92 × 0.74 to 1.32 × 1.00 mm). Atlantis—*Seamount 2* sta. DW261, 2 sh. (1.30 × 1.04 to 1.34 × 1.06 mm); TS270, 1 spm. (0.78 × 0.72 mm) and 10 sh. (0.74 × 0.70 to 0.82 × 0.74 mm); DW274, 2 sh. (0.78 × 0.70 mm).

Remarks

This very characteristic species has been adequately described and figured by Dautzenberg and Fischer (1897), Ponder (1985), and Bouchet and Warén (1993). It was found only on Atlantis and on Cruiser seamounts, which may represent its southernmost limit. The specimen and shells found in the shallower part of Atlantis are tiny, less than 1 mm, although adult with the characteristic reflected outer lip, but those found in deeper water are of the normal size and the lot from DW237 shows a continuous range of sizes within these limits.

Subfamily RISSOININAE Stimpson, 1865

Genus *Rissoina* d'Orbigny, 1840

Type species. Rissoina inca d'Orbigny, 1840, by original designation.

Rissoina meteoris n. sp.
(Figures 57, 58)

Type material

Holotype MNHN 9728 (sh., 8.25 × 2.25 mm) and 10 paratypes MNHN 9786 (sh., 7.55 × 2.45 to 10.00 × 2.50 mm) from *Seamount 2* sta. DW152; 20 paratypes MNHN 9787 (3 spm., 5.50 × 7.50 to 7.15 × 2.00 mm, and 17 sh., 5.20 × 1.65 to 7.50 × 2.35 mm) from *Seamount 2* sta. DW136, in MNHN.

Type locality

Meteor seamount, 30°02.0′N, 28°22.1′W, 470 m.

Material examined

Meteor—*Seamount 2* sta. DW136 [includes paratypes], 9 spm. (5.50 × 1.50 mm, 6.25 × 1.90 mm, drawing SM166 7.15 × 2.00 mm)+44 sh. (5.20 × 1.65 to 7.50 × 2.35 mm); DW139, 6 sh. (6.15 × 1.87 to 6.80 × 1.95); DE140, 1 spm. (5.90 × 1.80 mm) and 32 sh. (5.40 × 1.85 to 7.70 × 2.40 mm); DW143, 4 spm. (5.25 × 1.60 to 6.90 × 2.00 mm) and 20 sh.; DW147, 1 spm. (9.85 × 2.70 mm); DW152 [includes types], 10 sh. (7.55 × 2.45 to 10.00 × 2.50 mm)+jv.; DE157, 3 sh. (5.50 × 1.75 to 6.65 × 1.92 mm); DE161, 1 spm. (7.00 × 1.85 mm) and 1 sh. (6.10 × 1.70 mm); DW167, 2 sh. (jv.); DE169, 6 spm.+4 sh. (6.80 × 1.95 to 5.80 × 1.80 mm); DW172, 1 spm. (9.25 × 2.65 mm) and 4 sh. (8.50 × 2.70 to 9.00 × 2.57 mm); Hyères—*Seamount 2* sta. DW188, 18 sh. (4.65 × 1.62 to 6.57 × 2.07 mm); DW189, 1 sh. (6.05 × 1.75 mm). Irving—*Seamount 2* sta. DW205, 3 sh. (5.65 × 1.87 to

