

# PLIOCENE BRACHIOPODS FROM RHODES ISLAND (CAPE VAGIA SECTION)

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## Abstract

Six brachiopod species (5 terebratulids and 1 craniid) from the upper Pliocene sandy and calcareous deposits of the Cape Vagia (Rhodes Island) are described: *Gryphus* sp., *Terebratulina retusa*, *Megerlia truncata*, *Megerlia truncata* var. *monstruosa*, *Argyrotheca cordata*, *Megathiris detruncata* and *Novocrania anomala*. This is the first record of *Megerlia truncata* var. *monstruosa* from the Pliocene of Greece and of *Megerlia truncata* from the Pliocene of Rhodes. *Megathiris detruncata*, *Terebratulina retusa* and *Argyrotheca cordata* are described for the first time from the Pliocene of Rhodes. This brachiopod association displays close affinity with those from the Mediterranean province, where assemblages of similar composition are associated with shallow-water, high energy environments. However, the association of *Gryphus* sp., *Terebratulina retusa* and *Novocrania anomala* corresponds to deeper water moderate environments.

**Key words:** Pliocene, Mediterranean, Brachiopods, Rhodes, Greece.

## Περίληψη

Στην εργασία αυτή περιγράφονται επτά είδη Βραχιονόποδων (6 terebratulids and 1 craniid) των ανω-Πλειοκαινικών αμμοωδών αποθέσεων και ασβεστολίθων της τομής Cape Vagia (νήσου Ρόδου): *Gryphus* sp., *Terebratulina retusa*, *Megerlia truncata*, *Megerlia truncata* var. *monstruosa*, *Argyrotheca cordata*, *Megathiris detruncata* και *Novocrania anomala*.

Για πρώτη φορά αναφέρεται το *Megerlia truncata* var. *monstruosa* από το Πλειόκαινο της Ελλάδας και το είδος *Megerlia truncata* από το Πλειόκαινο της Ρόδου. Επίσης τα είδη *Megathiris detruncata*, *Terebratulina retusa* και *Argyrotheca cordata* περιγράφονται για πρώτη φορά από το Πλειόκαινο της Ρόδου. Τα Βραχιονόποδα αυτά αποτελούν βιοκοινότητα η οποία παρουσιάζει πολλές ομοιότητες με την αντίστοιχη συγκέντρωση ειδών στη σημερινή Μεσόγειο, η οποία χαρακτηρίζει ρηχών υδάτων και υψηλής ενέργειας περιβάλλοντα.

Η συνάθροιση των ειδών *Gryphus* sp., *Terebratulina retusa* και *Novocrania anomala* συσχετίζεται με τα ενδιάμεσα ενέργειας βαθιών υδάτων περιβάλλοντα.

Λέξεις κλειδιά: Πλειόκαινο, Μεσόγειος, Βραχιονόποδα, Ρόδος, Ελλάδα.

# 1. Introduction

Pliocene brachiopods of Greece have merely been mentioned or listed by a number of authors in studies dealing with mollusc faunas (Symeonides 1966, Dermitzakis 1969, Mutti *et al.* 1970b, Georgiades-Dikeoulia 1974, Spanopoulou 1997, Steinthorsdottir *et al.* 2006).

Pliocene brachiopods are also described from other Mediterranean regions such as Italy and Spain (see Bitner and Martinell 2001).

The Cape Vagia section in Rhodes Island is an extremely interesting area for the study of Pliocene brachiopods and their environments from shallow to deeper water, yielding a micromorph association. This section is located in a south-facing basin on the eastern coast of Rhodes, in the bay south of Cape Vagia (Fig.1).

In the present work the studied fauna comes from the lower part of the Cape Vagia section that belongs to the upper Pliocene Kolymbia limestone Member.

Even though the existence of brachiopods in the Kolymbia limestone was mentioned by Moissette and Spjeldnaes (1995), Spanopoulou (1997) and Steinthorsdottir *et al.* (2006), this is the first time that a micromorph fauna is described from the Pliocene deposits of Greece. *Megathiris detruncata*, *Argyrotheca cordata*, *Megerlia truncata*, *Megerlia truncata* var. *monstruosa* and *Terebratulina retusa* are described for the first time from the Pliocene of Rhodes and *Megerlia truncata* var. *monstruosa* for the first time from the Pliocene of Greece. The taxonomic position of the specimens described by Steinthorsdottir *et al.* (2006) as *Gryphus vitreus* has been revised.

