Annales de Paléontologie 105 (2019) 39–44

Disponible en ligne sur
ScienceDirect
www.sciencedirect.com

Elsevier Masson France
EM|consulte
www.em-consulte.com

Original article

Tindaria kretensis n. sp., a new deep water protobranch (Bivalvia) from the Early Pliocene of Crete (Southern Greece)

Tindaria kretensis *n. sp., une nouvelle espèce de protobranche (Bivalvia) d'eaux profondes du Pliocène Inférieur de Crète (Grèce méridionale)*

Efterpi Koskeridou[a,*], Rafael La Perna[b], Christina Giamali[c]

[a] *National and Kapodistrian University of Athens, Faculty of Geology and Geoenvironment, Department of Historical Geology - Paleontology, Panepistimioupoli Zographou, 15784 Athens, Greece*
[b] *Dipartimento di Scienze della Terra e Geoambientali, Università di Bari, Via E. Orabona 4, 70125 Bari, Italy*
[c] *Goulandris Natural History Museum, Levidou 13, 14562, Kifissia, Greece*

ARTICLE INFO

Article history:
Received 4 September 2018
Accepted 25 October 2018
Available online 19 December 2018

Keywords:
Nuculanoidea
Eastern Mediterranean
Deep-water molluscs
Systematics
Palaeoceanography

ABSTRACT

Tindaria kretensis n. sp., a minute deep-water protobranch, is described from Early Pliocene marls cropping out in the Voutes section, northern Crete Island. This is one of the few fossil records of *Tindaria* from the Mediterranean area, the first well documented for the Neogene. *Tindaria* is an almost cosmopolitan deep-water genus, absent from the modern Mediterranean. Its occurrence in the Early Pliocene is in agreement with what is known about the past psychrospheric conditions in the Mediterranean.

Mots clés :
Nuculanoidea
Méditerranée orientale
Mollusques d'eaux profondes
Systématique
Paléo-océanographie

RÉSUMÉ

Tindaria kretensis n. sp., une petite espèce de protobranche, est décrite. Elle provient de marnes du Pliocène Inférieur de la section Voutes, au nord de l'île de Crète. Il s'agit d'une occurrence rare de *Tindaria* en Méditerranée, et c'est la première fois qu'elle est aussi bien documentée dans le Néogène. *Tindaria* est un genre d'eaux profondes quasiment cosmopolite, absent de la Méditerranée actuelle. Sa présence dans le Pliocène Inférieur et en accord avec ce qui est connu sur les conditions psychrosphériques passées de la Méditerranée.

1. Introduction

Protobranchs are the most diverse and broadly distributed group of bivalves in deep waters, but they are also among the poorest and complex known molluscan groups (Allen and Sanders, 1996a; Zardus, 2002; Etter et al., 2011; Sharma et al., 2013).

Tindaria Bellardi, 1875, in the monotypic family Tindariidae Verrill and Bush, 1897, is a deep water protobranch genus, for which about 30 living species are known, outlining an almost cosmopolitan distribution (Huber, 2010; MolluscaBase, 2018). Some species are known from Eastern Atlantic and European seas, excluding the Mediterranean (Janssen and Krylova, 2014): *Tindaria callistiformis* Verrill and Bush, 1897, *T. derjugini* Gorbunov, 1946, *T. hessleri* Sanders and Allen, 1977, *T. miniscula* Sanders and Allen, 1977, *T. perrieri* (Dautzenberg and Fischer, 1896) and *T. sericea* (Jeffreys, 1876).

The genus is also known as a fossil, with a stratigraphic distribution ranging back to Paleocene (Aman and Jenkin, 2017). The type species itself is a fossil, *Tindaria arata* Bellardi, 1875, from the late Miocene of Italy. However, like for most groups, particularly the deep water ones, the knowledge of the fossil representatives is poor and their records are scarce.

* Corresponding author.
E-mail address: ekosker@geol.uoa.gr (E. Koskeridou).

