

Πρακτικά		6ου	Συνεδρίου	Μάϊος	1992
Δελτ. Ελλ. Γεωλ. Εταιρ.	Τομ.	XXVIII/3		σελ.	55-73
Bull. Geol. Soc. Greece	Vol.			pag.	
				Αθήνα	1993
				Athens	

UPPER CRETACEOUS RUDISTS FROM THE MENDERES MASSIF

S.OZER

ABSTRACT

The presence of the rudists in the Menderes Massif have been reported for the first time by Dürr (1975). The rudist bearing marbles have been accepted as Upper Cretaceous in age by Dürr and also in more recent investigations.

A preliminary study of the rudists in the Menderes Massif is presented in this paper.

The rudists are observed in the upper levels of the thick Mesozoic sequence of the Menderes Massif. This sequence consists of platform-type marbles which extends in the form an arc in the south of the Massif, whereas in the north of the Massif, it shows a less regular extension.

In the south of the Menderes Massif, the rudists are found towards the upper levels of the Mesozoic sequence consisting of dirty white-dark colored, medium thick bedded recrystallized limestones showing probably lateral and vertical changes with brecciated recrystallized limestones. The uppermost section of the sequence consists of recrystallized limestones without rudists and they grade into reddish, greenish, upper Senonian-Lower Paleocene, cherty pelagic limestones. At the top of the sequence, flysch like rocks consisting of shales, sandstones and crystalline limestones with foraminifers, indicating an Upper Paleocene-Eocene age, are observed. The Lycian nappes tectonically overlie this sequence.

The principal rudist localities are located around the Akbük area in the southern part of the Menderes Massif. They can also be observed in the areas surrounding Milas and Denizli. Hippuritids and Radiolitids are very abundant in the Akbük area: Hippurites

* Department of Geological Engineering, University of Dokuz Eylül, 35100 Bornova/Izmir-Turkey.

nabresinensis, Hippurites cf. colliciatus, Hippurites sp., Vaccinities sp., Sauvagesia cf. tenuicostata, Sauvagesia sp., Durania sp. and Radiolites sp. are determined. Small build-ups of H. nabresinensis are found in the Akbük area. The rudists are poorly preserved in the Milas and Denizli areas. However, Sauvagesia cf. tenuicostata, Sauvagesia sp., Durania sp., Hippurites cf. colliciatus, Hippurites sp. can be determined and also a single section of species Vaccinities cf. taburni showing a stratigraphic significance can be found.

The rudist fauna of the southern part of the Menderes Massif indicates a Santonian-Campanian age, and shows similarities with the Santonian rudist assemblage determined from the limestones of the İzmir-Ankara Zone.

In the north of the Menderes Massif the rudists are very rare and fragmented. They are observed in the dark-gray colored, medium thick bedded recrystallized limestones with foraminifers indicating Santonian and upper Campanian age around Akhisar and Selçuk areas.

INTRODUCTION

The Menderes Massif is located in Western Anatolia between the İzmir-Ankara Zone and the Torids (Fig. 1). It consists of gneiss schists and marbles with bauxite and rudists, in ascending order.

The presence of the rudists in the Menderes Massif were reported for the first time by Dürr (1975). The rudist bearing marbles from the southern part of the Massif have been accepted as Upper Cretaceous in age by Dürr (1975) and also in more recent investigations (Çağlayan et al., 1980; Konak et al., 1987).

In this study, the descriptions and distributions of the rudists in the Menderes Massif are presented and their stratigraphic positions are discussed.