In this study the collected brachiopod assemblages are analyzed and a paleoenvironmental interpretation is proposed, based on the micromorph fauna through the comparison with recent associations.

# 2. Geological setting

The Late Pliocene and Pleistocene marine succession of the island of Rhodes, overlies unconformably a metamorphosed Mesozoic limestone which formed a karstic landscape of considerable relief (Mutti *et al.* 1970a-b, Meulenkamp *et al.* 1972, Hanken *et al.* 1996). The infilling sequences are consequently of highly varying thickness.

In the Late Pliocene, a general tilting raised northeastern and lowered southwestern Rhodes. Normal faults separated the island into several tectonic blocks with differential vertical more or less independent and important movements (Mutti *et al.* 1970a-b, Pirazzoli *et al.* 1983, 1989, Hanken *et al.* 1996). These movements persisted during the Pleistocene and continue to the present day (Meulenkamp *et al.* 1972, Benda *et al.* 1977).

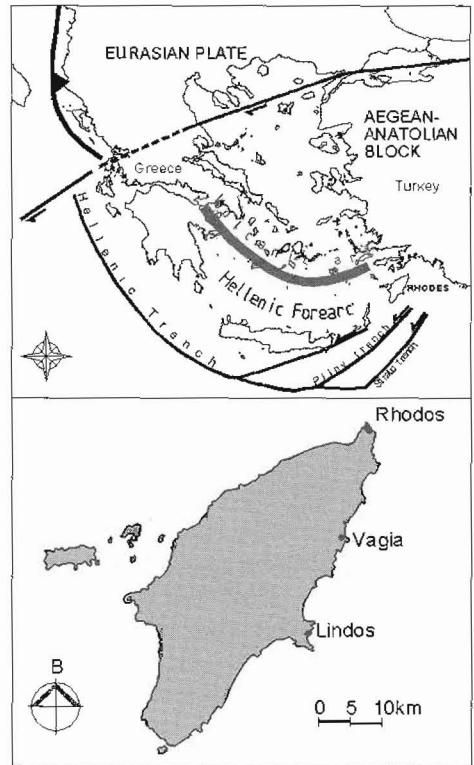


Figure 1 - Position of Rhodes in the Aegean Arc and schematic map of indicating the location of the Cape Vagia area

Many authors proposed lithostratigraphic subdivisions of the Plio-Pleistocene deposits (Hedenborg 1837, Bukowski 1899, Mutti *et al.* 1970b, Meulenkamp *et al.* 1972, Hanken *et al.* 1996). Cornée *et al.* (2006) revised the tectono-sedimentary organization of these deposits and defined a new formation (the Ladiko-Tsampika Fm) between the Rhodes Formation (now including three Members: Kritika, Kolymia, and Lindos Bay clay) and the Lindos Acropolis Formation. The Pliocene-Pleistocene boundary was positioned within the Lindos Bay clay (Keraudren 1970, Sissingh 1972, Benda *et al.* 1977, Løvlie *et al.* 1989, Hanken *et al.* 1996). Thomsen *et al.* (2001) assigned an Early Pleistocene age to the whole marine sequence. Cornée *et al.* (2006a-b) established that these three formations range from Late Pliocene (Kritika to base of the Lindos Bay clay) to Middle Pleistocene in age.

The Upper Pliocene Kolymia limestone on which the present study focuses, is a bryozoan-mollusc-dominated limestone corresponding to a deepening upward sequence (Moissette and Spjeldnaes 1995, Spjeldnaes and Moissette 1997, Steinthorsdottir *et al.* 2006). It consists of a muddy limestone at the base, overlain by a homogeneous limestone intercalated with coarser layers (Fig.2).

### 3. Materials and Methods

For this study, a total number of 5 samples were collected from the Cape Vagia section (Fig. 2). They were taken from the coarser beds which are characterized by large concentrations of shells and rhodoliths. Bulk samples of 1-1.5 kg were collected throughout the section. Samples 1 and 4 were treated with a solution of Glaubert's salt and then sieved through four mesh sizes (2, 1, 0.5, 0.25 mm). After drying, fossils were picked, and identified to species level whenever possible. Information about their modern ecological characteristics and distribution were used for a paleoenvironmental reconstruction.

Macro and microphotographs of brachiopods were taken with a Jeol JSM 5600. The studied material is housed in the laboratory of the Department of Historical Geology-Paleontology, Section of Geology and Geoenvironment, Athens University.