https://doi.org/10.1016/j.annpal.2018.11.001
0753-3969/

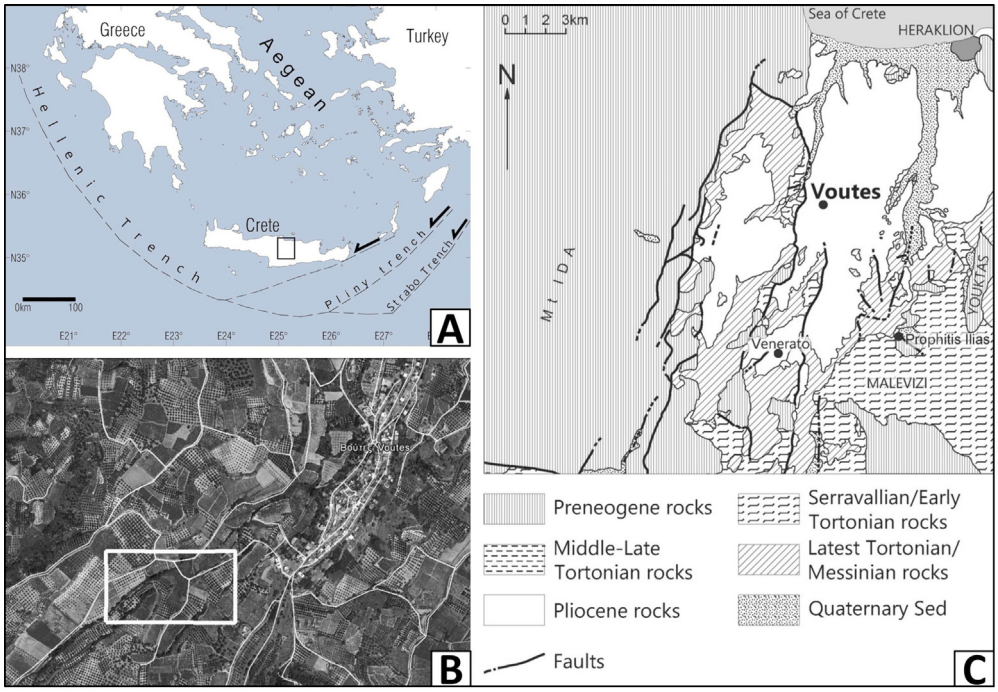

Fig. 1. Location of study area. **A**. Location map of the island of Crete at the southern margin of the Hellenic arc. **B**. Photograph of the study area (obtained from Google Earth). The square marks the extent of the Voutes outcrop. **C**. Geological map of the Heraklion area (simplified after Delrieu, 1990), indicating the Voutes village.
Localité étudiée. ***A****. Localisation de l'île de Crète sur la marge sud de l'arc Héllénique.* ***B****. Photographie de la localité étudiée (obtenue par Google Earth). Le carré marque l'étendue de l'affleurement de Voûtes.* ***C****. Carte géologique de la région d'Héraklion (simplifiée d'après Delrieu, 1990), indiquant le village de Voûtes.*

A new species of *Tindaria* from Early Pliocene deposits of Crete Island is described in the present work, aiming to contribute to the knowledge of the genus and to the deep Mediterranean molluscan fauna.

2. Geological setting

The study area (Fig. 1) is part of the Heraklion Basin, a Pliocene graben structure (Ten Veen and Postma, 1999a; Fassoulas, 2001; Ten Veen and Kleinspehn, 2003), located at the northern part of central Crete, in the southern segment of the Hellenic Arc, between the mountains Psiloritis and Dicti. Voutes section is located southwest of the village Voutes, 15 km south of Heraklion city (Fig. 1).

The lowermost Pliocene in Crete consists of deep marine marls and calcareous marls of the Finikia Formation (Benda et al., 1974) overlying either upper Miocene rocks or basement, or lower Pliocene mass-wasting deposits (Delrieu et al., 1991; Meulenkamp et al., 1979, 1994; Zachariasse et al., 2008). Similar and time-equivalent marls are widespread in the Mediterranean and generally referred to as "Trubi" (Van Couvering et al., 2000). Cyclically bedded marine sediments extend up into the upper Pliocene and at some location pass upward into sands (Zachariasse, 1975; Zachariasse et al., 2008).

During the Early Pliocene, small-scale tilting of fault blocks and increased seismic activity associated with the beginning activity of left-lateral, strike-slip faulting was probably sufficient to generate slope failures resulting in mass flows in the area (Zachariasse et al., 2008).

Even though micro and macro faunal studies from the Pliocene deposits of the greater Heraklion area have been done (Symeonides and Konstantinides, 1967; Dermitzakis and Georgiades-Dikeoulia, 1983; Koskeridou, 1997; Koskeridou et al., 2002; Drinia et al., 2005), macrofaunal research on the bathyal marls is still scarce (Agiadi et al., 2013).

3. Material and methods

The present work is part of a wider study on the molluscan fauna from deep water deposits at the basal part of Voutes succesion. The section consists of more than 50 m thick marls and sandy marls. In the basal part bathyal zone deposits were recognized by the macrofaunal analysis and strong mass-wastings of shallow water origin were found to have formed a series of sandy lenses into marls, whereas in the upper part three diatomite horizons are present (Fig. 2).

A total of 9 samples were collected throughout the section. Sediment bulks (5 kg each) were washed and sieved using a 250 mm mesh size. After drying, the mollusks were picked from the residual sediment under a stereoscope.