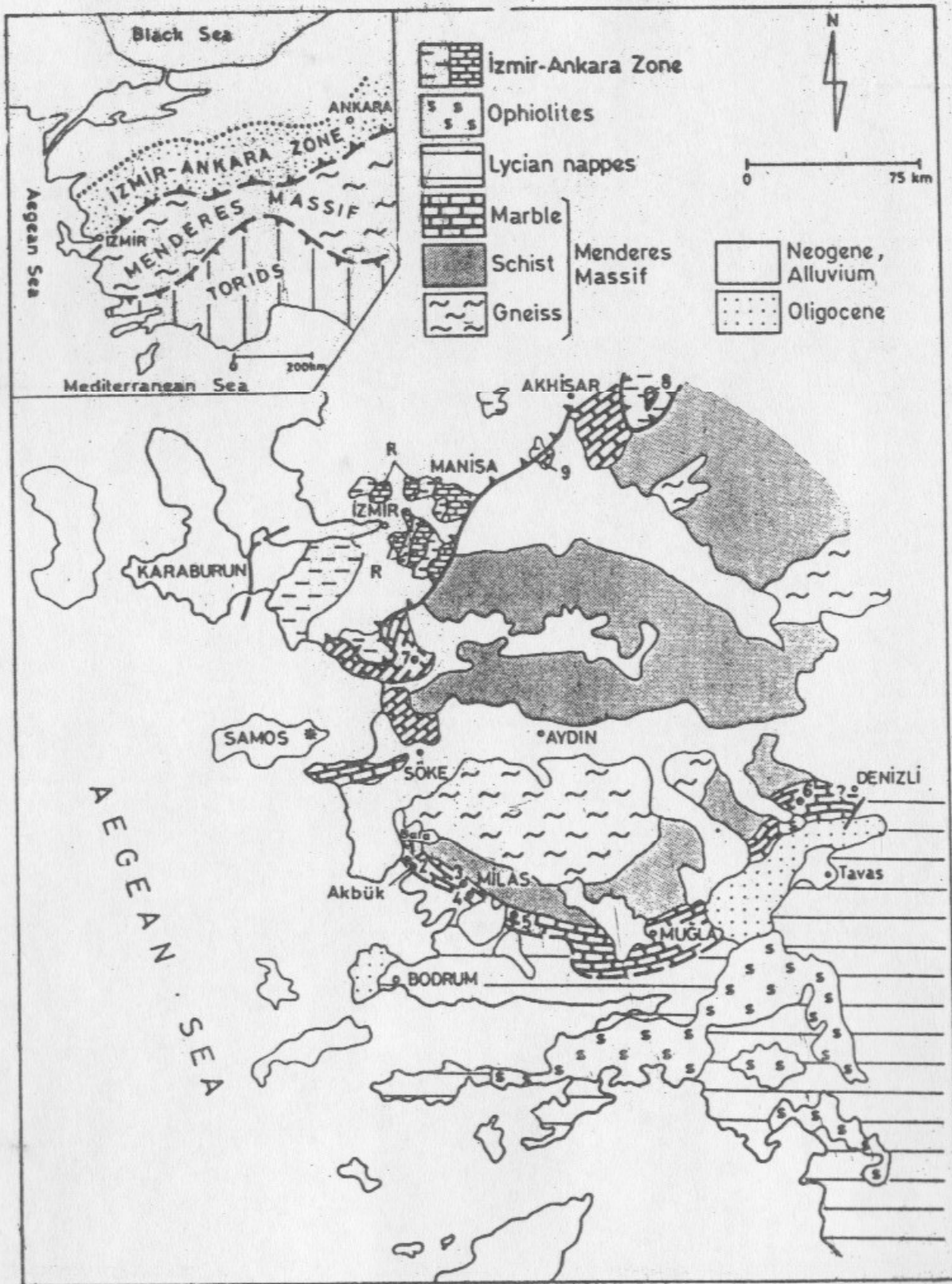


Fig. 1: Geographic situation of Menderes Massif and geological map of Western Anatolia (simplified from Dürr, 1975; Çağlayan et al., 1980; Erdoğan and Güngör, 1992).

The numbers indicate the rudist localities of Menderes Massif (1: Kömürburnu, 2: Saplıada-Akbük, 3: Asinyeniköy, 4: Yeniköy, 5: Akdağ, 6: Denizli, 7: Selçuk, 8: Görenez Mountain, 9: Kayaaltı); R shows the rudist localities of the Izmir-Ankara Zone; the asterisk (*) indicates the rudist locality of Samos noted by Papanikolaou, 1975.

PALEONTOLOGY

This is a preliminary study on the rudists of the Menderes Massif. The Upper Cretaceous marbles of the northern part of the Menderes Massif are not sufficiently studied, whereas, those of the southern part of the Massif contain dominant undetermined Radiolitid fragments. The difficulties for the determination of Radiolitids, and sometimes of Hippuritids, are due to metamorphism. Numerous rock specimens with rudists were collected, so some species having stratigraphic significance can be determined which will be presented later in this paper. On the other hand, the study of many thin sections show no presence of any microfossil.

Classis BIVALVIA

Ordo Hippuritoida NEWELL 1965

Familia Hippuritidae GRAY 1848

Genus Hippurites LAMARCK 1801

Hippurites nabresinensis FUTTERER 1893

(Pl. I, fig. 1,2,4,6)

- 1981 Hippurites nabresinensis- Sánchez, p. 20.
1981 Hippurites nabresinensis- Pamouktchiev, p. 156, pl. 76, fig. 2, 3
1982 Hippurites nabresinensis- Accordi, Carbone, Sirna, p.770, pl. 4, fig. 8-10.
1989 a Hippurites nabresinensis- Özer, p. 339, pl. I, fig. 10.

Description: Many sections of the lower valve are oval or subcircular in shape. The diameter ranges from 10x18 mm to 15x26 mm in the oval sections. Subcircular sections present a diameter variation of 15x13 mm to 24x22 mm. The shell wall is dark in color and thin (1 mm). The ligamental ridge (L) is lacking. The pillars S and E are very well preserved. They are open at the base and rounded at the top. The pillars are generally of the same length.

Discussion: The specimens may be compared with the structure of the siphonal pillars by the Hippurites lapeirousei GOLDFUSS; however, they have very developed pillars from those of the H. lapeirousei. The specimens show similarities with the thickness and the color of the shell wall with the H. nabresinensis determined from the Santonian limestones of the Izmir-Ankara Zone by özer (1989a).

Locality: Kömürburnu, Saplıada (NW of Akbuk), and Asinyeniköy (NW of Milas).