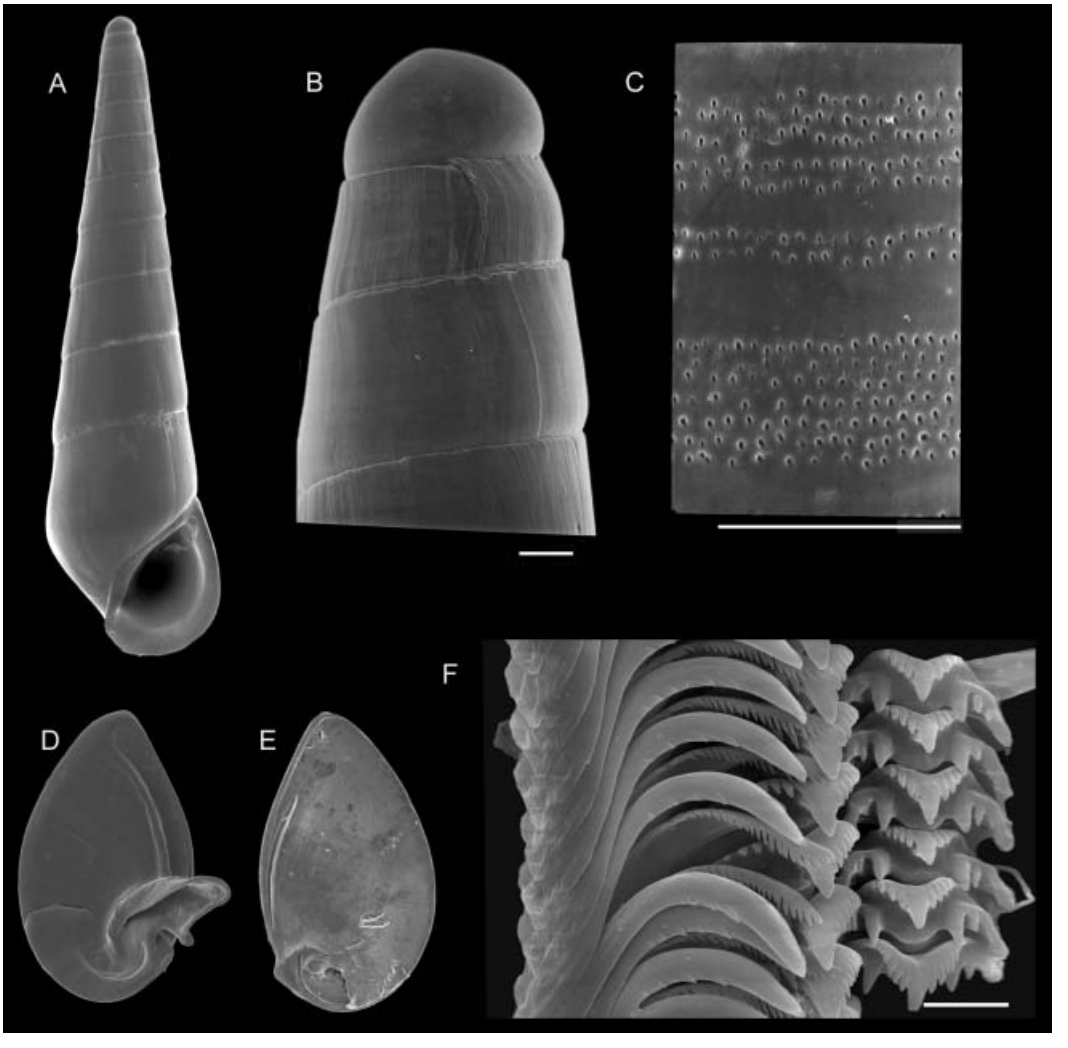

Figure 57. *Rissoina meteoris* n. sp. (A) Holotype (sh.) from Meteor seamount, DW152 (470 m), actual size 8.25 mm; (B) protoconch of a paratype, same locality; (C) microsculpture of teleoconch whorl; (D, E) operculum of another paratype from Meteor seamount, DW136 (305 m), actual size 1.1 mm; (F) partial view of the radula (laterals and marginals missing on the right), showing faint cusps developed on the upper part of outer marginals, same specimen as (D). Scale bars: 100 µm (B); 50 µm (C); 10 µm (F).

6.25 × 2.07 mm); DW209, 2 spm. (6.50 × 2.12 and 6.35 × 1.95 mm) and 2 sh. (6.20 × 1.95, 6.50 × 2.07 mm); DW217, 1 sh. (jv.); DW218, 1 sh. (7.40 × 2.07 mm).

Etymology

The species is named after Great Meteor seamount.

Description

Shell very slender, solid, up to 10.0 × 2.6 mm. Protoconch of 1.25 quite convex whorls, smooth. Teleoconch with ca 10 very flat whorls; body whorl with a blunt keel in

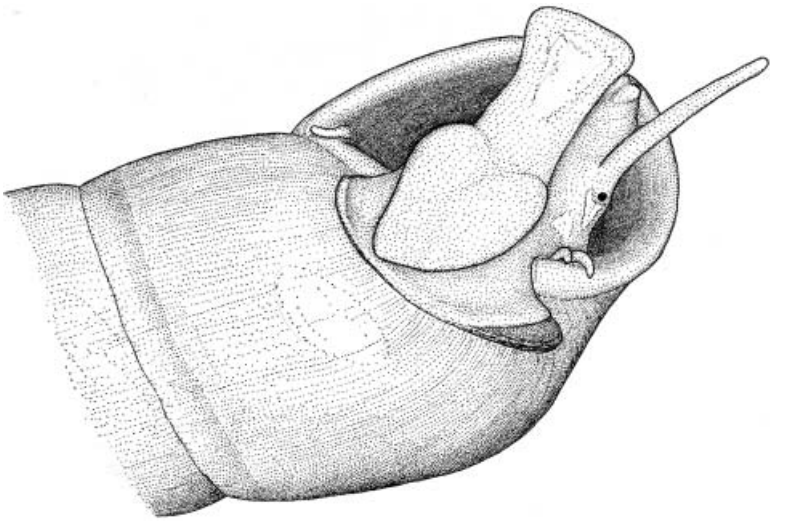

Figure 58. *Rissoina meteoris* n. sp., paratype (living specimen) from Meteor seamount, DW136 (305 m), actual size of complete shell 7.15 mm.

prolongation of the suture, then rather flattened abapically. Surface apparently smooth, with spiral bands bearing densely set, tiny punctures visible only under very high magnification. Aperture piriform, channelled at the insertion of outer lip on the previous whorl. Outer lip opisthocline, thickened but not demarcated from the body whorl, with rounded edge. Inside of outer lip slightly swollen near parietal insertion, and anteriorly making an angle with the columella. Inner lip thickened, appressed. Operculum (Figure 57D, E) thick, dark brown; outside with a sunken, submarginal nucleus and a faint ridge parallel to the columellar edge; inside with a distinct bifurcated and deeply grooved peg arising from near the nucleus.

Cephalic tentacles slender and tapering, with rounded tips. Eyes relatively small, embedded in a slight swelling at the base of each tentacle. Snout somewhat tapering, bilobed anteriorly, with tiny jaws visible by transparency, and anterior part tinged with pale brown. Large yellowish granular masses behind each eye. Sole of foot colourless with distinct triangular anterior pedal gland. No metapodial tentacle. Right pallial tentacle single, of moderate size, located on the adapical channel of the aperture; left pallial tentacle located near the abapical end of the columella, double.

Radula taenioglossate, ca 90 μm broad. Central teeth with a well-developed axial cusp flanked on each side by four to five smaller cusps decreasing in size. One distinct pair of basal denticles, and poorly developed U-shaped projection. Lateral margins of central teeth thickened, sloping at 45°, provided with some smaller additional basal denticles. Lateral teeth elongate, terminating in a broad triangular cusp which is serrated on the inner side facing the central tooth and smooth on the opposite side; denticulations also present on the inner part of the lateral teeth preceding the main triangular cusp. Marginals elongate and sickle-shaped. Inner marginals with ca 25 cusps on the upper part of the distal half, rather even in size. Outer marginals with ca 25 cusps on the distal one-third, facing towards the radular ribbon, and five to seven short, blunt cusps on their upper edge.

Remarks

The smooth surface with microscopic punctures would suggest allocation of this species in the genus *Zebina* H. and A. Adams, 1854, but several characters indicate that it is a *Rissoina* with a smooth shell. The generic placement is supported by the presence of an opercular peg, the bifurcated left pallial tentacle, and the angulation in the anterior part of the aperture. The presence of cusps on the upper edge of the outer marginals in the radula is more usual in *Rissoina* than in *Zebina* although they may exist in the latter. The presence of additional basal denticles on the central tooth is however not reported in *Zebina* (Ponder, 1985). Several species of *Zebina* living in the temperate and tropical Atlantic, all characterized by the tiny punctures in the apparently smooth shell surface (Gofas 1999), differ conchologically from *R. meteoris* in being considerably stouter, with a curved axis.