Tindaria kretensis n. sp. is described from two samples (c and 5; Fig. 2) of the blue marls. The faunistic context of the blue marls is composed by bivalves, gastropods, benthic and planktonic foraminifers, bryozoans and ostracods. Twenty-one species of bivalves were recognized, dominated mostly by protobranchs as *Ledella nicotrae* (Seguenza, 1877) and other species, such as *Kelliella miliaris* (Philippi, 1844), *Bathyarca* spp., *Jupiteria concava* (Bronn, 1831), *Nuculana clavata* (Calcara, 1841), *Saccella commutata* (Philippi, 1844), *Limopsis* spp., which indicate upper bathyal zone. Sandy lenses contain warm water species such as *Persististrombus coronatus* (Defrance, 1827).

The study interval for the Voutes section is assigned to the biozone MNN16 basing on calcareous nannoplankton biostratigraphy (Rio et al., 1990), within the latest Zanclean (Agiadi et al., 2013).

The new species here described was identified on two valves only. Additional material was treated in an effort of new findings,

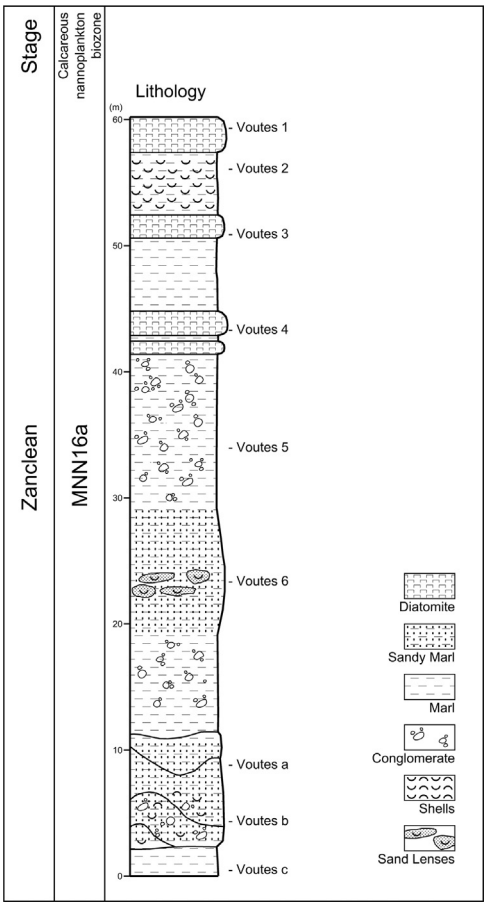

Fig. 2. Stratigraphic column of the Voutes section, indicating samples location. Calcareous nannofossil biozonation following Rio et al. (1990).
Coupe stratigraphique de Voûtes, indiquant l'emplacement d'échantillons. La biozonation des nannofossiles calcaires suit Rio et al. (1990).

however those efforts were unsuccessful. The fact that this scarce material is finely preserved and so clearly distinct from the congeners so far known, led us to confidently describe the new species.

4. Systematics

Classis Bivalvia Linnaeus, 1758
Subclassis Protobranchia Pelseneer, 1889
Order Nuculoida Dall, 1889
Superfamily Nuculanoidea H. Adams and A. Adams, 1858
Family Tindariidae Verrill and Bush, 1897
Genus ***Tindaria*** Bellardi, 1875
***Tindaria kretensis* n. sp.**

(Fig. 3)

Origin of the name: After Κρήτη (Krete), the name of the Greek island of Crete.

Type material: Holotype (left valve) and one paratype (left valve), hosted in the Museum of Paleontology & Geology of the National and Kapodistrian University of Athens (AMPG-IV, 1514, 1515).

Type Locality: Voutes section, Crete island, 35°15′N, longitude 25°2′E.

Type stratum: Early Pliocene (Zanclean) bluish marls.

Dimensions: Holotype 3.37 mm in length, 2.7 mm in height, width 0.9 mm in width; paratype 3.1 mm in length, 2.5 mm in height, 0.7 mm in width.

Diagnosis: Minute, ovate-elongate species of *Tindaria*, ventrally sculptured with marked commarginal ridges. Hinge taxodond, with no resilium. Pallial line entire.

Description: Shell minute, ovate-elongate, slightly inaequilateral, posteriorly larger, moderately convex, relatively solid. Umbo small, poorly prominent, anterior to shell mid-length; anterior margin well rounded; ventral margin long, moderately convex; posterior margin well rounded. Outer surface mostly smooth, with only growth striae, except for ventral area sculptured with some well distinct, wide spaced commarginal ribs, ventrally stronger, anteriorly obsolete, almost totally lost posteriorly. Thin external ligament furrow present posteriorly, slightly extending anteriorly. Hinge taxodont, moderately strong, obscurely angulose. Anterior hinge row markedly shorter, with nine teeth; posterior row with sixteen teeth; dentition below beak small and poorly distinct, with no gap between anterior and posterior row. Internal surface porcelaneous; anterior adductor muscle scar small, ovate; posterior adductor scar subquadrate. Pallial line entire, not well distinct. Prodissoconch rather large, ca. 315 μm in length, smooth.