Hippurites sp

(Pl. I, fig. 3)

Description: Some sections of the lower valve are very small and circular in shape. The diameter is about 0.5 mm to 12 mm. Siphonal pillars are less developed and about the same size.

Discussion: The shape of the pillars shows a resemblance with the Hippurites lapeirousei GOLDFUSS. However, the specimens may be young forms of the H. nabresinensis.

Locality: Around Akbuk, Milas, and Denizli.

Hippurites cf. colliciatus WOODWARD 1855

(Pl. I, fig. 5)

1981 Hippurites colliciatus- Sánchez, p. 10.

1982 Hippurites colliciatus- Accordi, Carbone, Sirna, p. 770, pl. IV, fig. 4.
7.

1989 b Hippurites colliciatus- özer, pl. I, fig. 5

Description: Two specimens show large and well pronounced costae in the sections of the lower valves. Wide and deep grooves are present between the costae. The diameter is about 40 to 50 mm. A slight inflexion indicates the ligamental ridge (L). Pillar S is short and open at the base and rounded at the top. Pillar E is

more developed than Pillar S.

Discussion: The specimens show affinities with the very developing costae to the Hippurites colliciatius WOODWARD, however, pillar E can not be clearly observed because of the recrystallization.

Locality K m rburnu (NW of Akb k) and Asinyenk y (NW of Milas).

Genus Vaccinites FISCHER 1867

Vaccinites cf. taburni GUISCARDI 1864

(Pl. I. fig. 9)

1981 Vaccinites taburni- S nchez, p. 54.

1982 Vaccinites taburni- Accordi, Carbone, Sirna, p. 771, pl.V. fig. 3.

1989 a Vaccinites taburni-  zer, p. 337, pl. I. fig. 1-6.

Description: A single section of the lower valve is oval in shape. The diameter is about 33x48 mm. The shell wall is 4 to 5 mm thick. The ligamental ridge (L) is long (10 mm), straight and probably truncated at its end. Pillar S has a short (4 mm), thin stem and oval head. The length of pillar S is 11 mm. Pillar E is very close to pillar S, and it has a long (10 mm), thin stem and is enlarged and turned towards pillar S. Pillar E is longer (19 mm), than pillar S and the ligamental ridge (L). The distance of L-S is considerably longer than the distance of S-E. The section of L-S-E occupy about 1/6 of the total circumference.

Discussion: The internal structure of the section is very similar to the Vaccinites taburni GUISCARDI; but the end of the ligamental ridge is not well preserved. Pillars S and E are very close in the specimen which are also observed in the many specimens of V. taburni from the Santonian limestones of the Izmir-Ankara Zone ( zer, 1989a).

Locality: Akdag (SE of Milas).

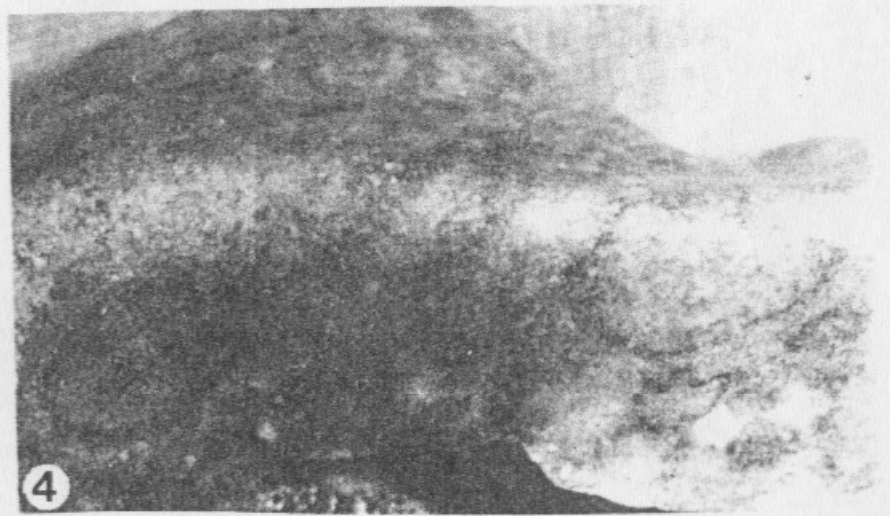
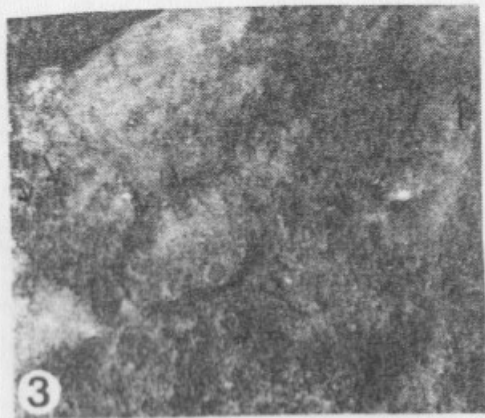


Fig. 1: Hippurites nabresinensis FÜTTERER

Kömürburnu (Akbük), No. MK. 12, x1.

S and E: pillars.

Fig. 2: Hippurites nabresinensis FÜTTERER

Kömürburnu (Akbük), No. Mk. 12, x1.6.