#### 3.1. Paleontology

The qualitative analysis led to the identification of 7 taxa of Brachiopods: *Gryphus* sp., *Terebratulina retusa* (Linnaeus), *Argyrotheca cordata* (Risso), *Megerlia truncata* (Linnaeus), *Megerlia truncata* var. *monstruosa*, *Megathiris detruncata* (Gmelin) and *Novocrania anomala* (Müller). *Novocrania anomala* has been already mentioned by Steinthorsdottir *et al.* 2006. However *Gryphus vitreus* identified by these authors is revised herein. The other species are described for the first time from the Pliocene of Greece.

Sample 1 is characterized by the dominance of *Ostrea lamellosa* and the presence of *Argyrotheca cordata*, *Megerlia truncata*, and *Megathiris detruncata*. Sample 2 is characterized by the abundance of *Gryphus* sp., the presence of *Megerlia truncata* var. *monstruosa*, and transported pectinids and rhodoliths. Sample 3 is dominated by *Ostrea lamellosa*, *Pecten jacobaeus*, the occurrence of *Gryphus* sp. in great number and the presence of *Terebratulina retusa*. Sample 4 is dominated by *Gryphus* sp. and *Terebratulina retusa* and *Novocrania anomala* is also present.

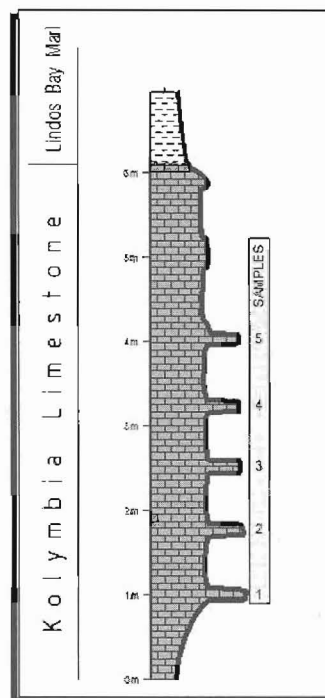


Figure 2 - Log of the brachiopod-yielding beds in the Cape Vagia section. Positions of samples are indicated

Sample 5 contains transported rhodoliths, small ostreids and pectinids, *Anomia ephippium* and rare *Gryphus* sp.

## SYSTEMATIC PALAEOONTOLOGY

A new supra-ordinal classification of the Brachiopoda (Williams *et al.* 1996) has been used here.

Since most investigated species are well known, only some more important and/or recent synonymies are given.

PHYLUM BRACHIOPODA Dumeril, 1806  
SUBPHYLUM RHYNCHONELLIFORMEA Williams *et al.*, 1996  
CLASS RHYNCHONELLATA Williams *et al.*, 1996  
ORDER TEREBRATULIDA Waagen, 1883  
SUBORDER TEREBRATULIDINA Waagen, 1883  
Superfamily TEREBRATULOIDEA Gray, 1840  
Family Terebratulidae Gray, 1840  
Subfamily Gryphinae Sahni, 1929  
Genus *Gryphus* Megerle von Mühlfeld, 1811  
***Gryphus* sp.**  
(Plate 1, Figs 1-4)

*Morphology.* The shell is very large, thick, subpentagonal, strongly biconvex, smooth, with concentric growth lines and has a large foramen. The lateral commissure is curvier than this of *Gryphus vitreus*. The shell is thicker posteriorly and is best preserved at this area. The dimensions of the collected specimens reach about 5 cm in length and 4.5 cm in width. The large size, the shell outline and the type of foramen resemble those of the Pliocene species *Gryphus sphenoides* that was described by Gaetani and Sacca (1984, 1985). The internal features are unknown and the limited material prevents detailed investigations and identification to the specific level.

The specimens from the Kolymia limestone attributed by Steinthorsdottir *et al.* (2006) to *Gryphus vitreus* have been re-investigated. It has the characteristics of our specimens and not those of the typical *Gryphus vitreus*.

*Occurrence.* The genus *Gryphus* is recorded from the Pliocene and Pleistocene of Italy, (Gaetani and Sacca 1984, 1985), of the Pliocene of Spain (Bitner and Martinell 2001) and the Pliocene of north-western Africa (Bitner and Moissette 2003).

The species *Gryphus vitreus* lives in the present day Mediterranean Sea. It is a stenotopic species and is observed on bottoms with moderate to strong currents, low sedimentation, abundance of nutrients and stable temperature and salinity. It has been found on substrates with gravels or shells of the bathyal zone, usually with *Terebratulina retusa* and on the shelf to the bathyal zone with *Novocrania anomala* (Logan 1979). The species found in the Kolymia limestone is associated with this fauna too.

