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Pleistocene Polyplacophoran species from Perachora Peninsula (Corinth, Greece)

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Key words: Mollusca, Polyplacophora, Pleistocene, Neotyrrhenian, Marine terraces, Perachora, Greece.

Abstract

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This study refers to fossil Polyplacophora that have been collected during an extensive study of the molluscan fauna of the Pleistocene marine terraces of Perachora peninsula near Loutraki in Greece (Vardala-Theodorou, 1998). At section F.93 valves have been collected from three Polyplacophoran species belonging to *Callochiton septemvalvis* (Montagu, 1803), *Chiton olivaceus* Spengler, 1797 and *Acanthochitona fascicularis* (Linnaeus, 1767). The accompanying fauna of the fossiliferous section F.93 includes 97 species of Bivalvia, Gastropoda and Scaphopoda. Section F.93, at a height of about 30 metrs above Mean Sea Level, is best correlated with the fossiliferous section F.110 that has given absolute dates ranging from 69 +/-11 Ka to 91 +/- 20 Ka by ESR, Electronic Spin Resonance or TL, Thermoluminence methods in NCSR-Demokritos. (Zacharias et al 1998. Michael et al 1998). The species *Chiton olivaceus* Spengler, 1797 and *Acanthochitona fascicularis* (Linnaeus, 1767) have also been also collected from the fossiliferous section F.20 at heights of less than 3 m. Molluscs from F.20 have been dated by E.S.R. at 78 +/- 13 Ka. The marine sediments of F.93

have been uplifted due to tectonic activity in the area. All these Polyplacophoran species have not been described previously for the Upper Pleistocene in Greece.

Περίληψη

Dell'Angelo B. & Βαρδαλά - Θεοδώρου Γ. Ε. 2006. Πλειστοκαινικά είδη Πολυπλακοφόρων από τη χερσόνησο Περαχώρας (Κόρινθος, Ελλάδα). *Ann. Musei Goulandris* 11: 321-339.

Κατά την εκτενή μελέτη των Πλειστοκαινικών αναβαθμίδων της χερσονήσου Περαχώρας στο Λουτράκι της Κορίνθου από την Vardala-Theodorou (1998) συλλέχθηκαν στην απολιθωματοφόρο τομή F. 93 θυρίδες Πολυπλακοφόρων που ανήκουν στα είδη *Callochiton septemvalvis* (Montagu,1803), *Chiton olivaceus* Spengler, 1797 και *Acanthochitona fascicularis* (Linnaeus, 1767). Τα είδη αυτά δεν έχουν αναφερθεί ξανά για το Πλειστόκαινο της Ελλάδος. Η συνοδός πανίδα περιλαμβάνει 97 είδη Δίθυρα, Γαστερόποδα και Σκαφόποδα. Η τομή F. 93 σε υψόμετρο 30m από τη στάθμη της θάλασσας συσχετίζεται με την τομή F. 110 που μετά από χρονολογήσεις απόλυτων ηλικιών Μαλακίων ελήφθησαν τιμές από 69 +/-11 Ka έως 91 +/- 20 Ka . Οι απόλυτες ηλικίες μετρήθηκαν με τη μέθοδο ESR, Electronic Spin Resonance και TL, Thermoluminence στο ΕΚΕΦΕ-Δημόκριτος. Τα είδη *Chiton olivaceus* Spengler, 1797 and *Acanthochitona fascicularis* (Linnaeus, 1767) συλλέχθηκαν επίσης από την απολιθωματοφόρο τομή F.20 σε απόλυτο υψόμετρο λιγότερο από 3 m. Μαλάκια από την F.20 χρονολογήθηκαν με τη μέθοδο ESR και έδωσαν απόλυτη ηλικία 78 +/- 13 Ka. Τα απολιθωματοφόρα θαλάσσια ιζήματα της τομής F.93 έχουν ανυψωθεί στο σημερινό τους υψόμετρο λόγω της τεκτονικής δραστηριότητας στη περιοχή.

Introduction

The study area

The study area (Fig. 1) is located on the Perachora Peninsula of mainland Greece, a region well known for its strong tectonic activity and its seismicity. It is in the province of Corinth, and is situated northwest of the town of Loutraki at 38° 1′ -38° 3′N and 22° 51′- 22° 55′ S. The very rich fossiliferous Pleistocene marine sections (more than 30 sections at heights varying from 0 to 100 m) have been studied by Vardala-Theodorou (1998) and their fossil fauna has been compared with the recent marine Molluscs of the "Perachora, Vouliagmeni Limni". Only at two fossiliferous sections of the Perachora peninsula (F.93 and F.20) were we able to collect Polyplacophoran valves.