Fig. 3: Hippurites sp.

Çaplıada (Akbük), No. MS. 26, x1.8.

Fig. 4: Specimen from the build-ups of Hippurites nabresinensis

FÜTTERER

Kömürburnu (Akbük), No. MK. 12, x1.4.

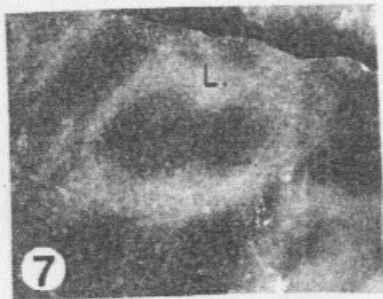
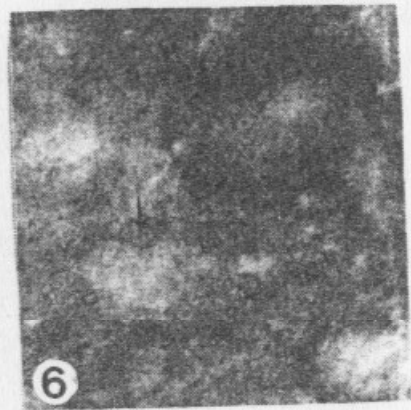
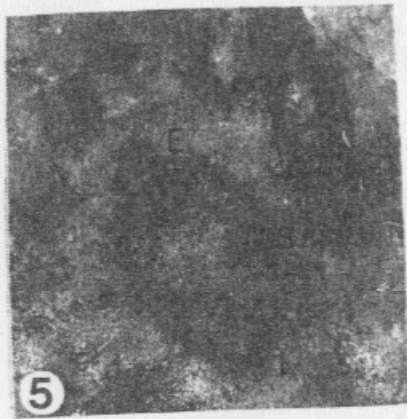


Fig. 5: Hippurites cf. colliciatus WOODWARD

Asinyeniköy (Milas), No. MA. 9, x1.4.

Note the well pronounced costae. L: ligamental ridge. S and E: pillars.

Fig. 6: Hippurites cf. nabresinensis FUTTERER

Asinyeniköy (Milas), No. MA. 9, x1.4.

Pillar is marked with an arrow. Other pillar is partly preserved.

Fig. 7: Sauvagesia sp.

Yeniköy (Milas), No. MY. 6, x1.

L: ligamental ridge.

Fig. 8: a: Sauvagesia sp.. b: Durania sp.

Saplıada (Akbük), No. MS. 34, x0.8.

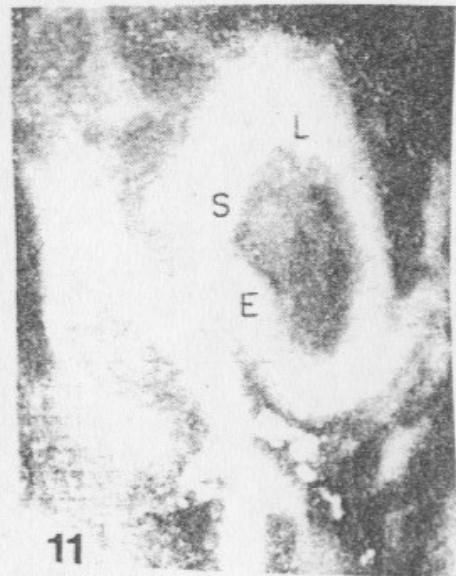
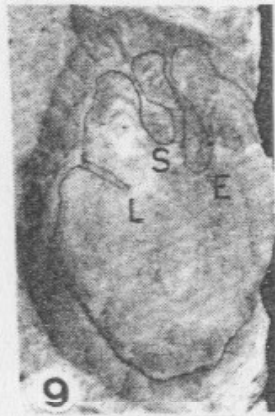


Fig. 9: Vaccinites cf. taburni GUISCARDI

Akdağ (Milas). No. MAK. 8. x1.

The contour of ligamental ridge (L) and pillars (S, E) are drawn.

Note the distance L-S is considerably longer than the distance S-E.

Fig. 10: Durania sp.