Superfamily CANCELLOTHYRIDOIDEA Thomson, 1926  
Family Cancellothyridae Thomson, 1926  
Subfamily Cancellothyridinae Thomson, 1926  
Genus *Terebratulina* d'Orbigny, 1847  
***Terebratulina retusa*** (Linnaeus, 1758)  
(Plate 1, Figs 5-6)

1758 *Anomia retusa*, Linnaeus, p. 701, no.191.

1983 *Terebratulina retusa* (Linnaeus) -Logan, p. 172.

1994 *Terebratulina retusa* (Linnaeus) -Taddei-Ruggiero, p. 209, pl. 2, figs 1-3.

*Morphology.* Shell biconvex, subpentagonal, longer than wide, slightly auriculate at hinge line. Anterior commissure uniplicate. Externally the valves have numerous, rather coarse, radial ribs,

with smooth rounded tubercles at the postero- lateral margins of both valves. Foramen large, mesothyrid with pedicle collar. The collected specimens reach about 1.1 cm in length and 0.8 cm in width.

*Occurrence.* Today, *T. retusa* has a wide geographical distribution. It lives in the eastern North Atlantic, eastern Greenland, off Iceland and Mediterranean (Alboran Sea to Greece). Its bathymetric range is from 15 to 450 meters in the Mediterranean (421 m in Greece), deeper in the Eastern Atlantic (15 to 1478 m, off the coast of the British Isles). In the bathyal zone it lives with *Gryphus vitreus* (Logan 1979).

It appeared in the Eocene and has been reported from the Pliocene and Pleistocene of Italy, (Gaetani and Sacca 1984, 1985, Taddei-Ruggiero 1994). In Rhodes, it has been also described from the Pleistocene deposits (Spanopoulou 1997).

In the Kolymia limestone it has been found in samples 3 and 4 and it is probably coming from deeper water.

SUBORDER TEREBRATELLIDINA Muir-Wood, 1955

Superfamily KRAUSSINOIDEA Dall, 1870

Family Kraussinidae Dal, 1870

Genus *Megerlia* King, 1850

(Syn. *Muhlfeldria* Batle, 1880)

*Megerlia truncata* (Linnaeus, 1767)

(Plate 1, Figs 7-8)

1767 *Anomia truncata*, Linné, p. 1152, no 229.

1927 *Muhlfeldtia truncata* (Linné) -Thomson, p. 226.

1979 *Megerlia truncata* (Linnaeus) -Logan, p. 68, tab. 9, figs 1-23.

1981 *Megerlia truncata* (Linné) -Cooper, p. 36, tab. 3, figs 5-11.

*Morphology.* Shell small, rounded, biconvex, wider than long. The anterior commissure is sulcate, brachial valve less convex than pedicle valve. Beak suberect, subtruncate, usually abraded. Foramen large, hypothyrid with pedicle collar. The collected specimens reach about 1.3 cm in length and 1.5 cm in width.

*Occurrence.* Today it is widely distributed in the Mediterranean and the North and East Atlantic, at depths of 15- 200 m. The individuals of *M. truncata* that live in shallow waters have cryptic habits, while the individuals that live in deeper waters exit from their hiding places and attached to small shells or gravels on the bottom of the sea (Logan 1979). In Greece it has been found at depths of 29 to 374 m.

*Megerlia truncata* appeared in the Miocene. In Crete island it was described by Georgiades-Dikeoulia (1974) from the middle Miocene of St. Asomati, where there had been found the varieties *serravallensis* and *sabata*. Also, Symeonides (1966) mentions *Muhlfeldtia truncata* from the Pliocene of the hill of Vigla, of the village Pachia Amos and Dermitzakis (1969) *Muhlfeldtia truncata* from the Pliocene of St. Haralambos, Peristera and Coutsounari.

In Rhodes, it has been also described from the Pleistocene deposits (Spanopoulou 1997).

Family Kraussinidae Dal, 1870

Genus *Pantellaria* Dall, 1919

*Megerlia truncata* var. *monstruosa* (Scacchi, 1838)

(Plate 2, Figs 1-2)

1891 *Muhlfeldtia monstruosa* (Scacchi) -Fischer and Oehlert, p. 87, pl. 7, figs 12 a-c.

1927 *Pantellaria monstruosa* (Scacchi) - Thomson, p. 228, figs 70 a-c.

1979 *Megerlia truncata* (Linnaeus) - Logan, p. 68, pl. 9, figs 20-23.