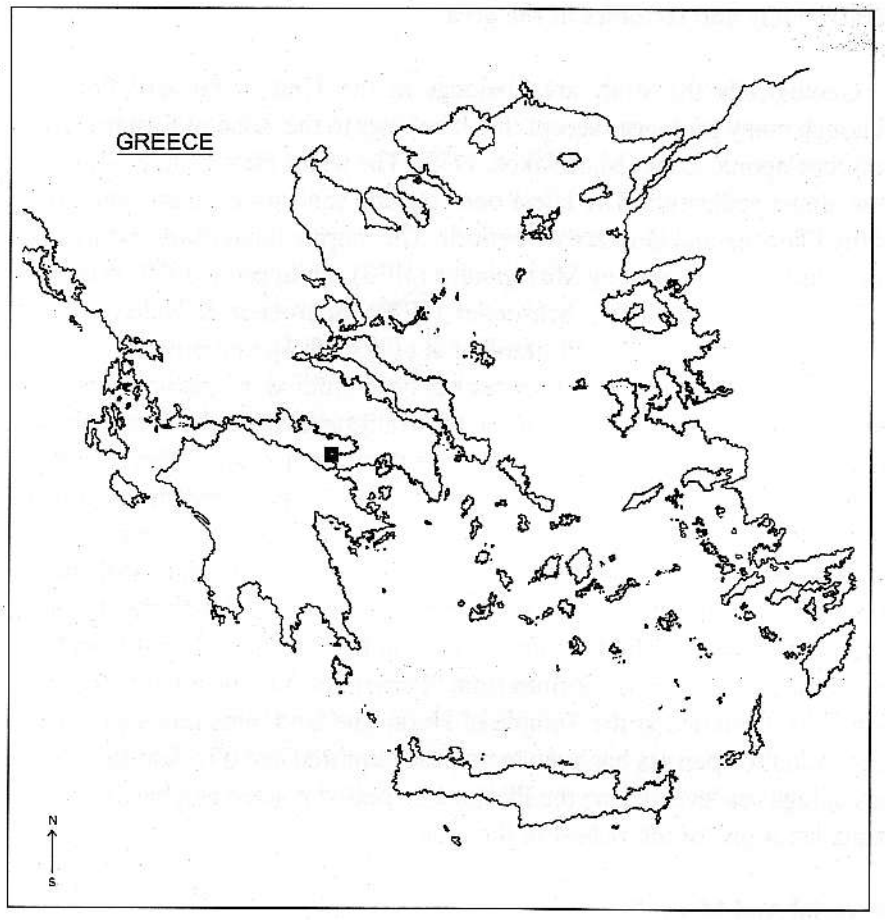


Fig. 1: Location map.

Polyplacophora in the Greek Pleistocene

From our knowledge, the first record of fossil Polyplacophora in the Greek Pleistocene was made by De Rochebrune in 1883. He reported *Lepidopleurus cajetanus* (Poli, 1791) from the island of Rhodes ("*Une valve postérieure un peu fruste, mais parfaitement déterminable, nous a été communiquée par M. le Dr. Fischer*"). This record is also reported by Malatesta (1962) in the distribution of *Lepidopleurus cajetanus* in Pleistocene layers (Upper Pleistocene: Rhodes).

Stratigraphy and tectonics of the area

Geologically the study area belongs to the Unit of Gerania-Perachora although many geologists accept that it belongs to the Zone of Eastern Greece or Subpelagonic Zone (Mariolakos, 1975). The wider area includes alpine and post-alpine sediments. The latest ones include sandstones, marls and gravels of the Pliocene and Quaternary periods. The marine quaternary terraces have been studied in the past by Mitzopoulos (1933), Philippson (1950) Imperatori (1962), Keraudren (1970), Schroeder (1970), Schroeder & Kelletat (1976), Vita –Fingi &King (1985), Pirazzoli et al (1993, 1994), and others.

The fauna of the marine terraces has been studied in respect to its height above MSL. The combination of the biostratigraphical methods and absolute dating methods and presence – absence dendrograms has allowed a better understanding of the geological evolution and the paleogeographical evolution and tectonism of the area. The "Perachora, Vouliagmeni Limni", regarded today as a lake, is now connected to the sea by an artificial canal that has been open for about 100 years and which has influenced drastically the benthic fauna of the lake. The fossiliferous section F.93 is situated on the land zone that separates the gulf of Corinth from "Perachora, Vouliagmeni Limni". Section F.20 is situated at the Temple of Hera. The land mass that separates the lake from the open sea has been tectonically uplifted and it is clear that at periods of high sea level during the Pleistocene period it acted as a barrier reef. Its fauna list is one of the richest in the area.

Material And Methods

At the 100 sampling sites of Perachora, Vouliagmeni Limni, 207 recent Molluscs species were collected including four recent Polyplacophoran species. Within the wider area sampling took place also at 30 fossiliferous sections at heights from 0 to 100 m. It was possible to collect 262 fossil species (111 Bivalvia species and 143 Gastropoda species, 3 Polyplacophora and 5 Scaphopoda species). At section F.93 it was possible to collect 58 Bivalvia species, 35 Gastropoda, 4 Scaphopoda and 55 valves of Polyplacophora belonging to 3 species (see Appendix). At section F.20 it was possible to collect 26 Bivalvia species, 22 Gastropoda, and 15 valves of Polyplacophora belonging to 2 species.

The systematic classification was based on the Catalogue of SIM (Sabelli *et*

al. 1990). The species name in the Appendix is followed by ecological data indicating the relationship of the species with the substratum (Endobionts=, Epibionts +) and the feeding types SF, SD, H, C, P, O. We followed the biocoenoses of the system of Peres & Picard (1964). It should be noted that the fauna of section F.93 is mixed. This section includes numerous fossils and just small quantities of sediment. No clear layers could be observed and the thickness of the layer that has been sampled was not more than 1 m from the foundation of a new house. Due to the building of the house this section is no longer accessible. The fossiliferous section is situated east of the artificial canal connecting the lake with the open sea (Vardala-Theodorou 1998, Fig. 10, Fig. 111).

Fossilization was excellent. Most bivalves were found with both valves still connected. Quantitatively, the species *Pecten jacobaeus, Tellina distorta, Turritella communis, Plagiocardium papillosum, Pitar rudis, Timoclea ovata, Natica lactea, Laevicardium oblongum, Glycymeris glycymeris, Clausinella brongniarti* were abundant. *Cerithium vulgatum* was rare. Species such as *Pteria hirundo, Cavolinia* cf. *inflexa, Trivia arctica,* which were very rare in other sections, were collected in section F. 93. The sediment was very rich in detritus material. Pebbles were rare and sediment was locally very fine. Of the characteristic species of the warm Pleistocene period, only *Natica lactea* was present.

At section F. 20 sampling was carried out at the Temple of Hera. The absolute date (78 +/- 13 Ka) was recorded from specimens from 4 m above MSL. Of the characteristic species of the warm Pleistocene, *Natica lactea* was present. The fauna list from the lower to the higher parts of the sections shows an increase in depth during deposition, which is due to eustatic sea level rise.