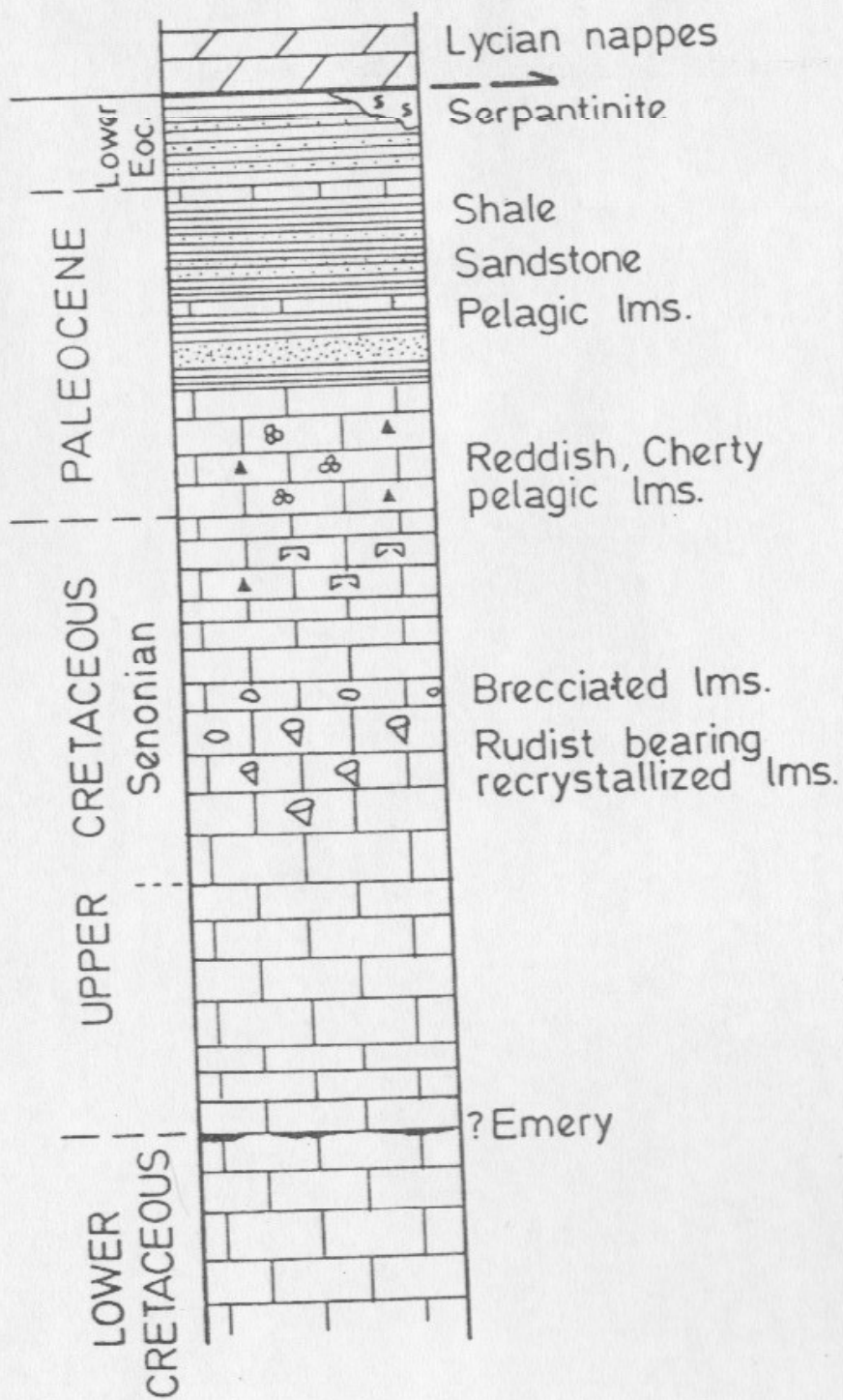
Kömürburnu (Akbük). No. MK. 26. x0.8.

Note the shell wall is very thick probably in the siphonal area.

Fig. 11: Sauvagesia cf. tenuicostata POLSAK

Saplıada (Akbük). No. MS. 36. x0.8.

L: ligamental ridge, S and E: pillars. The specimen occurs also in the sections of Sauvagesia sp.



Vaccinites sp.

Description: Some sections of the lower valves have a partly preserved ligamental ridge (L) and siphonal pillars S and E.

Locality: Kömürburnu (NW of Akbük) and Asınyeniköy (NW of Milas).

Genus Sauvagesia CHOFFAT 1986

Sauvagesia cf. tenuicostata POLSAK 1967

(Pl. I. fig. 11)

1967 Sauvagesia tenuicostata- Palsak, p. 86, pl. I, fig. 1-5, pl. LI, fig. 1-4,
pl. LII, fig. 1-7.

1973 Sauvagesia tenuicostata- Plenicar, p. 190, pl. 3, fig. 1.

1975 Sauvagesia tenuicostata- Civitelli, Mariotti, p. 96, fig. 9.

1976 Sauvagesia tenuicostata- Lupu, p. 133, pl. XXI, fig. 3 a-b, 4.

1977 Sauvagesia tenuicostata- Pons, p. 75, pl. LXXIII, fig. 1-4.

1982 Sauvagesia tenuicostata- Accordi, Carbone, Sirna, p. 772, pl. IV, fig. 1, 5.

Description: Two specimens of the lower valve show an oval section. The diameter ranges from 30x55 mm to 23x45 mm. The shell wall is very thick, about 17 mm in the cardinal area. Ligamental ridge (L) is marked and triangular in shape. Siphonal bands S and E can be observed: posterior band (S) is short and it is about 5 to 6 mm wide, while the anterior band (E) is about 16 to 18 mm wide. The anterior band is wider than the posterior band. Interband (I) is considerably narrower.

Discussion: The wider of the siphonal bands is identical in character of the Sauvagesia tenuicostata POLSAK; however, the surface ornamentation of the lower valve can not be determined in the sections.

Locality: Saplıada (NW of Akbuk) and Asinyeniköy (NW of Milas).

Sauvagesia sp.