Genus *Schwartziella* Nevill, 1881

Type species. Rissoina orientalis Nevill, 1881 (=? *Rissoina triticea* Pease, 1861), by original designation.

Schwartziella peregrina n. sp.
(Figure 59)

Type material

Holotype MNHN 9727 (sh., 6.28 × 2.12 mm) and nine paratypes MNHN 9785 (sh., 5.90 × 2.10 to 6.60 × 2.40 mm) from *Seamount 2* sta. DW152, in MNHN.

Type locality

Meteor seamount, 30°02.0′N, 28°22.1′W, 470 m.

Material examined

Meteor—*Seamount 2* sta. DW136, 1 sh. (5.80 × 1.84 mm); DW143, 16 sh. (5.15 × 1.85 to 6.37 × 2.00 mm); DW152, the type material.

Etymology

From Latin *peregrinus*, a wanderer or pilgrim, alluding to the remote geographical origin.

Description

Shell very slender, solid, up to 6.6 × 2.4 mm. Protoconch of 1.5 quite convex whorls, smooth. Teleoconch with ca 7.5 quite convex whorls; body whorl rounded. Surface with strong, opisthocline, slightly flexuous axial ribs (ca 14 on the penultimate whorl), equivalent in size to the interspaces; and a complex spiral microsculpture of longitudinal slots which are offset along the growth lines. Aperture piriform, channelled at both ends. Outer lip opisthocline, strongly thickened externally, inside smooth, with a sharp edge. Inner lip slightly thickened, appressed.

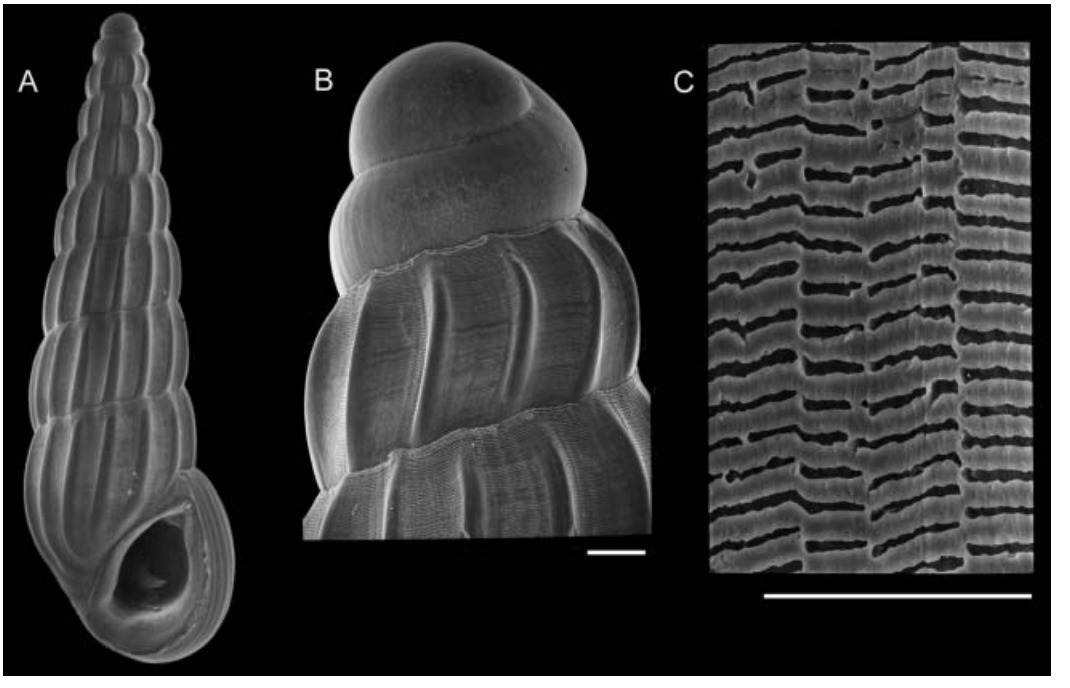

Figure 59. *Schwartziella peregrina* n. sp. (A) Holotype (sh.) from Meteor seamount, DW152 (470 m), actual size 6.28 mm; (B) protoconch of a paratype, same locality; (C) microsculpture of teleoconch whorl. Scale bars: 100 μm (B); 50 μm (C).

Remarks

There are many species of *Schwartziella* in the Cape Verde Islands (see Rolán and Luque 2000) and a few on the mainland of West Africa (see Gofas 1999), but *S. peregrina* differs in being much more slender than any of them.

Discussion

Species richness and levels of endemism

On the northeast Atlantic seamounts, the Rissoidae have the highest species richness of all molluscan families, with 48 species in total (24 on the Lusitanian seamounts and 26 on the Meteor group).

The species richness does not decrease with increasing distance to the mainland, the highest local richness being on Hyères seamount in the Meteor group with 17 species. This is in the order of magnitude of 10% of the total molluscan species richness in less than 500 m depth, estimated (S. Gofas, unpublished data) from preliminary sorting of material from the *Seamount* cruises to >242 species in the Lusitanian area and to >182 species in the Meteor group; these figures are minimal estimates as most unidentified (i.e. all undescribed) species are not included. The total species richness of molluscs on Seine seamount is estimated to be 269 species by Beck et al. (2006), including species not identified further than to genus or family. All these figures may seem low, but must be qualified by the consideration that seamount biota are generally species-poor compared to the mainland and to large archipelagos: as a point of comparison, Wilson and Kaufmann

(1987) reported only 596 invertebrate species for all phyla and all world seamounts studied to that time.

The similarity between the composition of the rissoid assemblage on the different seamounts included in this study is shown in Figure 60. There is virtually no overlap between the assemblages found on both groups of seamounts, the only shared species being the widespread *Benthonella tenella* and, surprisingly, the rare *Pusillina harpula*.