The Polyplacophora valves were photographed at the Goulandris Natural History Museum using the LEO 435 VP SEM. The material is deposited in the museum's collections.

Systematic Palaeontology

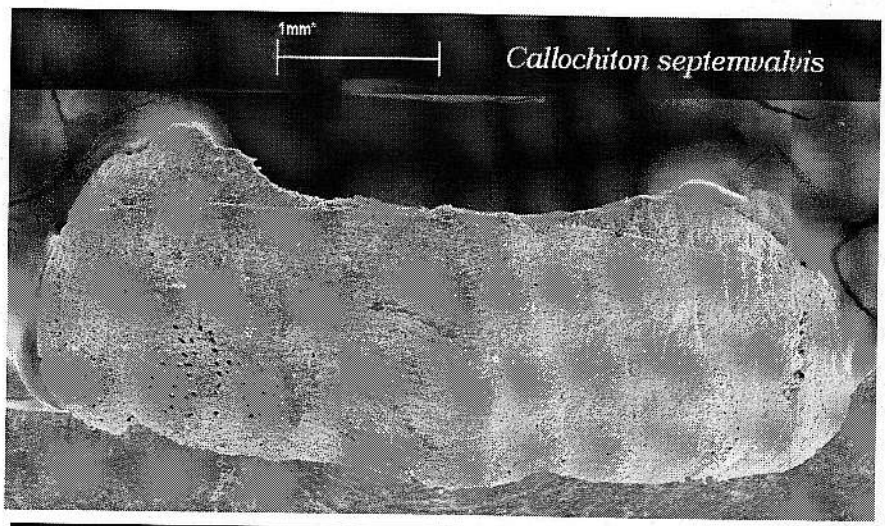
We report only an essential synonymy and bibliographical references regarding each species.

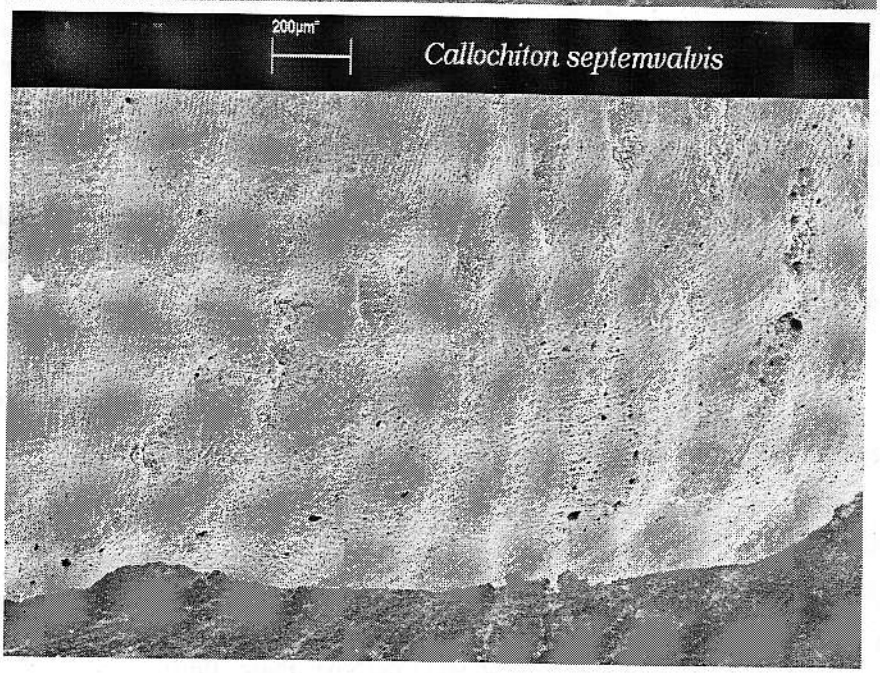
Class POLYPLACOPHORA Gray, 1821
Order NEOLORICATA Bergenhayn, 1955
Suborder ISCHNOCHITONINA Bergenhayn, 1930
Family ISCHNOCHITONIDAE Dall, 1889
Subfamily CALLOCHITONINAE Plate, 1901

Genus *Callochiton* Gray, 1847

***Callochiton septemvalvis* (Montagu, 1803)**

Chiton septemvalvis Montagu, 1803: 3.





Chiton achatinus Brown, 1823: 402.

Chiton euplaeae O.G.Costa, 1829: i,iv, tav.1, fig.3.

Chiton doriae Capellini, 1859: 325, tav.12, fig.2.

Chiton rariplicatus Reuss, 1860: 258, pl.8, figs. 9-11.

Callochiton achatinus euboecus Kattoulas, Koukouras & Economidis, 1973: 22, figs 6-7.

Callochiton laevis – BARASH & DANIN, 1977 : 9, fig. 4. – LAGHI, 1977: 108, tav.2, figs. 14-18. – BALUK, 1984: 290.

Callochiton (C.) achatinus – MALATESTA, 1962: 158, fig. 15.

Callochiton septemvalvis – KAAS & VAN BELLE, 1985: 11, fig. 2. – DELL'ANGELO & FORLI, 1995: 226, figs. 10,17. – DELL'ANGELO & SMRIGLIO, 1999: 125, figs 55-63, pls. 40-41. – DELL'ANGELO *et al.*, 2001: 147, fig. 10.

Callochiton septemvalvis euplaeae – STRACK, 1988: 76.

Callochiton euplaeae – GAGLINI, 1985: XI, tav. 4, fig. 4; tav. 8, figs. 5-6; tav. 9, figs. 1-2.

Callochiton rariplicatus – BALUK, 1971: 461, pl. 5, figs. 1-5.

Material

7 valves, 7 intermediate (maximum length 6 mm).