1981 *Pantellaria monstruosa* (Scacchi) - Cooper, p. 17, pl. 3, figs 16-18.

*Morphology.* Shell has almost smooth dorsal valve, where it has only distinct growth lines, often in clusters. Ventral valve ornamented with delicate radial ribs with nodulose crests. There are many different opinions about the taxonomic position of this taxa (see Logan 2004 and references herein). For the taxonomy I follow the opinion of Logan (1979) and Logan *et al.* (2004) which based on his observations and these of Davidson (1887) and Bitner (1990, 1993), regard *monstruosa* as a variety of *M. truncata* because the shape of the shell and the amphithyrid foramen is influenced by the angle of attachment to the substrate. The foramen is elongated to include the umbonal region of the dorsal valve. The collected specimens reach about 1cm in length and 1.5 cm in width.

*Occurrence.* The Recent *Megerlia truncata* var. *monstruosa*, in the Mediterranean lives on rocky substrates at depths of 36 to 553 m (Cooper 1981, Logan 1979). In the eastern Atlantic it has been found at depths of 400-2780 m.

Superfamily MEGATHYRIDOIDEA Dall, 1870

Family Megathyrididae Dall, 1870

Genus *Megathiris* d'Orbigny, 1847

***Megathiris detruncata*** (Gmelin, 1790)

(Plate 2, Figs 3-4)

1790 *Anomia detruncata* Gmelin, p. 3347.

1979 *Megathiris detruncata* (Gmelin) -Logan, p.55-59, text-figs 15, 16, pl. 6, figs 1-13.

1985 *Megathiris detruncata* (Gmelin) -Gaetani and Sacca, p. 17, 18, pl. 9, figs 10-12, pl. 6, figs 1-7.

1994 *Megathiris detruncata* (Gmelin) -Taddei Ruggiero, p. 208, pl. 3, figs 6-9.

2003 *Megathiris detruncata* (Gmelin) -Bitner and Moissette, p. 473, fig. 6 (G,H).

*Morphology.* It is a micromorphic species with a biconvex shell, oval in outline, wide, straight hinge line, large triangular foramen and 10-14 broad ribs. The collected specimens are about 5 mm in length and 6 mm in width.

*Occurrence.* The Recent *M. detruncata* lives in the Mediterranean at depths of 20 to 160 m (Logan 1979). It also lives in the Lusitanian and Mauritanian regions of the Atlantic Ocean and in the Caribbean Sea (Logan 1983, 1988, 1993, Cooper 1977).

It is very common in the Miocene of the Paratethys (Bitner 1990) and the Pliocene of Italy (Gaetani and Sacca 1985, Taddei Ruggiero 1994) and it was described from the Pliocene of North Africa (Bitner and Moissette 2003). In Rhodes, it has been also mentioned from the Pliocene and described from the Pleistocene deposits by Spanopoulou (1997).

Family Megathyrididae Dall, 1870

Genus *Argyrotheca* Dall, 1900

(Syn. *Cistella* Gray, 1853)

***Argyrotheca cordata*** (Risso, 1826)

(Plate 1, Figs 5-6)

1979 *Argyrotheca cordata* (Risso) -Logan, p.96, pl. 5, figs 1-12.

1994 *Argyrotheca cordata* (Risso) -Taddei Ruggiero, p. 211, pl.3, figs 1-2.

2004 *Argyrotheca cordata* (Risso, 1826) -Bitner and Kaim, p. 197, Tab. 2, figs 2D-K, 3A-E.

*Morphology.* Two complete and a lot of fragmented specimens. It is small, thin-shelled, subtriangular in outline, smooth covered with almost imperceptible ribs. The anterior commissure is slightly sulcate with a shallow sulcus present in both valves. The sizes of the shell reach the 2 mm in length and 2 mm in width.

*Occurrence.* As a fossil *A. cordata* is known from the Miocene throughout Europe and from the Pliocene of Italy and Spain. Today it is living in the Mediterranean Sea and the Mauritanian region

of the Atlantic Ocean (see Bitner 1990). It is living in the infra-circallitoral zone no deeper than 100 m and belongs to the “shallow water” group of brachiopods in the Mediterranean sea (Logan 1979). Asgaard and Bromley (1991) confirm the cryptic mode of life of *A. cordata* in shallow water.