Remarks: According to Sanders and Allen (1977), *Tindaria* is very close conchologically to *Pseudotindaria* Sanders and Allen, 1977 (type species *Tindaria erebus* Clarke, 1958) and mostly differing in soft parts, particularly in the presence of siphons, which are absent in *Tindaria*. More recently, *Pseudotindaria* was synonymized with *Neilonella* Dall, 1808, and thus moved to the Neilonellidae Schileyko, 1989 (Huber, 2010; Janssen and Krylova, 2014; MolluscaBase, 2018), while it was considered an *incertae sedis* genus when described by Sanders and Allen (1977). As discussed by Warén (1989) and La Perna (2008), a shell character allowing *Tindaria* to be kept distinct from *Pseudotindaria*, i.e. from *Neilonella*, is the continuous hinge series, without the short edentulous gap between anterior and posterior row, occurring in the latter. In addition, in *Tindaria* the pallial line, though feeble, lacks a pallial sinus. No edentulous gap is present in the new species' hinge, the central part of which is occupied by small teeth (Fig. 3D), and no posterior indentation is seen in the pallial line (Fig. 3B). External ligament, long, curved hinge, rather robust and inflate shell, commarginal ridges, are all distinctive characters of *Tindaria*, as typified by *T. arata* (Warén, 1989: figs. 19c, d; Merlino, 2007: pl. 8, figs. 8a, b). This last species is much larger (up to ca. 10 mm in shell length) than *T. kretensis* n. sp., more robust, almost equidimensional and with a more uniform commarginal sculpture. The main character by which the new species differs from the type species of *Tindaria* is its shape: as defined by Verrill and Bush (1897), the tindariid shell is typically "short ovate or veneriform", while it is ovate-elongate in the new species. However, as currently agreed (Huber, 2010; MolluscaBase, 2018), *Tindaria* includes species whose shell shape range from veneriform to slightly ovate-elongate, from poorly to moderately inequilateral; anteriorly and posteriorly well rounded, with no trace of rostration, which instead is present in *Neilonella* (Allen and Sanders, 1996b; La Perna, 2007). As shown by the growth series of larger veneriform tindariids reported by Sanders and Allen (1977), juveniles are ovate-elongate, not much dissimilar from *T. kretensis* n. sp., whose shape thus seems to be mainly related with small size.

Of the six living *Tindaria* species known from the Eastern Atlantic, the most similar to *T. kretensis* n. sp. is *T. miniscula* Sanders and Allen, 1977, from deep waters in the Angola Basin (Sanders and Allen, 1977: fig. 23). It is a small species, not exceeding 2.5 mm in shell length. In addition to the small size, both species share an ovate-elongate shape, but the living species is slightly more elongate, with a larger umbo, more uniformly ridged and with a delicate hinge. It should be noticed that the living species has a shorter hinge, particularly the anterior row, and a distinct edentulous gap in the hinge: these characters leave some doubts about its actual position in *Tindaria*.