Remarks

This species of *Callochiton* has been long known under the names of *C. laevis* (Montagu, 1803, *non* Pennant, 1777), *C. achatinus* (Brown, 1823), or *C. doriae* (Capellini, 1859). Kaas (1978) proposed the name *Callochiton septemvalvis* (Montagu, 1803) for this taxon, and the separation of the typical Atlantic form, *C. septemvalvis septemvalvis*, from the Mediterranean one, *C. septemvalvis euplaeae* (O.G.Costa, 1829), at subspecific level. The latter taxon is characterized by its smaller size and by the presence of 3-5 longitudinal scars on the pleural areas. Dell'Angelo & Palazzi (1994) suggested the adoption of the taxon *Callochiton septemvalvis* to designate this complex species taking into account that *Chiton euplaeae* was clearly described by O.G. Costa (1829) as having a smooth surface, without any trace of scars.

The valves of our material have the same tegmentum sculpture as living specimens, with 5-8 longitudinal grooves on the pleural area, very variable, very short in some valves and longer, reaching the anterior margin in others.

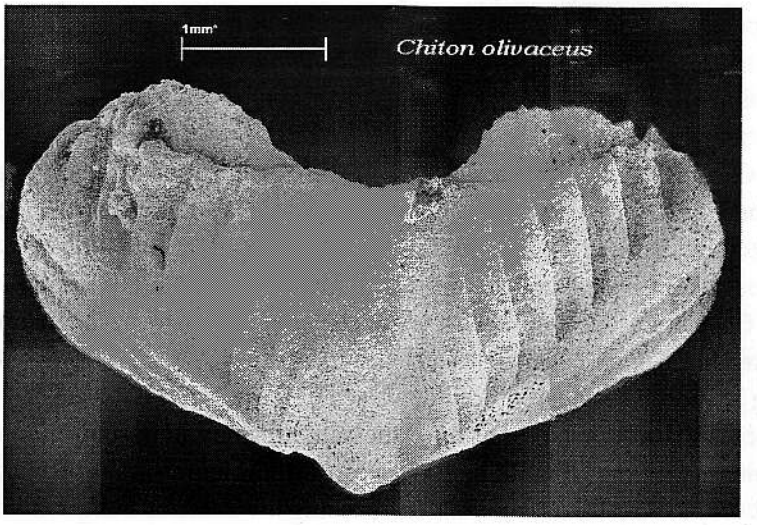
Laghi (1977) considered the Miocene (Badenian) specimens from Korytnica (Poland), identified by Baluk (1971) as *Callochiton rariplicatus* (Reuss, 1860), as well as those from the Miocene of the Vienna Basin illustrated by Reuss (1860) and Sulc (1934), conspecific with *Callochiton septemvalvis*, a synonymy accepted by Baluk (1984) and subsequent authors.

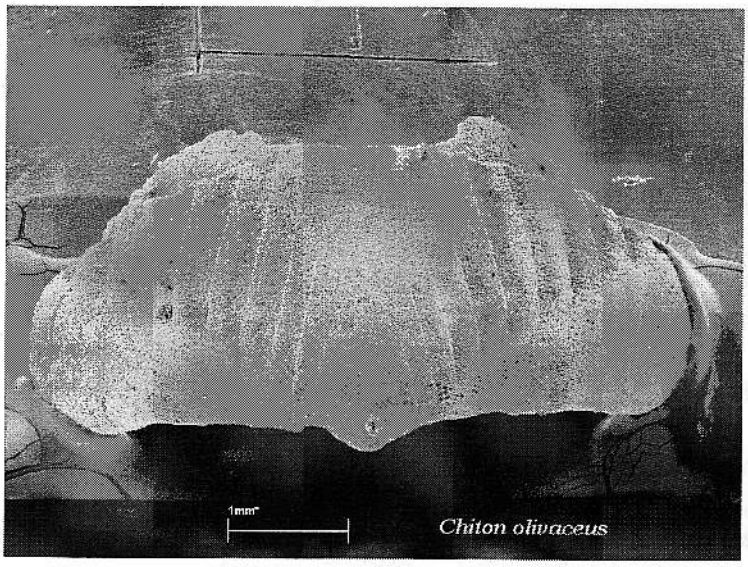
Distribution

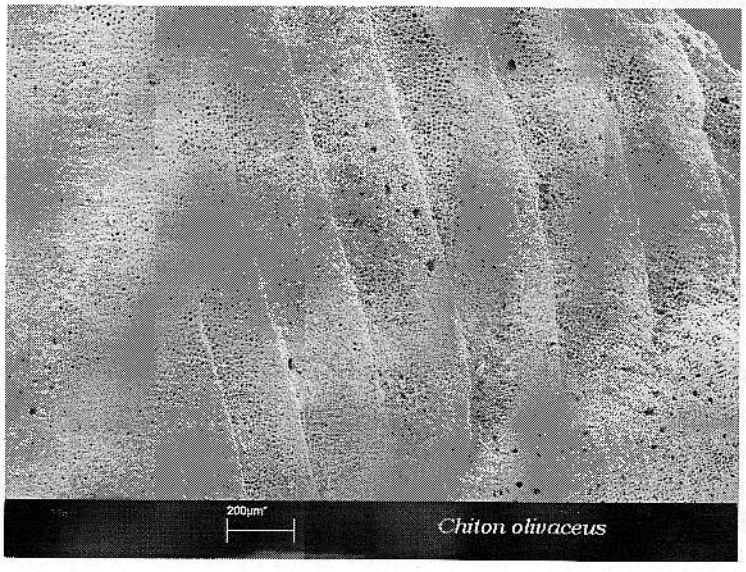
Currently, *Callochiton septemvalvis* is known to be widely distributed in the north-eastern Atlantic Ocean, ranging from Norway to the Canary islands and the Mediterranean Sea. It was reported from the Miocene period of central-eastern Europe (under the name of *Chiton rariplicatus* Reuss, 1860) and in the Italian locality of Montegibbio (Modena prov.). *Callochiton septemvalvis* is more common in the Italian Plio-Pleistocene, and it is recorded from Portuguese and Spanish Pliocene deposit.