#### SUBPHYLUM CRANIFORMEA

#### CLASS CRANIATA

#### ORDER CRANIIDA Waagen, 1885

#### SUBORDER CRANIIDINA Waagen, 1885

#### Superfamily CRANIOIDEA Menke, 1828

#### Family Craniidae Menke, 1828

#### Genus *Novocrania* Lee and Brunton, 2001

#### *Novocrania anomala* (Müller, 1776)

(Plate 1, Figs 7-8)

- 1888 *Crania turbinata* (Poli) -Davidson, p. 188, pl. 27, figs. 14-23  
1981 *Crania anomala turbinata* (Poli) -Cooper, p. 211, pl. 1, fig. 26  
1986 *Neocrania anomala* (Muller) -Lee and Brunton, p. 150, figs 32-37.  
2001 *Novocrania anomala* (Muller) -Lee and Brunton, p. 5

*Morphology.* Only the dorsal valve is available for examination. It is roundly elliptical, with conical profile, smooth, exterior ornamented only by concentric growth lines. Its shape is often determined by the shape of its host. The collected specimens are about 4 mm in length and 4.9 mm in width.

*Occurrence.* *N. anomala* is recorded from the Middle Miocene of Poland (Popiei-Barczyk and Barczyk 1990), the Pliocene and Pleistocene of Italy (Taddei Ruggiero, 1994) and is still living. It is epifaunal attached to hard substrates, living from the low tide limit in low intensity light (caves), to the bathyal zone.

Today in the Mediterranean it lives at depths from 3 to more than 300 m. It is associated with *Gryphus vitreus* on hard substrates at depths of 120 m to more than 1000 m (Logan 1979, Logan *et al.* 2004).

### 3.2. Paleoecology

The distribution of brachiopods depends on many factors as the type of substrate, hydrodynamics, temperature and salinity (Emig 1988). They should thus be used with caution as palaeobathymetric indicators (Fisher and Oehlert 1891, Logan 1993).

Steinhorsdottir *et al.* (2006), have given the paleobathymetry of Kolymia limestone deposits according to which “the limestone comprises two parasequences in a transgressive systems tract and deposition occurred at paleodepths between 30 and 120 m”.

These paleobathymetric data are reinforced by the study of the brachiopod and other faunas in each coarser horizon:

The dominance of *Ostrea lamellosa* in the sample 1 at the bottom of the section, indicates an environment of the littoral zone, rich in oxygen and with high turbulence, as this species is attached and generally forms asymmetrical banks in this zone (Pouyet 1984, Ben Moussa 1994). The simultaneous presence of the micromorph brachiopod fauna of *Argyrotheca cordata*, *Megerlia truncata*, along with the presence of *Megathiris detruncata*, indicates a very shallow-water and high energy environment (Laurain 1984, Asgaard and Bromley 1991).