On the Lusitanian seamounts (Table I), seven of the species (nearly one-third) are also known from the mainland shelf or slope. The species shared with the mainland shelf are *Alvania cimicoides* on all four seamounts, *A. cancellata* on Gorringe, Ampère and Seine, *Alvania zylensis* and *A. punctura* on Gorringe and Ampère, *Rissoa lilacina* on Ampère only, and *Alvania vermaasi* on Gorringe only. Furthermore, the widespread bathyal species *Benthonella tenella* was found on the slopes of Gorringe and Josephine seamounts (not sampled on Seine and Ampère).

Of the species shared with the mainland and having a planktotrophic development, only two are represented by somewhat higher numbers and collected alive. These are *Alvania cimicoides* and *A. zylensis*, which normally live deeper than 100 m and therefore may find a sufficient extension of their habitat on the seamounts to form permanent populations. The higher proportion of shared mainland species between Gorringe and Ampère (resulting in a higher similarity index; Figure 60) may reflect the presence of a photic zone, which allows for the occasional settlement of species which lack a suitable habitat on the deeper plateaus of Seine and Josephine. The extension of the photic community is, however, so limited that the permanence of these populations remains uncertain.

The bulk of the rissoid population on the Lusitanian seamounts belongs to species which are not shared with the mainland, thus either endemic to these seamounts as a whole (11 species), shared with the Meteor group (*Pusillina harpula*), shared with Galicia Bank (*Gofasia galiciae* and *Pseudosetia amydralox*), or shared with islands in the Macaronesian archipelagos (*Alvania microstriata*, *Gofasia vanderlandi*, '*Benthonellania*' *fayalensis*). The endemic species are essentially distributed on the large upper platforms of the seamounts, in a depth interval between 160/200 and 500 m. Nevertheless, only *Pseudosetia amydralox* is

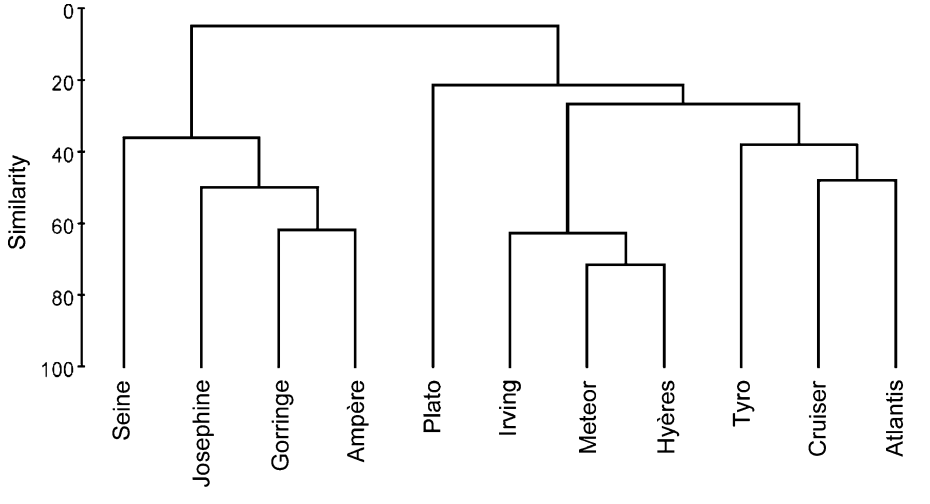

Figure 60. Dendrogram representing similarity between the rissoid assemblages on seamounts of the northeast Atlantic, using a Bray-Curtis similarity index based on presence/absence data.

Table I. Distribution of rissoid species on the Lusitanian seamounts.

	Mainland	Galicia Bank	Canaries/ Madeira	Meteor group	Azores	Gorringe	Josephine	Ampere	Seine
Rissoa lilacina Récluz, 1844	**c**							+	
Pusillina (Vicinirissoa) harpula n. sp.				**r**			+	+	
Alvania cancellata (da Costa, 1778)	**cc**		**cc**		**cc**	+		+	+
Alvania cimicoides (Forbes, 1844)	**c**	**c**				+	+	+	+
Alvania zylensis Gofas and Warén, 1982	**c**					+		+	
Alvania punctura (Montagu, 1803)	**c**					+		+	
Alvania vermaasi van Aartsen, 1975	**c**					+			
Alvania adinogramma Bouchet and Warén, 1993						+	+		
Alvania microstriata Hoenselaar and Goud, 1998			**r**						+
Alvania seinensis n. sp.									+
Pseudosetia amydralox Bouchet and Warén, 1993		**c**				++	++	++	+
Crisilla ovulum n. sp.							++		+++
Manzonia lusitanica n. sp.						+			
Manzonia taeniata n. sp.						+			
Manzonia arata n. sp.								+	
Manzonia geometrica n. sp.								+	+
Manzonia fusulus n. sp.						+			
Gofasia josephinae Bouchet and Warén, 1993						++	++	+++	
Gofasia vanderlandi Bouchet and Warén, 1993			**r**					+	
Gofasia vinyllina n. sp.							++		
Gofasia galiciae Bouchet and Warén, 1982							+	+	
Gofasia tenuicula n. sp.						+	+	+	
Benthonella tenella (Jeffreys, 1869)	cc	c	c	c	c	+	+		
Benthonellania fayalensis (Watson, 1886)					r			+	
Total number of species on seamount						13	10	14	7
Total number of species (<500 m)						12	8	12	7

Abundances on the seamounts are based on the material examined herein and noted by: +, less than 100 specimens or shells; ++, 100–500; +++, more than 500. Abundances elsewhere based on literature data and noted by: cc, common or very common; c, moderately common in appropriate habitat; r, rare. Boldface denotes species with their main range on the seamounts in less than 500 m depth.

found on all four seamounts with a shallow summit, whereas the endemics are found on only one, two, or three seamounts (or, in the case of *Gofasia vanderlandi* and *Alvania microstriata*, on one seamount and one neighbouring island). Six species are endemic to a single seamount, among which four are *Manzonia* (*M. taeniata*, *M. lusitanica*, and *M. fusulus* on Gorringe, *M. arata* on Ampère). *Alvania seinensis* is very similar to the sympatric *A. microstriata* but the latter lives deeper and is shared with the island of Madeira.