Family CHITONIDAE Rafinesque, 1815
Subfamily CHITONINAE Rafinesque, 1815
Genus *Chiton* Linnaeus, 1758
Subgenus *Rhyssoplax* Thiele, 1893

Chiton (Rhyssoplax) olivaceus Spengler, 1797







Chiton olivaceus Spengler, 1797: 73, Pl. 6, fig. 8.
Chiton siculus Gray, 1828: 5.
Chiton polii Deshayes, 1832: 132.
Chiton olivaceus – KATTOULAS, KOUKOURAS & ECONOMIDIS, 1973: 20, fig. 3 – BARASH & DANIN, 1977: 10, fig. 7 – LAGHI, 1977: 109, Pl. 2, figs. 5-8, 13 – SABELLI, 1978: 269, figs. 3-4, 9-10, 16, 18 – GAGLINI, 1985: XIII, Pl. 5, fig.

1; Pl. 8, fig. 4 – KAAS & KNUDSEN, 1992: 59, figs. 8a-d.
Chiton (Chiton) olivaceus – MALATESTA, 1962: 161, figs. 17-18.
Chiton (Rhyssoplax) olivaceus – STRACK, 1988: 77 – DELL'ANGELO & FORLI, 1995: 231. –DELL'ANGELO & SMRIGLIO, 1999: 169, figs. 86-96, pls. 56-57.

Material

32 valves, 7 head (maximum length 5,9 mm), 23 intermediate (maximum length 6,2 mm) and 2 tail (maximum length 3,0 mm).

Remarks

Chiton olivaceus is the most common and best known Mediterranean species, easily recognizable by its characteristic sculpture of rather coarse but very variable radial grooves on terminal and lateral areas and longitudinal grooves on pleural areas.

In many of our valves the longitudinal grooves are convergent towards the jugum, the width of the jugal area is variable. The same variation occurs in the radial and longitudinal grooves. The variability of the fossil forms is so vast that the old authors established a number of specific taxa, as did the 19th century authors who attributed specific rank to the many colour variations, producing an extensive synonymy.

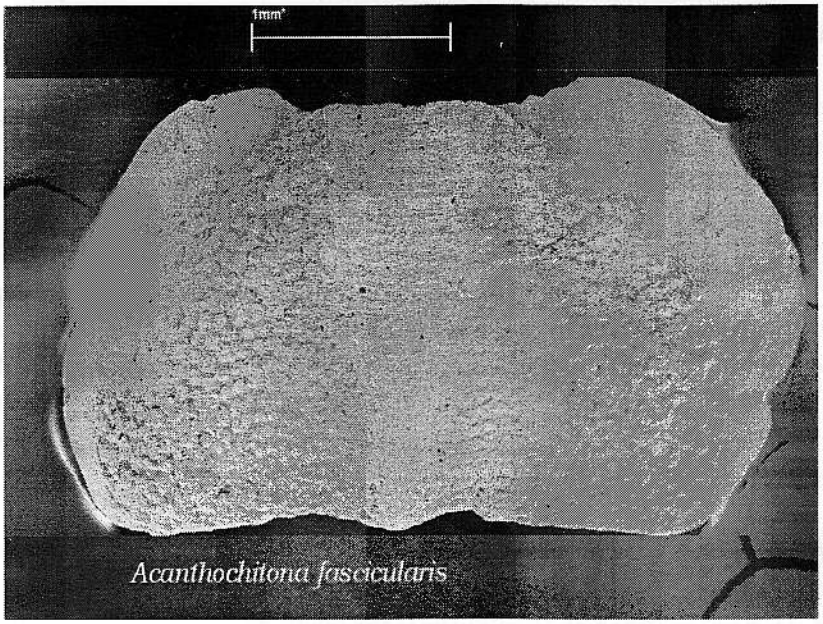
Distribution

Currently, *Chiton olivaceus* in known to occur over the whole Mediterranean, in the Sea of Marmara and in the Atlantic, both on the southern coast of Portugal and at Tangier. It was reported from the Tortonian period in the Northern Apennines (Montegibbio, Rio di Bocca d'Asino) and in the Messinian of Borelli (Turin). In the Pliocene this species is recorded, less frequently, from various Italian and French localities; in the Pleistocene it is present, with greater frequency, in many Italian and Spanish localities.

Suborder ACANTHOCHITONINA Bergenhayn, 1930
Family ACANTHOCHITONIDAE Simroth, 1894
Subfamily ACANTHOCHITONINAE Simroth, 1894

Genus *Acanthochitona* Gray, 1821

***Acanthochitona fascicularis* (Linnaeus, 1767)**



Chiton fascicularis Linnaeus, 1767: n.1106.
Acanthochites communis Risso, 1826: 268.
Acanthochites faluniensis de Rochebrune, 1883: 60.

Acanthochitona fascicularis – KAAS, 1985: 585, figs. 1-6. – STRACK, 1988: 77 – DELL'ANGELO & FORLI, 1995a: 235, figs. 8,11. – DELL'ANGELO & GIUSTI, 1997: 56, figs. 11,17,18. – DELL'ANGELO *et al.*, 1998: 249, tav. 3, figs. 8-9. – DELL'ANGELO & SMRIGLIO, 1999: 192, figs. 113-123, tav. 64-65. – DELL'ANGELO *et al.*, 2001: 153, figs. 30, 33.
Acanthochitona communis – MALATESTA, 1962: 166, fig. 24-25. – KATTOULAS, KOUKOURAS & ECONOMIDIS, 1973: 19, fig. 1 – BARASH & DANIN, 1977 : 13, fig. 10 – LAGHI, 1977: 110, tav. 3, figs. 13-19.
Acanthochitona faluniensis – SULC, 1934: 17, pl. 1, fig.29; pl. 2, figs. 30-32. – BALUK, 1984: 291, pl. 8, figs 1-5.