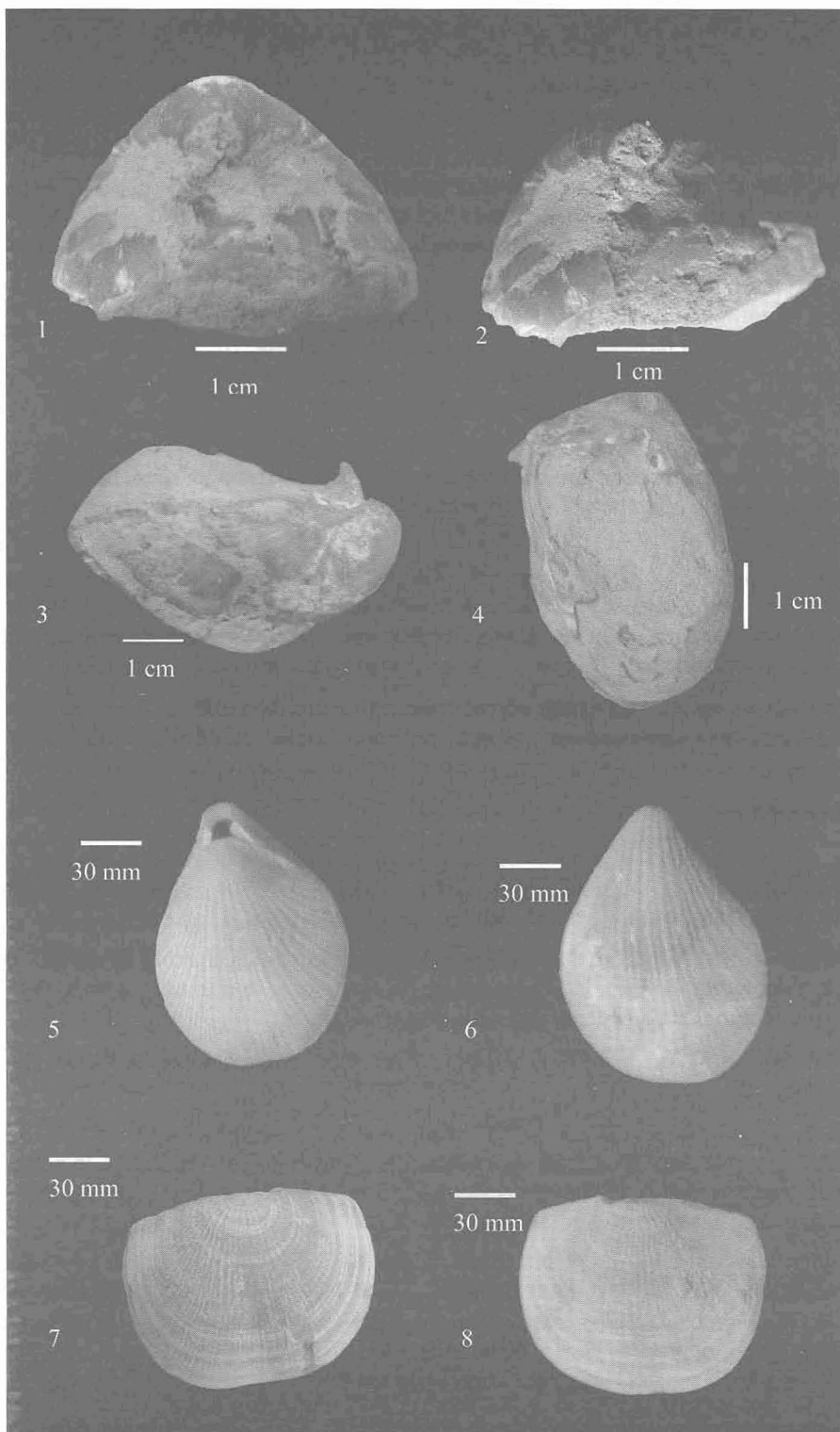
In sample 2 the presence of *Celleporaria palmata* points to a depth of 30-50 m (Spjeldnaes and Moissette 1997, Steinhorsdottir *et al.* 2006). In this bed *Gryphus* sp. and *Megerlia truncata* var. *monstruosa*, have been found in situ, with transported rhodoliths.



Plate 1 - Figs 1, 2, 3, 4. -*Gryphus* sp. posterior, posterior, lateral and latero-dorsal views.

Figs 5, 6. -*Terebratulina retusa* (Linnaeus) dorsal and ventral views.

Figs 7, 8. -*Megerlia truncata* (Linnaeus) dorsal and ventral views



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In samples 3 and 4 the association of *Gryphus* sp., *Terebratulina retusa* and *Novocrania anomala* points to a depth of more than 120 m of moderate energy (Logan 1979, Logan *et al.* 2004, Emig 1989a, b). Sample 4 according to Steinthorsdottir *et al.* (2006) represents a tectonic or storm event where fauna mixing dominates and *Gryphus* is coming from deeper water.

Sample 5 resembles sample 2 by its the fauna content.

## 4. Conclusions

The Pliocene brachiopod assemblages identified in this study have similar composition to some Recent assemblages of the Mediterranean Sea.

For the first time *Megerlia truncata* var. *monstruosa*, is recorded from the Pliocene of Greece and *Megerlia truncata* from the Pliocene of Rhodes. *Megathiris detruncata*, *Terebratulina retusa* and *Argyrotheca cordata* have been first described from the Pliocene of Rhodes. Also the species *Novocrania anomala* and *Gryphus* sp. are described and *Gryphus vitreus* of Steinthorsdottir *et al.* (2006) is discussed to be revised.

The three micromorph species of brachiopods *Argyrotheca cordata*, *Megerlia truncata* and *Megathiris detruncata*, are present in the assemblage of the sandy, lower part of the Cape Vagia section. This indicates a shallow-water and high-energy littoral environment.

In accordance with previous sedimentological and paleoecological studies based on bryozoans (Spjeldnaes and Moissette 1997, Steinthorsdottir *et al.* 2006), the associations of *Gryphus* sp. and *Megerlia truncata* var. *monstruosa*, and of *Gryphus* sp., *Terebratulina retusa* and *Novocrania anomala*, are interpreted as indicating depths of 30-50 and more than 120 m respectively.