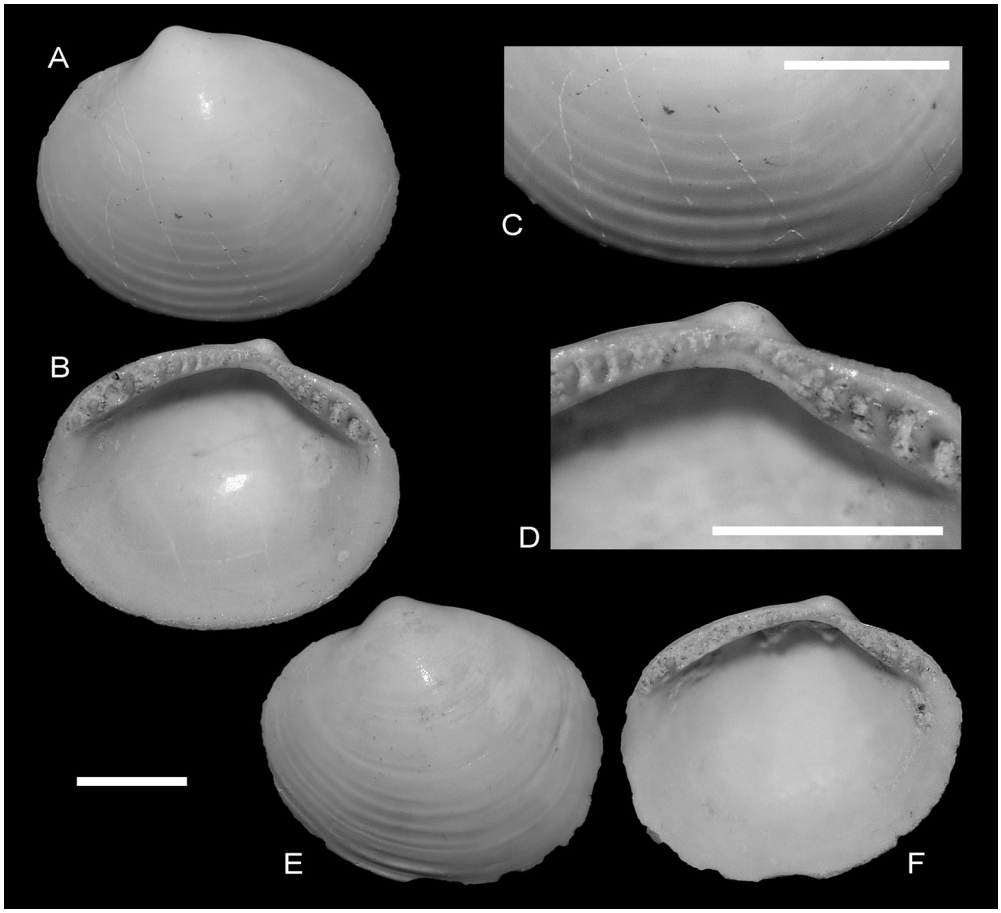

Fig. 3. A and B. *Tindaria kretensis* n. sp. internal and external views of the holotype, L. 3.37 mm. **E and F**. internal and external views of the paratype, L. 3.1 mm. **C**. Detail of sculpture of A. **D**. Detail of hinge teeth of B. Scale bars: 1.0 mm.
A et B. Tindaria kretensis *n. sp. intérieur et extérieur de l'holotype, L. 3,37 mm.* **E et F**. *intérieur et extérieur du paratype, L. 3,1 mm.* **C**. *Détail de la sculpture de A.* **D**. *Détail des dents cardinales de B. Échelle : 1,0 mm.*

As for the other Eastern Atlantic species, *T. callistiformis* and *T. hessleri* (Sanders and Allen, 1977: figs. 1, 11, 12) are much larger (approximately 6–10 mm in shell length) and robust, particularly similar to the type species. *Tindaria perrieri* differs notably from the congeners by being markedly ovate and inequilateral (La Perna, 2008: figs. 9a–c), while *T. derjugini*, is rather thin shelled and apparently with a sculpture of only growth striae (Bouchet and Warén, 1979: figs. 25, 26); further, both species are markedly larger than *T. kretensis* n. sp. The last species, *T. sericea* (Jeffreys, 1876), known from NE Atlantic, including the Ibero-Moroccan Gulf (Jeffreys, 1876; Salas, 1996: figs. 25–27), is larger than *T. kretensis* n. sp. (ca. 4 mm), more inequilateral, somewhat elongate posteriorly and uniformly ridged.

In addition to *T. arata*, the distinctive characters of which were reported above, other fossil tindariids have been described from Italy: *Tindaria arata* var. *subcytherea* Sacco, 1898, *T. solida* Seguenza, 1877a, 1877b and *T. solida* var. *minor* Seguenza, 1879. The first variety, from the Burdigalian (early Miocene) of the Turin Hill area, Piedmont (Sacco, 1898: 64, pl. 12, figs. 57, 58), was described as being smaller, more delicate and elongate than *T. arata*. Also *T. solida*, from the Plio-Pleistocene of southern Italy (Seguenza, 1877a: 96; 1877b: 1185, pl. 5, fig. 34) is markedly larger than *T. kretensis* n. sp., more convex and robust, with a large and prominent umbo and more evenly sculptured. It must be rather similar to *T. arata*, as Bellardi (1875) observed on material obtained by Seguenza. var. *minor* was briefly described as "small, without sculpture" (Seguenza, 1879: p. 284). Another species, from the Tortonian of the Aquitaine Basin is *T. inopinata* Cossmann & Peyrot, 1912 (Cossman and Peyrot, 1912: 245, pl. 5, figs. 85, 86): it is rather large (7.5 mm in shell length) and markedly inequilateral. As far as we are aware, these are the only records of *Tindaria* from the Neogene of Europe and none of these species can be considered as corresponding to *T. kretensis* n. sp.

Stratigraphic and geographic range: Only known from the Early Pliocene of Crete.