Material

31 valves, 9 head (maximum length 3.2 mm), 19 intermediate (maximum length 6.2 mm) and 3 tail (maximum length 5.2 mm).

Remarks

A. fascicularis is an extremely variable species with a very complicated synonymy. It is characterized by the tegmentum uniformly covered with small roundish granules arranged along orderly arched lines on the valves, except for the jugal area, and by its flat or slightly concave surface.

Our valves fit very well the characteristics of the species.

A similar species, *A. faluniensis* De Rochebrune, 1883, which differs specifically from *A. fascicularis* by the shape of the lateral margins of the tegmentum and by the thinner granulation, consisting of slightly larger roundish granules, was recorded from the Miocene period in central-eastern Europe, and was considered by Laghi (1977) to be a later synonym of *A. fascicularis*. This synonymy was not accepted by Baluk (1984).

Distribution

A. fascicularis is known to occur over the whole Mediterranean and in the Atlantic from the English Channel and Brittany to the Azores and the Canary Islands. It was reported from the Miocene (Badenian) period of central-eastern Europe, and in Italy from the Tortonian period of Montegibbio (Modena) and the Messinian of Borelli (Turin). It is recorded in various Italian Plio-Pleistocene localities, being locally very frequent, and in the Spanish Pliocene.

Conclusions

This paper presents the first descriptions and illustrated account of fossil chitons from the Pleistocene period in Greece. The three chiton species (70 valves) identified in the Pleistocene marine terraces of the Perachora peninsula are common, recent Eastern Atlantic and Mediterranean species. All these species range, in the Mediterranean, continuously from the Miocene to the present day. From the three species of Pleistocene Polyplacophora identified from Perachora, only *Chiton olivaceus* Spengler, 1797 (at depths from less

than 1m to 22 m) and *Acanthochitona fascicularis* (Linnaeus, 1767) (at depths from 1m to 32m) have been found living in "Perachora, Vouliagmeni Limni" today.

Acknowledgements

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Appendix

Check list of section **F. 93** from Perachora after Theodorou (1998).

BIVALVIA

1. Acanthocardia echinata = SF DC-DL-DE C
2. Acanthocardia paucicostata = SF SM-SFBC-VTC MIC
3. Aequipecten opercularis = SD AP-SFBC-DC I-C
4. Arca noae + SF HP -AP I-C
5. Arca tetragona + SF HP-DC I-C
6. Astarte sulcata
7. Azorinus chamasolen = SF DC-DE C
8. Barbatia clathrata + SF AP I
9. Callista chione = SD SFHN-SFBC-HP-SGCF I
10. Cardita calyculata = SD AP I
11. Chlamys flexuosa = SF SGCF-DC I-C
12. Chlamys multistriata + SF HP I
13. Chlamys pesfelis = SF AP-HP I
14. Chlamys varia =/+ SF SPRV-HP-DL I-C
15. Clausinella brongniartii = SD .....I-C (4-100)
16. Clavagella cf. *melitensis*
17. Coralliophaga lithophagella = SF AP-RM M-I-C
18. Corbula gibba = SF-SD DC I-C
19. Diplodonta rotundata = SD SGCF I
20. Dosinia exoleta = SF SGCF I
21. Dosinia lupinus = SF SFBC I

22. *Ensis ensis = SF SFBC I*
23. *Ensis minor = SF SFBC I*
24. *Gastrana fragilis = SD SVMC-LEE I*
25. *Gastrochaena dubia = SF HP I-C*
26. *Globivenus effossa = ... HP I*
27. *Glycymeris glycymeris = SF SGCF-DC I-C*
28. *Glycymeris glycymeris pilosa = SF SGCF-DC I-C*
29. *Gouldia minima = H SGCF-DC I-C*
30. *Hiatella arctica + SF HP I (O -1400m)*
31. *Laevicardium crassum = SF SGCF I*
32. *Laevicardium oblongum = SF DC C*
33. *Lorípes lacteus = SD SVMC I*
34. *Lucinoma boreale = ... DC C*
35. *Lyssopecten hyalinus = SF HP I*
36. *Musculus discors + SF HP I*
37. *Mysia undata = ... SFBC I*
38. *Mytilus galloprovincialis + SF AP-HP I*
39. *Nucula nucleus = SF DE C*
40. *Nuculana pella = SF SFBC I*
41. *Ostrea edulis = SF AP I*
42. *Paphia lucens = SF SGCF I*
43. *Paphia rhomboides = SF-C SGCF I*
44. *Pecten jacobaeus =/+ SF SGCF-DC I-C*
45. *Pitar rudis = SF-SD SFBC-DC I-C*
46. *Plagiocardium papillosum = SF DC C*
47. *Pododesmus patelliformis + SF AP-C I-C*
48. *Psammobia costulata = SF SGCF I*
49. *Pteria hirundo + SF C? C*
50. *Scrobicularia cottardi = ... DE C*
51. *Solecurtus scopula = SF VTC C*
52. *Spondylus gaederopus + SF AP I*
53. *Striarca lactea = SF HP-DC C*
54. *Tellina distorta = SD SVMC I*
55. *Tellina serrata = SF C-DC-DE C*
56. *Timoclea ovata = SF-SD DC-DL-DE C*
57. *Venerupis senegalensis = SD HP I ??*
58. *Venus verrucosa = SD HP -SGCF-C I-C*