(Pl. I., fig. 7, 8a, 11)

Description: Some sections of the lower valve have a subcircular shape. The diameter varies from 30x25 mm to 40x26 mm. The ligamental ridge (L) is subtriangular in shape. Siphonal bands S and E and also Interband (I) are not clearly preserved. Probably siphonal bands S and E are narrower.

Locality: Around Akbuk, Milas, Denizli, and Akhisar.

Genus Durania Douvillé 1908

Durania sp

(Pl. I., fig. 8b, 10)

Description: The sections are subcircular or ovaloid. The diameter is generally small, about 20x25 mm. However, a single section (Pl. I., fig. 10) is larger, its diameter is 50x60 mm and its shell wall is very thick, especially in siphonal area (26 mm). The ligamental ridge (L) is absent. The siphonal bands are probably narrower.

Locality: Kömürburnu and Saplıada (NW of Milas), Asinyeniköy and Yeniköy (NW of Milas).

Genus Radiolites LAMARCK 1801

Radiolites sp.

Description: Some sections of the lower valves are circular in shape. The diameter is variable from 10 mm to 22 mm. The ligamental ridge (L) is long (8 mm). Siphonal bands S and E are not clearly observed.

Locality: Kömürburnu (NW of Akbük), Akdag (SE of Milas) and around Görenez Mountain (Akhisar).

STRATIGRAPHY

Rudist bearing recrystallized limestones of the Mesozoic sequence crop-out in the southern and northern parts of the Menderes Massif, and their stratigraphic characters are as follows:

South of the Menderes Massif

The Mesozoic sequence extends in the form of an arc (fig. 1), and consists of platform-type marbles characterized by the presence of the baukite-emery lenses, in the south of the Menderes Massif. Previous studies (Dirr, 1975; Caglayan et al., 1980; Konak et al., 1987) suggest that the lower levels of the sequence contain foraminifers indicating an Upper Triassic-Jurassic-Lower Cretaceous age, whereas, in the upper levels only rudist fragments conferring an Upper Cretaceous age occur.

In detail, the rudists are found towards the upper levels of the sequence consisting of dirty white-dark colored, medium to thick bedded, 10 to 15 m thick, recrystallized limestones. Around Milas and Akbük (Fig. 1), the rudist bearing recrystallized limestones show probably lateral and vertical changes with 3 to 4 m thick brecciated recrystallized limestones (Fig. 2). The uppermost section of the sequence consists of 15 to 20 m thick recrystallized limestones without rudists and they grade into reddish, greenish, upper Senonian- lower Paleocene cherty, well bedded, locally medium crystalline pelagic limestones. At the top, flysch like rocks (Konak et al., 1987) consisting of shales, sandstones and crystalline limestones with foraminifers, indicating an Upper Paleocene-Eocene age, are observed. The Lycian nappes tectonically overlie this sequence.

The principal rudist localities are located around the Akbük area in the southern part of the Menderes Massif. They can also be observed in the areas

surrounding Milas and Denizli (Fig. 1)

Akbük area: The rudists are very abundant in the Akbük area and are represented by the Hippuritid and Radiolitid sections.

Hippuritids are located in the Kömürburnu locality, NW of Akbük (Fig. 1), where the sections of Hippurites nabresinensis FUTTERER are dominant and small build-ups of this species have developed (Pl. I, fig. 4). Hippurites cf. colliciatus WOODWARD, Hippurites sp., Vaccinites sp., Sauvagesia sp., Durania sp. and Radiolites sp. are also determined (Pl. I).

Many sections of Radiolitids are found in the Saplıada locality, NW of Akbük (Fig. 1). Hippuritids are rare. Radiolitids are generally represented by large forms of preserving ligamental ridge and/or siphonal region: Sauvagesia cf. tenuicostata POLSAK, Sauvagesia sp., Durania sp., Radiolites sp., Hippurites nabresinensis FUTTERER and Hippurites sp.

Milas area: The rudists are poorly preserved in the Milas area.

To the southwest of Milas, the rudists are observed around Asinyeniköy and Yeniköy localities (Fig. 1), and they are generally fragmented: Sauvagesia cf. tenuicostata POLSAK, Sauvagesia sp., Durania sp., Hippurites cf. colliciatus WOODWARD, Hippurites sp., and Vaccinites sp. can be determined.

To the southeast of Milas, the rudist bearing recrystallized limestones are observed around Akdağ (Fig. 1), where the rudists are represented by fragments of Hippuritids and Radiolitids. However, a single section of species Vaccinites cf. taburni GUISCARDI showing a stratigraphic significance is found (Pl. I, fig. 9). Hippurites sp., Sauvagesia sp. and cf. Radiolites sp. are also determined.

Denizli area: The rudists are very sparse and fragmented to the west of Denizli. Some sections of Hippurites sp. and cf. Sauvagesia sp. can be determined.