Three species (*Gofasia josephinae*, *G. vinyllina*, and *Crisilla ovulum*) account for 75% of the total rissoid catch on the Lusitanian seamounts. One of these species always outnumbers the others but the prevalent species varies from place to place: it is *G. josephinae* on Gorringe and Ampère, *G. vinyllina* on Josephine, and *C. ovulum* on Seine seamount.

The overall circulation of superficial waters flows from the seamounts to the Ibero-Moroccan Gulf and to the Canaries, and the distances separating the closest seamounts (Gorringe and Ampère) from the coast are not more considerable than the distances between seamounts. Therefore the absence of all these species along the mainland probably reflects profound differences in the habitat, and the prevalence of coarse bioclastic gravels and hard bottom over soft bottoms, rather than an effect of the distance. There remains the possibility that the seamount species may be found on deep hard bottoms near the mainland, e.g. the Spartel banks in the Straits of Gibraltar, but such bottoms remain hitherto very poorly sampled.

The 11 endemic species of Rissoidae contribute most of the endemic component of the molluscan fauna on the Lusitanian seamounts. In the preliminary listings made after *Seamount 1* cruise, the number of suspected endemic species was less than 10% of the total. Endemic species belonging to other families include an undescribed species of *Sukasitrochus* (Scissurellidae, see Beck et al. 2006, p 44), the trochid *Clelandella dautzenbergi* Gofas, 2005, and the neogastropods *Marginella coloborum* Bozzetti, 1995 and *Microvoluta superstes* Bouchet and Warén, 1985, also common species on the seamounts.

On the Meteor group of seamounts (Table II), the only rissoid species shared with the mainland is the only one with a planktotrophic development, namely *Benthonella tenella*. Among the other species, a definite bathymetric zonation can be seen. A first group of 'shallow' species is distributed on the upper part (mostly less than 500 m) of one or more of the four seamounts (Meteor, Hyères, Irving, and Atlantis) with an upper plateau around 300 m depth, and is absent on the three deeper seamounts (Cruiser, Plato, and Tyro) sampled during *Seamount 2* cruise. This assemblage includes *Pusillina fuscapex*, most of the *Alvania* species (*A. micropilosa*, *A. elenae*, *A. hyerensis*, *A. suroiti*, *A. microtuberculata*, *A. adiaphoros*), *Porosalvania solidula* and *P. angulifera*, *Gofasia atlantidis* and *G. obtusellaeformis*, and the two Rissoininae (*Rissoina meteoris* and *Schwartziella peregrina*). A distinct deeper group, with little overlap despite the physiography which is prone to downslope transport, includes *Alvania funiculata*, *A. stenolopha*, and *A. macella*, all the remaining *Porosalvania* species (*P. decipiens*, *P. vixplicata*, *P. semisculpta*, *P. diaphana*, *P. profundior*, *P. hydrobiaeformis*), and *Benthonella tenella*. *Pseudosetia azorica* and the rare *Pusillina harpula* and *Amphirissoa cyclostomoides* are ambiguous in this respect, being found on the plateau of Atlantis seamount but deeper on Cruiser seamount. This zonation could not be assessed on the Lusitanian seamounts, because the sampling was concentrated on the upper area.

Among the 'shallow' species in the Meteor group, *Alvania adiaphoros* was found on all four seamounts with a shallow plateau, and also in the Azores from where it was described. *Pseudosetia azorica* was found on Meteor, Hyères, and Atlantis but not on the Irving plateau and is unexpectedly present in deeper water on Cruiser, an inconsistent distribution which may indicate that more than one species is involved. *Pusillina harpula* was found on three

Table II. Distribution of rissoid species on the Meteor group seamounts.

	Mainland	Azores	Meteor	Hyeres	Irving	Cruiser	Plato	Atlantis	Tyro
Pusillina (Pusillina) fuscapex n. sp.			+	+++				+++	
Pusillina (Vicinirissoa) harpula n. sp.				+		+		+	
Alvania micropilosa n. sp.			+++	+	+				
Alvania elenae n. sp.			+++	+	+				
Alvania hyerensis n. sp.				++					
Alvania suroiti n. sp.			++	++					
Alvania microtuberculata n. sp.								+++	
Alvania adiaphoros Bouchet and Warén, 1993		**r**	++	+++	**?**			+++	
Alvania funiculata n. sp.				++		++		+	+++
Alvania stenolopha Bouchet and Warén, 1993		r		+				+	
Alvania macella n. sp.								++	
Pseudosetia azorica Bouchet and Warén, 1993		**r**	+	++		+		++	
Gofasia atlantidis n. sp.								+++	
Gofasia obtusellaeformis n. sp.								+++	
Porosalvania solidula n. sp.			+++	+++	+				
Porosalvania angulifera n. sp.			+	**?**					
Porosalvania decipiens n. sp.				++					
Porosalvania vixplicata n. sp.								+	
Porosalvania semisculpta n. sp.					+	++	+	+	
Porosalvania diaphana n. sp.							+		
Porosalvania profundior n. sp.				++	+	+		+++	+++
Porosalvania hydrobiaeformis n. sp.				+			++	++	++
Benthonella tenella (Jeffreys, 1869)	cc	cc	+	++	+	+	+		+
Amphirissoa cyclostomoides Dautzenberg and Fischer, 1897		r				+		+	
Rissoina meteoris n. sp.			++	+	+				
Schwartziella peregrina n. sp.			+						
Total number of species on seamount			11	17	8	7	4	15	4
Total number of species (<500 m)			10	11	5	0	0	7	0

Abundances on the seamounts are based on the material examined herein and noted by: +, less than 100 specimens or shells; ++, 100–500; +++, more than 500. Abundances elsewhere based on literature data and noted by: cc, common or very common; c, moderately common in appropriate habitat; r, rare. Boldface denotes species with their main range on the seamounts in less than 500 m depth.

seamounts of the group and is shared with the distant Lusitanian seamounts. All the other species were hitherto undescribed and are endemic to the Meteor group as a whole. As in the Lusitanian group, most of them are found on only one, two, or three seamounts. Five species (*Alvania hyerensis*, *A. microtuberculata*, *Gofasia atlantidis*, *G. obtusellaeformis*, *Schwartziella peregrina*) are endemic to only one of the seamounts, and of these three are concentrated on Atlantis seamount. The higher similarity between Meteor, Hyères, and Irving is consistent with the occurrence of several shared species, whereas Atlantis seamount stands apart with the three endemic species. The similarity index of Meteor and Hyères with Irving is lower when quantitative data are considered, because most shared species (*Alvania micropilosa*, *A. elenae*, *A. adiaphoros*, *Porosalvania solidula*, *Rissoina meteoris*) are much more rare on Irving.