GASTROPODA

1. Alvania carinata .....
2. Atys brocchi + SVMC,SFBC I
3. Caecum trachea .....
4. Capulus hungaricus + O DC C
5. Cavolinia cf *inflexa* .....
6. Cerithium vulgatum + H AP I
7. Cerithiopsis tubercularis .....
8. Circulus tricarinatus .....
9. Crassopleura incrassata + C DC C
10. Cylichnina subcylindrica + VTC C
11. Diodora gibberula + C AP I
12. Diodora graeca + C AP I
13. Emarginella huzardii + C AP I
14. Emarginula octaviana + C AP I
15. Epitonium lamellosum + P SFBC-HP I
16. Erato voluta + C DC C
17. Fusinus rostratus + SD C I
18. Gibbula magus + H SFBC-DC I-C
19. Hexaplex trunculus + C AP-SFBC-DC I-C
20. Lamellaria latens + C HP I
21. Mangelia stossiciana .....
22. Marshallora adversa + C AP-HP-C I-C
23. Mitrella minor + C AP-HP I
24. Nassarius incrassatus = C-0 SVMC- AP I
25. Nassarius pygmaeus = O SPRV-SFHN-SFBC I
26. Nassarius reticulatus = O SVMC-LEE I
27. Natica lactea = C ....
28. Philine catena + C ....
29. Pseudotorinia architae + C DC C
30. Pyrunculus sp.
31. Raphitoma echinata + C C C
32. Scissurella costata
33. Trivia arctica + C AP? I?
34. Turbonilla jeffreysii
35. Turritella turbona =/+ SF-SD VTC C

SCAPHOPODA

1. Dentalium dentalis = SF-SD C
2. Dentalium inaequicostatum = SF SGCF I
3. Fustiaria rubescens = SD ..... M-I-C
4. Cadulus politus = SD .....

POLYPLACOPHORA

Chiton olivaceus + *H LDL-RM M*
Acanthochitona fascicularis + *H RM M*
Callochiton septemvalvis + H AP

References

Baluk, W. 1971. Lower Tortonian chitons from the Korytnica clays, southern slopes of the Holy Cross Mts. *Acta geologica Polonica*, Warszawa 21: 449-472, pls.1-6.

Baluk, W. 1984. Additional data on chitons and cuttlefish from the Korytnica clays (Middle Miocene; Holy Cross Mountains, Central Poland). *Acta geologica Polonica*, Warszawa 34: 281-297, pls.1-17.

Barash, A. & Danin, Z. 1977. Polyplacophora (Mollusca) from the Eastern Mediterranean. *Journal de Conchyliologie* 114: 1-28.

Delamotte, M. & Vardala-Theodorou, E. 1994. *Shells from the Greek Seas* [in Greek] 320pp, Publ. Goulandris Natural History Museum. Kifissia (*Cum. Literature*).

Dell'Angelo, B. & Forli, M. 1995. I Polyplacophora del Pleistocene inferiore di Riparbella (Pisa), con elenco dei molluschi rinvenuti. *Bollettino Malacologico*, 30 (1994): 221-252.

Dell'Angelo, B. & Smriglio, C. 1999. *Chitoni viventi del Mediterraneo.* Edizioni Evolver, Roma, 256 pp. (English edition, 2001).

Dell'Angelo, B., Forli, M. & Lombardi, C. 2001. I Polyplacophora plio-pleistocenici della Toscana. *Bollettino Malacologico*, 36 (2000): 143-154.

Dell'Angelo, B., Lombardi, C. & Taviani, M. 1998. Chitons (Mollusca, Polyplacophora) collected during cruise CS96 in the Straits of Sicily. *Giornale di Geologia* (3) 60: 235-252.

Dell'Angelo, B. & Palazzi, S. 1994. *Callochiton calcatus* n.sp. con note su *Callochiton septemvalvis* (Montagu, 1803). *La Conchiglia* 26(273): 15-23.

Deperet, Ch.1913. Observations sur l' Histoire ge'ologique plioce'ne et quaternaire du golfe et de l'isthme de Corinthe. *Comptes rendus Ac. d. Sc.*166 : pp 480 & 156: 427-431 & 156: 659-663, &

Dermitzakis, M. & Theodorou, G. 1985. Contribution to the nomenclature of Strati-

graphical, Palaeontological and Palaeoecological terms. (Glossary of selected geological concepts) 410 pp. Athens.

Dermitzakis, M. & Georgiades - Dikeoulia, E. 1990. Biozonation of the Neogene invertebrate Megafauna of the Hellenic Area. *Ann. Inst. Geol. Publ. Hung.* LXX 125-136, Budapest.

Gaglini, A.1985. Classe Amphineura. In F. Settepassi (1972), *Atlante Malacologico. I Molluschi Marini viventi nel Mediterraneo*. Vol. III. Roma, Tip. INIVAG. 19 pp. 13 tav.

Imperatori, L. 1962. Livelli quaternari nel Golfo di Corinto e nel Sud del Peloponneso. *Quaternaria* 5 : 131-133, Rome.

Kaas, P. 1978. Notes on Loricata, 10. On the European *Callochiton* species. *Basteria* 42: 73-75.

Kaas, P. 1985. The genus *Acanthochitona* Gray, 1821 (Mollusca, Polyplacophora) in the north-eastern Atlantic Ocean and in the Mediterranean Sea, with designation of neotypes of *A.fascicularis* (L., 1767) and of *A.crinita* Pennant, 1777). *Bulletin du Museum National d'Histoire Naturelle* (4)7(A3): 579-609.

Kaas, P. & Knudsen, J. 1992. Lorentz Spengler's descriptions of chitons (Mollusca: Polyplacophora). *Zoologische Mededelingen* 66: 49-90, figs 1-27.

Kaas, P. & Van Belle, R.A. 1985. *Monograph of Living Chitons (Mollusca: Polyplacophora). Volume 2. Suborder Ischnochitonina, Ischnochitonidae: Schizoplacinae, Callochitoninae & Lepidochitoninae*. Leiden-London-Köln-Kø benhavn, E.J. Brill W. Backhuys. 198 pp, 76 figs, 40 maps.

Kattoulas, M., Koukouras, A. & Economidis, P.1973. Benthic fauna of the Evvoia Coast and Evvoia Gulf. 2. Polyplacophora. *Sci.Annals, Fac.Phys. & Mathem., Univ.Thessaloniki*, 13: 17-26.