5. Conclusions

The fossil record of bathyal taxa is strongly biased by the low availability of outcropping deep water deposits, mainly occurring in areas with strong tectonics (Di Geronimo and La Perna, 1997; Moissette et al., 2017), as well as to their general scant content in macrofossils, compared with the widespread and richly fossiliferous shallow water formations. However, in the last decades, several studies have contributed to the knowledge of the Pliocene and Pleistocene bathyal molluscs from the Mediterranen and to outline its evolution (e.g. Di Geronimo and La Perna, 1997; La Perna, 2004).

Tindaria is a deep water genus, which is absent from the Mediterranean, in spite of its occurrence in the Ibero-Moroccan Gulf, with *T. sericea* (Salas, 1996). Therefore, it is one of the many taxa known from the bathyal deposits of the Mediterranean Plio-Pleistocene, among which several protobranchs (La Perna, 2007, 2008), with a clear psychrospheric meaning. The loss of pychrosphere and

the disappearance of many deep water taxa, probably occurred at about 0.9 million years, when the uplift of the Gibraltar sill cut the Mediterranean away from the deep oceanic circulation (La Perna, 2004).

Based on literature data, *Tindaria* was present in the Mediterranean since the Early Miocene the Miocene(Bellardi, 1875; Sacco, 1898; Robba, 1971; Spano, 1989) at least, up to the Plio-Pleistocene, as discussed above about *T. solida* and *T. solida* var. *minor*, and as documented in the present work.

Based on palaeobathymetric estimations and considerations about the extent of vertical movements (Di Geronimo and La Perna, 1997; Moissette et al., 2017), the Plio-Pleistocene or older bathyal assemblages can be referred to upper bathyal settings, probably not exceeding 500–600 m. The Mediterranean fossil records of *Tindaria*, including the present one, should be then referred to such a bathymetric range, unusually shallow compared with that of the living species of *Tindaria*, largely exceeding upper bathyal depths (Sanders and Allen, 1977; Salas, 1996). A similar bathymetric range of bathyal species, markedly shallower in Mediterranean than in Atlantic, is also known for other benthic groups (Zibrowius, 1987; Moissette et al., 2017).

The geographical and stratigraphical range of the small tindariid species here described may turn out to be wider than so far known, once the bathyal molluscan fauna of the eastern Mediterranean is better known. These studies could also contribute to a better knowledge of the Plio-Pleistocene deep-water fauna, which is so strikingly different from the modern one.

Acknowledgements

The authors would like to express their gratitude to Bruno Delrieu for his help in the field work.

References

Agiadi, K., Koskeridou, E., Triantaphyllou, M., Girone, A., Karakitsios, V., 2013. Fish otoliths from the Pliocene Heraklion basin (Crete, eastern Mediterranean). Geobios 46 (6), 461–472, http://dx.doi.org/10.1016/j.geobios.2013.07.004.

Allen, J.A., Sanders, H.L., 1996a. The zoogeography, diversity and origin of the deep-sea protobranch bivalves of the Atlantic: the epilogue. Progress in Oceanography 38, 95–153.

Allen, J.A., Sanders, H.L., 1996b. Studies on deep-sea Protobranchia (Bivalvia), The family Neilonellidae and the family Nuculanidae. Bulletin of the Natural History Museum (Zoology) 62 (2), 101–132, http://dx.doi.org/10.1016/S0079-6611(96)00011-0.

Aman, K., Jenkin, R.G., 2017. Paleocene protobranch bivalves from Urahoro Town in Eastern Hokkaido, Northern Japan. Journal of Conchology 42 (5), 283–297.

Bellardi, L., 1875. Monografia delle nuculidi trovate finora nei terreni terziari del Piemonte e della Liguria. Tipografia Eredi Botta, Torino (32 p.).

Benda, L., Meulenkamp, J.E., Zachariasse, W.J., 1974. Biostratigraphic correlations in the eastern Mediterranean Neogene. 1. Correlation between planktonic foraminiferal, uvigerinid, sporomorphal and mammal zonations of the Cretan and Italian Neogene. Newsletter of Stratigraphy 3, 205–217.

Bouchet, P., Warén, A., 1979. The abyssal molluscan fauna of the Norwegian Sea and its relation to other faunas. Sarsia 64, 211–243, http://dx.doi.org/10.1080/00364827.1979.10411383.

Cossman, M., Peyrot, A., 1912. Conchologie néogénique de l'Aquitaine. Actes de la Société Linéenne de Bordeaux., pp. 121–324.

Delrieu, B., 1990. Évolution tectono-sédimentaire du Malévisi et du secteur d'Ano Moulia au Miocène supérieur (bassin d'Héraklion, Crète centrale, Grèce). Mémoire de Géologie de l'IGAL 42, 1–369.