When considering only the deeper species, there is less difference between Hyères, Cruiser, and Atlantis seamounts, whereas Meteor appears poorly sampled. Most of the deeper species are found on several seamounts, but two (*Alvania macella* and *Porosalvania vixplicata*) are endemic to Atlantis seamount, one (*P. diaphana*) is endemic to Plato, and one (*P. decipiens*) to Hyères.

The 20 rissoid species (12 species in the depth interval less than 500 m) endemic to the Meteor group represent here also in the order of 10% of the total species richness. Contrary to the Lusitanian seamounts, they are a minority in the overall endemic component, which is much more important and was estimated to be one-third of the species (i.e. ca 60 species) in the preliminary species counts for less than 500 m depth. Other groups contributing to this endemic component are the Trochoidea (Vilvens & Swinnen 2003; Gofas 2005; and more undescribed species); the Triphoroidea (10 species in the genus *Trituba* revised by Gofas 2003; and undescribed Cerithiopsidae and Triphoridae), the Epitoniidae and Conidae (an estimated 10 species each, pending study), Pyramidellidae (21 species, of which eight shallower than 500 m; Peñas & Rolán 1999), Pectinidae (three species, Dijkstra & Gofas 2004), Mytilidae (three species of *Dacrydium*; Salas & Gofas 1997), and some 10 more undescribed species scattered in different families.

Events of colonization and inter-seamount speciation

The species found on the seamounts can be partitioned into those which colonized one group of seamounts as an already differentiated species, and those which are the result of speciation events occurring between seamounts, after the initial arrival of founder populations. Although ideally this should be evaluated in the frame of a broader phylogenetic hypothesis, some figures can be bracketed using the empirically assumed relationships between some groups of seamount and mainland species.

On the Lusitanian seamounts, all species shared with the mainland or those which are more similar to an alien species than to other species in the same seamount group can be hypothesized to constitute colonization units. These are (1–7) the seven mainland species, (8) *Pseudosetia amydralox* (very similar to the mainland *P. turgida*), (9) *Pseudosetia harpula* (shared with Meteor group), (10) *Benthonellania fayalensis* (shared with the Azores), and (11) *Crisilla ovulum*.

The genus *Manzonia* includes four of the six species endemic to one single seamount, and among these three (*M. lusitanica*, *M. taeniata*, and *M. arata*) are more similar to each other and to the Madeiran *Manzonia crispa*, than to any other *Manzonia* species. It is plausible that this similarity reflects a single colonization (12) and a relatively recent allopatric differentiation between seamounts. The other two species of *Manzonia* (*M. fusulus*, resembling the Canarian

M. manzoniana, and *M. geometrica* with unique morphology) are best interpreted as resulting from separate colonization events (13, 14). The species in the group of *Alvania adinogramma* (with *A. microstriata* and *A. seinensis*) probably result from a single colonization event (15). Three species of *Gofasia* (*G. josephinae*, *G. vanderlandi*, *G. vinyllina*) also could have originated from a single colonization of the Lusitanian group (16), whereas this is less likely for *G. tenuicula* and *G. galiciae* (17, 18).

Therefore the total number of 24 species boils down to a low number of colonization events, between 12 (the most conservative estimate, counting every species shared with or similar to the mainland, and assuming one event for every genus of the endemic component) and 18 (the hypothesis above).

Although there are data on the age of the seamounts, it seems unreasonable to translate this into rates of colonization because there are few clues to the time of resilience of a given species, or to the rate of turnover in the composition of the assemblage. The oldest seamount in the Lusitanian area (Gorringe) is also the closest to the mainland, so that this may obscure the trend of age-driven species richness, if any.

Regarding the Meteor group seamounts, the most parsimonious hypothesis for colonization events would consider as putative local radiations all groups of species included within the same genus or subgenus and sharing a particular protoconch morphology. This leads to hypothesizing only 10 separate colonization events, less than for the Lusitanian seamounts: (1) *Pusillina fuscapex*, (2) *Pusillina harpula*, (3) *Alvania micropilosa*, *A. elenae*, *A. hyerensis*, and *A. microtuberculata*, which share a protoconch sculpture comparable to that seen on the protoconch 1 of the mainland *Alvania cancellata* (see Figure 5B), (4) *Alvania adiaphoros* and *A. funiculata*, (5) *Alvania suroiti*, (6) *Alvania stenolopha*, *A. macella*, and *Pseudosetia azorica*, and (7–10) the genera *Gofasia*, *Porosalvania*, *Rissoina*, and *Schwartziella*, respectively. The species here included in *Porosalvania* have very different shapes and occupy discrete bathymetric intervals, but show an array of forms which can plausibly be derived from each other. Their present diversity parallels that of the triphoroid *Trituba* (Gofas 2003) with a high proportion of one-seamount endemism and probably only one colonization event at the stem of the whole radiation. In the case of *Trituba*, the extinction of the genus on the European mainland shelf in the Miocene constrains the age of the colonization to ca 20 million years ago; there is no such reference for *Porosalvania* but the diversity achieved suggests that this is also an old member of the seamount fauna.

There is further differentiation between seamounts which has not been given taxonomic recognition at the species level but brings evidence for some degree of isolation and possibly incipient allopatric speciation. In the Lusitanian seamounts, *Alvania adinogramma* from Gorringe can be recognized from those collected on Josephine, whereas this species-group is represented on Seine by the stouter form given species-status as *A. seinensis*. *Gofasia vanderlandi* from Ampère differs markedly from the supposedly conspecific population of the type locality in the Canaries. In the Meteor group, the observation of more or less recognizable differences is the rule in all the species which were found on more than one seamount, and are particularly obvious in *Pusillina fuscapex*, *Alvania elenae*, *A. suroiti*, *A. adiaphoros*, and *Pseudosetia azorica*. However, it is assumed that the figures for species richness could not vary more than 10% due to issues of taxonomic opinion.