## 5. Acknowledgements

The author is grateful to Pierre Moissette (University of Lyon 1) for his collaboration during field work. The critical comments and useful suggestions made by Aleksandra Bitner and Pierre Moissette and the help provided by Daphne Lee, were greatly appreciated. Thanks are due to Dimitri Velitzelos for his help with the macrophotographs and the technician Evangelos Michailides for his help during SEM observations. Financial support for this study was provided by Research Project 70/4/5849 of the University of Athens.

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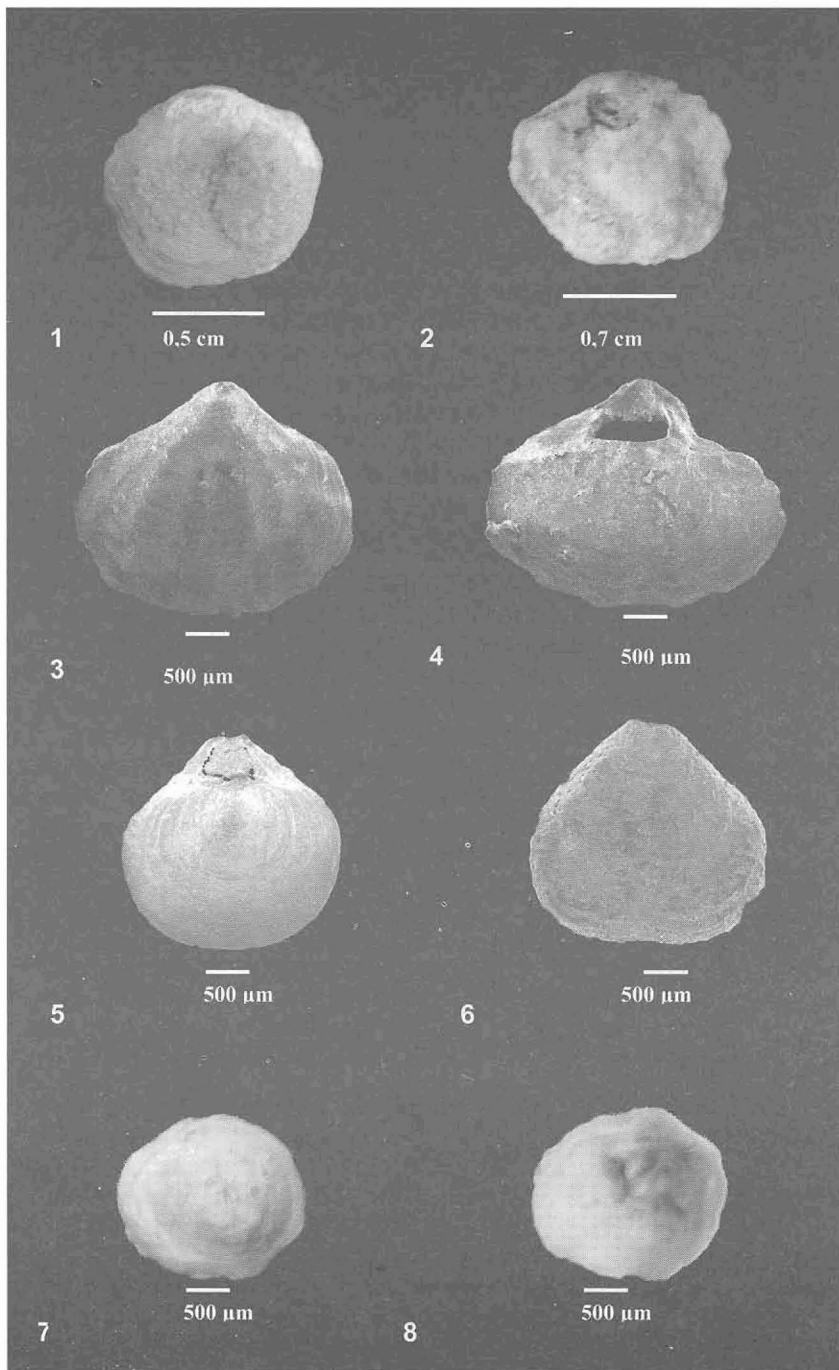
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Plate 2 - Figs 1, 2. -*Megerlia truncata* var. *monstruosa* ventral and dorsal views.

Figs 3, 4. -*Megathiris detruncata* (Gmelin) ventral and dorsal views.

Figs 5, 6. -*Argyrotheca cordata* (Risso) dorsal and ventral views.

Figs 7, 8. -*Novocrania anomala* (Müller) outerl and inner of the dorsal valve.



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