Keraudren, B. 1970. Les formations quaternaires Marines de la Grece. *Bulletin du Musee d' Anthropologie Prehistorique de Monaco* Fasc. 16 :1- 321, Monaco.

Keraudren, B., Sorel, D. 1988. The terraces of Corinth (Greece). A detailed record of eustatic sea -level variations during the last 500.000 years. *Marine Geology* Amsterdam 81 : 316-318.

Laghi, G.F. 1977. Polyplacophora (Mollusca) neogenici dell'Appennino settentrionale. *Bollettino della Società Paleontologica Italiana* 16: 87-115, tav.1-4.

Malatesta, A.1962. Mediterranean Polyplacophora Cenozoic and Recent. *Geologica Romana* 1: 145-171.

Mariolakos, I.1975. Geology and tectonism of Peloponnese and relative problems and aspects. *A.G.P.H.* 27: 215-313. Athens.

Markopoulou-Diakantoni, A. 1983. Observations paleoécologiques basées sur l'association faunistique des couches Pleistocenes inferieures de la presque île de Perachora (Grece Meridionale). *Rapp. Comm. Int. Mer. Med.* 28. 4: 243-245. Athens.

Michael, Ch., Zacharias, N., Dimotikali, D., & E. Vardala-Theodorou 1998. Combined absolute dates by TL and EPR on fossil Molluscs. *14th Panhellenic Congress on Solid State Physics*. Ioannina, Sept. 1998.

Mitzopoulos, M. K. 1933. Le quaternaire marin (Tyrrhénien) dans la Presqui île de Perachora. *D.A.G.P.H.* 8 : 286-292.

Nicolaidou, A. &. Anagnostaki, K. 1983. Spatial and temporal variation in the distribution of the mussel *Mytilaster marioni* in a brackish water lagoon of the Amvrakikos gulf. *Rapp. Comm. int. Mer. Medit.* 28(6) : 237-238.

Peres, J. M. & J. Picard 1964. Nouveau manuel de bionomie benthique de la Mer Mediterranee. *Rec. Trav. Stn. Mar. Endoume* 31(47) :1-137.

Philippson, A.1950. *Die griechischen Landschaften*. Band I. Vittorio Klostermann. Frankfurt am Main. (Das Megaris und das Gerania Gebirge S., 940-970.

Pirazzoli, P. A., Stiros, S. C., Laborel, J., Laborel-Deguen, F., Arnold, M., Papageorgiou, C. & Morhange, C. 1994. Late -Holocene shoreline changes related to paleoseismic events in the Ionian Islands, Greece. *The Holocene* 4(4): 397-405.

Pirazzoli, P. A., Stiros, S. C., Arnold, M., Laborel, J., Laborel- Deguen, F.& Papageorgiou C. 1993. Episodic uplift deduced from Holocene shorelines in the Perachora Peninsula, Corinth area, Greece. *Tectonophysics* 229 (1994) : 201 - 209.

Poli, G.S. 1791/95. *Testacea utriusque Siciliae eorumque historia et anatome*. Parma, Bodoni ed., Tomus primus: 257 pp. 18 tav.; Tomus secundus: 234 pp. 20 tav.

Reuss, A.E.1860. Die marinen Tertiarschichten Bohmens und ihre Versteinerungen. *Sitzungberichte Akademie (K.) der Wissenschaften*.39: 250-270.

Rochebrune (de), A.T.1883. Monographie des espèces fossiles appartenant a la classe des Polyplaxiphores. *Annales des Sciences Geologiques*.14: 1-74, pls.1-3.

Sabelli, B. & Taviani, M. 1979. I Polyplacophora del Pleistocene inferiore del T. Stirone (Preappennino Parmense, Italia). *Bollettino della Società Paleontologica Italiana* 18: 157-161.

Sabelli, B. 1978. Il genere *Chiton* in Mediterraneo, osservazioni al microscopio elettronico a scansione. *Bollettino di Zoologia*.45: 269-274.

Sabelli, B., Giannuzzi - Savelli, R. & Bedulli, D. 1990.- *Annotated Check-list of Mediterranean Marine Mollusks*. 1-781 pp., SIM, Bologna.

Schröder, B. & Kelletat D. 1976. Geodynamical conclusions from vertical displacement in the Peloponnesos. Greece. *N. Jahrbuch Geol. Pal.1976 (H.3) : 174-186.*

Schröder, B.1970. Über mittel- und Jung-pleistozäne Meeres-Hochstände der Landenge von Korinth. *N. Jb. Geol. Pal.* 1970 (H1): 27-33.

Strack, H.L. 1988. The distribution of Chitons (Polyplacophora) in Greece. *Apex* 3 (4) 12 : 67-80.

Strack, H.L. 1990. The distribution of Chitons (Polyplacophora) in Greece. *Apex* 5 (1-2) : 13-15.

Sulc, J.1934. Studien uber die fossilen Chitonen. I. Die fossilen Chitonen im Neogen des Wiener Beckens und der angrenzenden Gebiete. *Ann. des Naturhistorischen Museums Wien*, 47: 1-31, taf.1-2.

Symeonidis, N.1973. Aufsammlung 1970 aus dem Gebiet des Isthmus von Korinth. *Erlang. Geo. Abh.* 95 : 179-182, Erlangen.

Vardala-Theodorou, E.1998. Study of recent and fossil Quaternary molluscs of Vouliagmeni lake, Heraion at Perachora. *PhD. Dissertation, University of Athens.* 479 pp.

Vita-Finzi, C. & King, G.C.P.1985. The seismicity, Geomorphology and structural evolution of Corinth area of Greece. *Philos. Trans. R. Soc. London, Ser. A,* 314 : 379 - 407.

Zacharias, N., Michael, C.T., Dimotikali, D., Vardala-Theodorou, E., and Bassiakos, Y., 1998. A combined Thermoluminescence and ESR Dating of calcite shells from an Upper Pleistocene Marine Formation. *31st International Symposium on Archaeometry*, Budapest

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