Success of dispersal and relation to the mode of larval development

With the exception of *Alvania vermaasi*, all the species shared with the mainland in the Lusitanian seamounts have a multispiral larval shell denoting planktotrophic development;

Alvania cancellata has proved its capability for relatively long-distance dispersal with its widespread occurrence in the Canaries, Madeira, and the Azores (Gofas 1990). However, these species are not doing well on the seamounts: the number of individuals amounts only to 177 out of nearly 5000 collected in total. Therefore, most of these occurrences may represent occasional settlements which do not produce stable populations.

The species endemic to the Lusitanian seamounts, and among them the successful ones, all have a paucispiral protoconch denoting non-planktotrophic development (i.e. short larval pelagic stage if any, and poor ability for dispersal). It is understood that there is an advantage to minimize dispersal on such small 'islands', where a large proportion of pelagic larvae would drift away and get lost, thus reducing adults to extremely small numbers (see Rogers 1994, p 332). Most species with this type of larval dispersal fail to colonize successfully all four Lusitanian seamounts, which indicates that the distances in the order of magnitude of 200 km separating the seamounts are critical as barriers to their dispersal. The presence of a competing, well-established species may also be a limiting factor to the settlement of newcomers: it is possible that *Gofasia josephinae* never reached Seine seamount, but alternately it may have failed to settle there because of the existence of a competing species *Crisilla ovulum*. Nevertheless, if dispersal events were commonplace, it would be expected to find all the species from a given depth interval coexisting in variable proportions on all four seamounts with a shallow summit.

In the Meteor group, all the species except *Benthonella tenella* have a protoconch morphology indicating direct development. This situation reflects the deficit in species with medium-lived planktonic larval stages, which was already noted by Parker and Tunnicliffe (1994, p 342) for the biota of Cobb seamount in the Pacific Ocean. Whereas species with long-lived, teleplanic larvae [e.g. Ranellidae and Bursidae (Gofas & Beu 2003); Coralliophilinae (Oliverio & Gofas 2006)] are more plentiful than usual on the Meteor group seamounts, the other successful pattern is direct development. Intermediate patterns, as exemplified by the planktotrophic rissoids, would enable the larvae to drift away from the seamounts but yet would not enable them to cover routinely the trans-oceanic distances. In contrast to the observation on the seamounts, more than half of the species in the rissoid assemblage from West Africa (11 species out of 18) have a multispiral protoconch denoting planktotrophic development (Gofas 1999).

The differences in distribution, between species endemic to one seamount and those ranging through several seamounts in the group, are not correlated with observable differences in protoconch morphology. Different performances between species may reflect other aspects of their reproductive biology, including fecundity and mode of fixation of the egg capsules. Adult size may be a key factor for the ability for dispersal in the absence of planktonic stages. Very small molluscs, in the order of magnitude of 1 mm size, may drift in suspension, possibly with the help of a mucous thread. A specimen of the small benthic skeneine *Anekes paucistriata* Warén, 1992, common on the seamounts, was collected in a plankton tow above Gorringe bank during *Seamount 1* cruise (Warén 1992, p 166). This kind of dispersal may explain the otherwise surprising shared occurrence of *Pusillina harpula* on both seamount groups, and be a factor in the dispersal of small, common species such as *Gofasia* spp. (particularly the small *G. tenuicula* which is rare but widespread) or *Crisilla ovulum*.

A final view

In conclusion, the rissoid assemblage on the northeast Atlantic seamounts makes up an important part of a species-poor but original fauna. This good representation of the family

in the total fauna parallels that of the Macaronesian archipelagos, and supports the view (Wilson & Kaufmann 1987; Rogers 1994) that seamount faunas are essentially similar to the shelf fauna of the nearest surrounding areas.

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Appendix 1. Coordinates and depth of the collecting localities

Station no.	Coordinates	Depth (m)	Comments
Gorringe seamount			
DW04 (3)	36°32′N, 11°34′W	93–96	Rocks, bioclastic debris and rhodoliths
DW05 (5)	36°32′N, 11°38′W	180	Bioclastic debris
DW06 (3)	36°30′N, 11°38′W	250	Bioclastic sand with ophiurids
DW08 (6)	36°28′N, 11°37′W	470–485	Coarse bioclastic sand and hard-ground
DE09 (4)	36°31′N, 11°38′W	350–360	Bioclastic sand
DE10 (1)	36°27′N, 11°35′W	500–545	Bioclastic sand
CP12 (3)	36°24′N, 11°43′W	1005–1040	
DW15 (4)	36°33′N, 11°29′W	300–330	Bioclastic sand and gravel; gorgonians
DW16 (9)	36°31′N, 11°32′W	255–265	Coarse bioclastic sand with bryozoans and sponges
FA18 (1)	36°30′N, 11°36′W	90–130	
CP20 (7)	36°34′N, 11°30′W	305–320	
DW21 (1)	36°35′N, 11°28′W	460–480	Rocks, bioclasts and abundant sponges
CP28 (1)	36°38′N, 11°30′W	605–675	
CP30 (2)	36°44′N, 11°23′W	1940–2075	
DW33 (1)	36°31′N, 11°34′W	55–70	Rocks and algae
Josephine seamount			
DW38 (4)	36°41′N, 14°17′W	235–245	Bioclastic gravel with *Limopsis*
DE39 (3)	36°40′N, 14°16′W	207–222	Bioclastic gravel with *Limopsis*
DW41 (1)	36°40′N, 14°15′W	200	Bioclastic sand and gravel with *limopsis*
DW43 (5)	36°45′N, 14°17′W	260–285	Rocks with epifauna, bioclastic sands with ophiurids
DW45 (6)	36°46′N, 14°17′W	315–335	Rocks and bioclastic gravel
DW58 (1)	36°46′N, 14°20′W	340–380	Rocks with sponges
DW60 (3)	36°43′N, 14°17′W	240–255	Sandstone, bioclastic gravel with *Limopsis*
DW61 (6)	36°40′N, 14°16′W	200–205	Bioclastic gravel with bryozoans, gorgonians, *Limopsis*
Seine seamount			
DE71 (2)	33°44′N, 14°21′W	182–190	Bioclastic gravel with *Limopsis*
DE72 (5)	33°45′N, 14°21′W	165	Bioclastic sand
DE73 (2)	33°45′N, 14°24′W	165	Bioclastic sand and rhodoliths
CP79 (1)	33°49′N, 14°23′W	242–260	
DE80 (3)	33°48′N, 14°23′W	250–256	Bioclastic sand
DE82 (2)	33°48′N, 14°24′W	320–400	Bioclastic gravel with fragments of brachiopods
DE84 (1)	33°48′N, 14°24′W	450–455	Rocks
Ampère seamount			
DW92 (3)	35°03′N, 12°53′W	117–129	Coarse bioclastic sand with rhodoliths
DE95 (6)	35°05′N, 12°55′W	197–210	Bioclastic sand
DE98 (10)	35°03′N, 12°55′W	300–325	Bioclastic sand
CP99 (6)	35°04′N, 12°55′W	225–280	
VH97/94 (2)	35°03.34′N, 12°55.03′W	204	Bioclastic sand and gravel
VH97/97 (7)	35°03.55′N, 13°00.27′W	800	Pteropod and foraminiferal sand
VH97/102 (2)	35°03.29′N, 12°54.18′W	149	Bioclastic sand with rhodoliths
VH97/103 (3)	35°03.19′N, 12°54.42′W	164	
VH97/104 (2)	35°01.52′N, 12°57.02W	751	
VH97/296 (4)	35°01.70′N, 12°52.98′W	130	Bioclastic sand with *Miniacina*
VH97/298 (4)	35°03.97′N, 12°53.20W	110	Bioclastic sand