Delrieu, B., Saint Martin, J.-P., Merle, D., 1991. Un modèle d'évolution tectono-sédimentaire dans le domaine sud-égéen au Miocène supérieur : l'accident d'Aghia Varvara (Crète centrale, Grèce). Comptes Rendus de l'Académie des Sciences de Paris 313, 1043–1049.

Dermitzakis, M.D., Georgiades-Dikeoulia, E., 1983. Pliocene faunal assemblages in Atsipades Section at Heraklion Province (E. Crete, Greece). Rapport international Mer Méditerranée 28, 231–234.

Di Geronimo, I., La Perna, R., 1997. Pleistocene bathyal molluscan assemblages from Southern Italy. Rivista Italiana di Paleontologia e Stratigrafia 103, 389–426, http://dx.doi.org/10.13130/2039-4942/5298.

Drinia, H., Koskeridou, E., Antonarakou, A., 2005. Late Pliocene benthic foraminifera and molluscs from the Atsipades Section, Central Crete; Palaeoecological distribution and use in palaeoenvironmental assessment. Geobios 38, 315–324, http://dx.doi.org/10.1016/j.geobios.2003.11.008.

Etter, R.J., Boyle, E.E., Glazier, A., Jennings, R.M., Dutra, E., Chase, M.R., 2011. Phylogeography of a pan-Atlantic abyssal protobranch bivalve: implications for evolution in the Deep Atlantic. Molecular Ecology 20, 829–843, http://dx.doi.org/10.1111/j.1365-294X.2010.04978.

Fassoulas, C., 2001. The tectonic development of a Neogene basin at the leading edge of the active European margin: the Heraklion basin, Crete, Greece. Journal of Geodynamics 31, 49–70.

Janssen, R., Krylova, E.M., 2014. Deep-sea fauna of European seas: An annotated species check-list of benthic invertebrates living deeper than 2000 m in the seas bordering Europe. Invertebrate Zoology 11 (1), 43–82.

Jeffreys, J.G., 1876. New and peculiar Mollusca of the *Pecten*, *Mytilus* and *Arca* families procured in the "Valorous" Expedition. Annals & Magazine of Natural History 4, 424–436.

Koskeridou, E., 1997. The Neogene Turritellidae of Greece (PhD Thesis). Gaia 3, 1–210.

Koskeridou, E., Antonarakou, A., Drinia, H., Triantaphyllou, M.V., 2002. Paleoecological observations on the Upper Pliocene deposits of Atsipades Section (C. Crete). In: Proceedings 6th Pan-hellenic geographical conference of hellenic Geographical Society, pp. 123–130.

La Perna, R., 2004. The identity of *Yoldia micrometrica* Seguenza, 1877 and three new deep-sea protobranchs from the Mediterranean (Bivalvia). Journal of Natural History 38, 1045–1057, http://dx.doi.org/10.1080/0022293021000056936.

La Perna, R., 2007. Taxonomy of the family Neilonellidae (Bivalvia, Protobranchia): Miocene and Plio-Pleistocene species of *Pseudoneilonella* Laghi, 1986 from Italy. The Veliger 49, 196–208.

La Perna, R., 2008. Revision of the protobranch species described by Dautzenberg & Fischer (1897) with description of a new species and taxonomic comments on *Bathyspinula* (Bivalvia, Nuculanoidea). The Veliger 50 (2), 149–162.

Merlino, B., 2007. Catalogo dei tipi esemplari figurati della collezione Bellardi e Sacco. Parte III. Catalogo Museo Regionale de Scienze Naturali 17, 1–271.

Meulenkamp, J.E., Dermitzakis, M., Georgiadou-Dikeoulia, E., Jonkers, H.A., Boger, H., 1979. Field guide to the Neogene of Crete. Publications of the Department of Geology and Paleontology, University of Athens (A32), Athens (32 p.).

Meulenkamp, J.E., Van der Zwaan, G.J., Van Wamel, W.A., 1994. On late Miocene to Recent vertical motions in the Cretan segment of the Hellenic arc. Tectonophysics 234, 53–72, http://dx.doi.org/10.1016/0040-1951(94)90204-6.

Moissette, P., Cornée, J.-J., Quillévéré, F., Zibrowius, H., Koskeridou, E., López-Otálvaro, G.-E., 2017. Pleistocene (Calabrian) deep-water corals and associated biodiversity in the eastern Mediterranean (Karpathos Island, Greece). Journal of Quaternary Science 32 (7), 923–933, http://dx.doi.org/10.1002/jqs.2966.

MolluscaBase, 2018. *Tindaria* Bellardi, 1875. Accessed through: World Register of Marine Species at: http://www.marinespecies.org/aphia.php?p=taxdetails&id=138554 on 2018-06-14.

Sacco, F., 1898. I molluschi dei terreni terziarii del Piemonte e della Liguria. Parte 25. Carlo Clausen ed, Torino, http://dx.doi.org/10.5962/bhl.title.12269 (92 p.).