North of the Menderes Massif

The Mesozoic sequence shows a less regular extension in the north of the

Massif (Fig. 1), and consists of dark-gray colored, medium thick bedded recrystallized limestones with bauxite-emery lenses. According to new observations (Erdogan and Güngör, 1992), rudist bearing recrystallized limestones of the Görenez Mountain, E of Akhisar (Fig. 1), belong to the Mesozoic sequence of the Menderes Massif. Around Kayaaltı locality and to the north of Selçuk (Fig. 1), the rudist bearing recrystallized limestones are also observed.

The rudists are very rare and fragmented in all the localities of the northern part of the Menderes Massif. The Radiolitid fragments belonging to the genera cf. Radiolites sp. and cf. Sauvagesia sp. can be determined from the recrystallized limestones of the Görenez Mountain.

Stratigraphic positions of the rudists

The rudist species of the southern part of the Menderes Massif are well known in the Mediterranean Province and they allow us to determine the age span of the rudist fauna.

Hippurites nabresinensis is widespread in the Santonian-Campanian of Yugoslavia, Romania, Italy, and the Eastern Alps (Milovanovic, 1934; Plenicar, 1960, 1975; Lupu, 1976; Polsak, 1979; Accordi et al., 1982). This species is also determined in the Maastrichtian of Yugoslavia (Sladic - Trifunovic, 1972) and Bulgaria (Pamouktchiev, 1981).

Vaccinites taburni is known from the upper Coniacian to lower Campanian of Italy, Yugoslavia, Greece and Algeria (Douvillé, 1897, 1910; Parona, 1901, 1926; Pasic, 1957; Pejovic, 1957; Polsak, 1967; Plenicar, 1975; Accordi et al., 1982).

Both of the species, Hippurites nabresinensis and Vaccinites taburni are very abundant in the Santonian limestones of the Izmir-Ankara Zone (Özer, 1989a, b; Erdogan, 1990).

Hippurites colliciatus is widespread in the Senonian of the Eastern Alps, Dinarids, Apennines and Asia Minor (Sánchez, 1981).

Sauvagesia tenuicostata is present in the Santonian-Campanian of Yugoslavia

(Polsak, 1967; Plenicar, 1973) and Italy (Accordi et al., 1982).

The geographic and stratigraphic distributions of the species indicate a Santonian-Campanian age for the rudist fauna of the southern part of the Menderes Massif

The rudist species can not be determined from the recrystallized limestones of the northern part of the Menderes Massif. However, the rudist bearing limestones of Görenez Mountain are upper Campanian age, and those of the Kayaalti locality are Santonian age according to Erdoğan and Güngör (1992).

The rudist bearing recrystallized limestones of the Menderes Massif seem to resemble in point of paleontologic and stratigraphic characters the rudist limestones of the Izmir-Ankara Zone.

The rudist fauna of the southern part of the Menderes Massif shows similarities with the Santonian rudist assemblage of the Izmir-Manisa area. The presence of Hippurites nabresinensis and Vaccinites taburni, support this assertion, because they are significant forms of the Santonian assemblage around Izmir and Manisa (Özer, 1989a, b). The Hippuritids of the southern part of the Menderes Massif, are well preserved and determined than the Radiolitids, like those of the Izmir-Ankara Zone. The brecciated limestones showing lateral and vertical changes with the rudist bearing limestones of the southern part of the Massif, are also observed and well known in the Santonian limestones with rudists of the Izmir area (Erdoğan, 1990).

The rudist fragment undetermined of the upper Campanian recrystallized limestones of the northern part of the Menderes Massif, around Görenez Mountain (Akhisar), which can be correlated with the bioclastic limestones of the Izmir-Manisa area, where the rudist fragments are also very abundant in the same stratigraphic level (Özer and Irtem, 1982; Özer, 1989a; Erdoğan, 1990).

The rudists have been noted from the marbles with emery of the unit of Vourliotes to the east of Samos (Greece) by Papanikalau (1979); according to the presence of rudists, the Upper Cretaceous age has been conferred on the marble.

The sections of rudists in Fig. 4 of Papanikolaou (1979), seems to belong to the Radiolitids (probably Sauvagesia and Durania) showing affinities with those of the Menderes Massif (compare with Pl. I. fig. 7.8.10.11): but, there is a need for paleontologic study of the rudists of Samos to better understand the stratigraphic positions of the marbles with emery in the Cycladic Massif.