Great Meteor seamount			
DW136 (5)	30°01.5′N, 28°28.3′W	305	Bioclastic sand
DE140 (5)	30°01.1′N, 28°27.7′W	308	Bioclastic sand
DW143 (9)	30°09.9′N, 28°28.1′W	330	Bioclastic sand
DW147 (1)	30°11.2′N, 28°27.1′W	340	Bioclastic sand with sponges
DW148 (1)	30°12.0′N, 28°24.6′W	615	Pteropod ooze
DW152 (10)	30°02.0′N, 28°22.1′W	470	Coarse bioclastic sand with sponges
CP157 (2)	29°56.2′N, 28°31.8′W	290	Bioclastic sand
DE161 (1)	29°40.2′N, 28°27.0′W	290	Bioclastic sand
TS163 (1)	29°40.2′N, 28°26.0′W	290	
DW167 (1)	30°04.6′N, 28°42.1′W	520	Pteropod ooze with *Flabellum* corals
DW172 (1)	30°05.1′N, 28°41.5′W	455	Fine bioclastic sand with hard-ground
DW173 (2)	30°03.5′N, 28°43.6′W	920	Coarse bioclastic sand with oxide crusts
DE174 (1)	30°02.4′N, 28°42.7′W	620	Fragments of hardened bioclastic sediment
DW179 (2)	30°00.6′N, 28°42.3′W	730	Bioclastic sand with hard-ground
Hyères seamount			
DW182 (8)	31°23.2′N, 28°53.5′W	480	Bioclastic sand with abundant sponges
DW188 (8)	31°30.0′N, 28°59.5′W	310	Bioclastic sand and gravel with abundant sponges
DW189 (1)	31°30.3′N, 28°59.2′W	290	Bioclastic clean sand
DW192 (2)	31°27.9′N, 28°59.1′W	750	Bioclastic sand with few sponges
DW200 (4)	31°19.1′N, 28°36.0′W	1060	Bioclastic sand with cirripeds and styilasterids, oxide crusts
DW203 (6)	31°09.5′N, 28°43.5′W	845	Bioclastic sand with cirripeds and styilasterids, oxide crusts
Irving seamount			
DW205 (1)	32°01.1′N, 27°57.2′W	348	Bioclastic sand
DW208 (6)	32°03.9′N, 27°53.9′W	790	Pteropod and foraminiferal ooze
DW209 (3)	31°59.2′N, 27°55.9′W	460	Bioclastic sand with abundant sponges
DW215 (2)	31°53.6′N, 28°02.9′W	275	Bioclastic sand with abundant sponges
DW217 (1)	31°53.5′N, 28°03.1′W	270	Bioclastic sand with abundant sponges
DW218 (1)	31°52.3′N, 28°03.6′W	480	Hardground
DW225 (2)	32°08.6′N, 28°10.7′W	1035	Hardground with some pteropod ooze
Cruiser seamount			
DW237 (5)	32°15.9′N, 27°31.8′W	670	Bioclastic gravel with large sponges
DW238 (4)	32°17.3′N, 27°32.3′W	890	Pteropod and foraminiferal ooze
Plato seamount			
DW242 (2)	33°11.8′N, 28°57.0′W	710	Coarse bioclastic sand with corals
DW250 (1)	33°12.6′N, 29°17.2′W	1500	Fragments of dead corals
Atlantis seamount			
DW255 (7)	34°04.9′N, 30°15.3′W	340	Bioclastic sand with sponges
DW258 (6)	33°59.8′N, 30°12.1′W	420	Bioclastic gravel with *Limopsis*
DW261 (6)	34°22.4′N, 30°27.8′W	1340	Coarse bioclastic gravel with cirriped and coral debris
DW263 (3)	34°25.9′N, 30°32.5′W	610	Bioclastic gravel with corals and sponges
TS270 (6)	34°04.8′N, 30°14.9′W	330	
DW274 (6)	34°05.1′N, 30°13.6′W	280	Bioclastic sand with large sponges, hard-ground

Tyro seamount			
DW275 (1)	34°03.5′N, 28°18.1′W	1665	Bioclastic gravel with coral debris, fragments of limestone
DW278 (2)	33°57.8′N, 28°22.4′W	890	Bioclastic sand with corals; a few dropstones

The number in brackets after station number indicates the number of rissoid species found in the haul.