Salas, C., 1996. Marine Bivalves from off the Southern Iberian Peninsula collected by the Balgim and Fauna 1 expeditions. Haliotis 25, 33–100.

Sanders, H.L., Allen, J.A., 1977. Studies on the deep sea Protobranchia (Bivalvia); the family Tindariidae and the genus Pseudotindaria. Bulletin of the Museum of Comparative Zoology 148, 23–59.

Seguenza, G., 1877a. Studi stratigrafici sulla formazione pliocenica dell'Italia meridionale. Bullettino del Reale Comitato Geologico d'Italia 3 (4), 92–99.

Seguenza, G., 1877b. Nuculidi terziarie rinvenute nelle province meridionali d'Italia. Memorie della Reale Accademia dei Lincei, Classe di Scienze Fisiche. Matematiche e Naturali 3 (1), 1163–1200.

Seguenza, G., 1879. Le formazioni terziarie della provincia di Reggio Calabria. Memorie della Reale Accademia dei Lincei, Classe di Scienze Fisiche. Matematiche e Naturali 3 (6), 1–446.

Sharma, P.P., Zardus, J.D., Boyle, E.E., González, V.L., Jennings, R.M., Mcintyre, E., Wheeler, W.C., Etter, R.J., Giribet, G., 2013. Into the deep: a phylogenetic approach to the bivalve subclass Protobranchia. Molecular Phylogenetics and Evolution 69, 188–204, http://dx.doi.org/10.1016/j.ympev.2013.05.018.

Symeonides, N., Konstantinides, D., 1967. Observations on the Neogene deposits of central Crete. Annales Geologiques des Pays Helleniques 19, 657–688 (in Greek).

Spano, C., 1989. I molluschi del Langhiano superiore-Serravalliano inferiore del Cagliaritano (Sargegna meridionale). 1° Atti della Società Toscana di Scienze Naturali 96 (A), 333–397.

Rio, D., Raffi, I., Villa, G., 1990. Pliocene-Pleistocene calcareous nannofossil distribution patterns in the western Mediterranean. In: Kastens, K.A., Mascle, J., et al. (Eds.), Proceedings of the ODP, Scientific Results, 107. College Station TX, ODP, pp. 513–533.

Robba, E., 1971. Associazioni a Pteropodi della Formazione di Cessole (Langhiano). Rivista Italiana di Paleontologia e Stratigrafia 77 (1), 19–126.

Ten Veen, J.H., Postma, G., 1999a. Neogene tectonics and basin fill patterns in the Hellenic outer-arc (Crete, Greece). Basin Research 11 (3), 243–266, http://dx.doi.org/10.1046/j.1365-2117.1999.00097.x.

Ten Veen, J.H., Kleinspehn, K.L., 2003. Incipient continental collision and plate-boundary curvature: late Pliocene-Holocene transtensional Hellenic forearc, Crete, Greece. Journal of the Geological Society of London 160, 161–181, http://dx.doi.org/10.1144/0016-764902-067.

Van Couvering, J.A., Castadori, D., Cita, M.B., Hilgen, F.J., Rio, D., 2000. The base of the Zanclean stage and of the Pliocene series. Episodes 23, 179–187, http://dx.doi.org/10.2475/ajs.s4-3.13.51.

Verrill, A.E., Bush, K.J., 1897. Revision of the genera of Ledidae and Nuculidae of the Atlantic coast of the United States. American Journal of Science 3, 51–63, http://dx.doi.org/10.2475/ajs.s4-3.13.51.

Warén, A., 1989. Taxonomic comments on some protobranch bivalves from the Northeastern Atlantic. Sarsia 74, 223–259, http://dx.doi.org/10.1080/00364827.1989.10413432.
Zachariasse, W.J., 1975. Planktonic foraminiferal biostratigraphy of the Late Neogene of Crete. Utrecht Micropaleontological Bulletin 11, 1–171.
Zachariasse, W.J., van Hinsbergen, D.J.J., Fortuin, A.R., 2008. Mass wasting and uplift on Crete and Karpathos (Greece) during the Early Pliocene related to beginning of South Aegean left-lateral, strike slip tectonics. Geological Society of America Bulletin 120, 976–993, http://dx.doi.org/10.1130/B26175.1.
Zardus, J.D., 2002. Protobranch bivalves. Advances in Marine Biology 42, 1–65, http://dx.doi.org/10.1016/S0065-2881(02)42012-3.
Zibrowius, H., 1987. Scléractiniaires et Polychètes Serpulidae des faunes bathyales actuelle et plio-pléistocène de Méditerranée. Documents et Travaux de l'Institut Géologique Albert de Lapparent 11, 255–257.