REFERENCES

- ACCORDI, G., CARBONE, F. and SIRNA, G. (1982). Relationship among tectonic setting substratum and benthonic communities in the Upper Cretaceous of Northeastern Matase (Malise, Italy). *Geologica Romana*, Roma, 21, 755-793.
- CIVITELLI, G. and MARIOTTI, G. (1975). Paleontological and sedimentological characteristics of the Senonian of Pietrasecca (Carseolani Mountains, Central Apennines). *Geologica Romana*, Roma, 14, 87-123.
- CAGLAYAN, M.A., ÖZTURK, E.M., ÖZTURK, Z., SAV, H. and AKAT, U. (1980). Some new data for southern Menderes Massif and structural interpretation (in Turkish). *Jeoloji Mühendisleri Odası yayın organı*, Ankara, 10, 9-19.
- DOUVILLE, H. (1897). Etudes sur les Rudistes. Révision des principales espèces d'Hippurites. *Mém.Soc.Géol.France*, Paris, 6, 2-6, 236 p.
- DOUVILLE, H. (1910). Etudes sur les Rudistes d'Algérie, d'Egypte, du Libon et de la Perse. *Mém.Soc.Géol.France*, Paris, 41, 84 p.
- DURR, S. (1975). Über Alter und geotektonische Stellung des Menderes-Kristallins/SW-Anatolien und seine Aequalentin in der mittleren Aegais. Thesis, Marburg, 106 p.
- ERDOĞAN, B. (1990). Stratigraphy and tectonic evolution of Izmir-Ankara Zone between Izmir and Seferhisar. *TPJD Bull.*, Ankara, 2, 1, 1-20.
- ERDOĞAN, B. and GÜNÇÖR, T. (1992). Stratigraphic and tectonic evolution of the northern edge of the Menderes Massif. 6th Congress of the Geological Society of Greece (in this volume).
- KONAK, N., AKDENİZ, N. and ÖZTURK, E.M. (1987). Geology of South of Menderes Massif. IECF Project N.5, Guide Book for the Field Excursion Along Western Anatolia, Turkey. Mineral Research and Exploration of Turkey, Ankara, 42-53 p.

- LUPU, D. (1976). Contributions à la Paléontologie du Jurassique terminal et Crétacé des Carpates. Mém.Inst.Géol.Géoph. Bucarest, 24, 83-151.
- MILOVANOVIC, B. (1934). Les Rudistes de la Yougoslavie. I. Ann. Géol.Pen. Balk., Beograd, 12 (1), 178-254.
- ÖZER, S. AND IRTEM, O. (1982). Geological setting stratigraphy and facies characteristics of the Upper Cretaceous limestones in the Isiklar-Altındağ (Bornova-Izmir) area. Bull.Geol.Soc.Turkey, Ankara, 25, 41-47.
- ÖZER, S. (1989a). Sur une faune d'Hippuritides des calcaires du Crétacé Supérieur de la zone d'Izmir-Ankara (Anatolie occidentale). Interêt Paléontologique et stratigraphique. Revue de Paléobiologie, Genève, 8, 2, 335-343.
- ÖZER, S. (1989b). Distributions stratigraphiques et géographiques des Rudistes du Crétacé Supérieur en Turquie. First International Conference on Rudists 1988, Belgrade, Serbian Geol.Soc. and Inter.Paleont. Associa. (in press).
- PAMOUKTCHIEV, A. (1981). Les fossiles de Bulgarie (Crétacé Supérieur). Acad.Bulg. Sciences, Sofia, 1-233.
- PAPANIKOLACU, D. (1979). Unités tectoniques et phases de déformation dans L'île de Samos, Mer Egée, Grèce. Bull.Soc.géol. France, Paris, 21, 6, 745-752.
- PARONA, C.F. (1901). Le Rudiste e le Chamacee di s. Polo Matese raccolte de Francesco. Bassoni. Mem.R.Acc.Sc.Torino, Torino, 2, 50, 195-214.
- PARONA, C.F. (1926). Ricerche sulle Rudiste e su altri fossili del Cretacico Superiore del Carso goriziano e dell'Istria. Mem.Ist.Geol.R.Univ. Padua, 7, 56 p.
- PASIC, M. (1957). Biostratigrafski odnosi i tektonica gornje krede sire okolice Kosjerica (Zap. Srbija). Geol.Inst. "Jovan Zuyovic", Beograd, 7.
- PLENICAR, M. (1960). Stratigrafski razvoj Krednin plasti na juznem Primorsken in Notranskem. Geologija, Ljubljana, 6, 63-69.
- PLENICAR, M. (1973). Radiolites from the Cretaceous Beds of Slovenia. Part I. Geologija, Ljubljana, 16, 187-226.
- PLENICAR, M. (1975). Hippuritidae of Nanos and Trieste-Komen plain. Razprave, Classis IV. Historia Naturalis, Ljubljana, 18, 4, 85-115.

- POLSAK, A. (1967). Macrofaune Crétacée de l'Istrie méridionale (Yougoslavie).
Paleont. Jugos., Zagreb, 8. 1-219.
- POLSAK, A. (1979). Stratigraphy and paleogeography of the Senonian biolithitic
complex at Donje Oresje (Mt. Medvednica, North Croatia). Acta Geol., Zagreb,
9. 6. 195-230.
- PONS, J.M. (1977). Estudio estratigráfico y paleontológico des los yacimientos don
Rudistidos del Cret. sup. del Prepirineo de la Prov. de Lérida. Tesis. Fac.
Ciencias UAB. 3. 105.
- SÁNCHEZ, M.V. (1981). Hippuritidae y Radiolitidae (Bivalvia) Catalogo de
Especies. Universidad Autonoma de Barcelona Publicaciones de Geologia, No.
15.
- SLADIC-TRIFUNOVIC, M. (1972). Senonian limestones with Orbitoides and
Rudists from Kozluk (Northeastern Bosnia). Ann. Géol. Pen. Balk.,
Beograd, vol. 37, No 2, p. 111-150, 15 fig., 13 pl.