Turkish Journal of Earth Sciences (Turkish J. Earth Sci.), Vol. 18, 2009, pp. 393–425. Copyright ©TÜBİTAK
doi:10.3906/yer-0612-5 First published online 10 September 2008

Benthonic Foraminiferal Biostratigraphy of the Upper Cretaceous (Middle Cenomanian–Coniacian) Sequences of the Bey Dağları Carbonate Platform, Western Taurides, Turkey

BİLAL SARI[1], KEMAL TASLI[2] & SACİT ÖZER[1]

[1] Dokuz Eylül Üniversitesi, Mühendislik Fakültesi, Jeoloji Mühendisliği Bölümü, Tınaztepe Yerleşkesi, Buca, TR–35160 İzmir, Türkiye
(E-mail: bilal.sari@deu.edu.tr)

[2] Mersin Üniversitesi, Mühendislik Fakültesi, Jeoloji Mühendisliği Bölümü, Çiftlikköy Kampusü, TR– 33340 Mersin, Türkiye

Received 20 December 2006; revised typescript received 07 May 2008; accepted 23 July 2008

Abstract: Identification of the benthonic foraminiferal assemblages from ten stratigraphic sections from the inner platform limestones of the Middle Cenomanian–Coniacian successions of the Bey Dağları carbonate platform (BDCP) allowed the recognition of one biozone and two subzones. The lower part of the platform limestones (Middle–Upper Cenomanian) is represented by relatively rich benthonic foraminiferal assemblages, while the upper part (Turonian–Coniacian) contains poor assemblages. The benthonic foraminiferal assemblages determined in the BDCP are dominated by long-ranging species. The shorter-ranging, stratigraphical index species have been selected to date the Upper Cretaceous platform limestones of the BDCP based on the distributions of the species in the circum-Mediterranean region. The *Pseudolituonella reicheli-Pseudorhapydionina dubia* Concurrent Range Zone is defined from the Middle–Upper Cenomanian platform limestones. The biozone includes the *Cisalveolina lehneri* Subzone and the *Coxites zubairensis* Subzone of Middle Cenomanian and Upper Cenomanian age respectively. The first occurrences of *Moncharmontia apenninica-compressa* and *Pseudocyclammina sphaeroidea* indicate the Late Turonian and the Coniacian respectively.

The spread of hemipelagic limestones in the BDCP during the Coniacian shows that neritic accumulation on the BDCP persisted from the Middle Cenomanian to the Coniacian. These data indicate that the global sea level rise at the Cenomanian–Turonian boundary, which caused the general demise of many Tethyan carbonate platforms, did not result in deepening on the BDCP.

Key Words: benthonic foraminifera, biostratigraphy, Upper Cretaceous, Bey Dağları carbonate platform, western Taurides

Bey Dağları Karbonat Platformu Üst Kretase (Orta Senomaniyen–Koniasiyen) İstiflerinin Bentonik Foraminifer Biyostratigrafisi, Batı Toroslar, Türkiye

Özet: Bey Dağları karbonat platformunun (BDKP) Orta Senomaniyen–Koniasiyen yaşlı platform içi karbonatlarından ölçülen on stratigrafik kesitten saptanan bentonik foraminifer toplulukları bir bentonik foraminifer biyozonu ve iki alt zonun tanımlanmasını sağlamıştır. Platform karbonatlarının alt bölümü (Orta–Üst Senomaniyen) bağıl olarak zengin bentonik foraminifer toplulukları ile temsil edilir. Üst bölüm ise (Turoniyen–Koniasiyen) fakir topluluklar ile simgeseldir. BDKP'de saptanan bentonik foraminifer toplulukları düşey dağılımı geniş türlerce baskındır. BDKP'nin Üst Kretase kireçtaşlarını yaşlandırmak amacıyla, düşey dağılımı dar, stratigrafik açıdan karakteristik türler, Akdeniz kuşağındaki stratigrafik dağılımları esas alınarak seçilmiştir. *Pseudolituonella reicheli-Pseudorhapydionina dubia* Aşmalı Menzil Zonu platform kireçtaşlarının Orta–Üst Senomaniyen bölümünde tanımlanmıştır. Biyozon, sırasıya Orta Senomaniyen ve Üst Senomaniyen'e karşılık gelen *Cisalveolina lehneri* Alt Zonu ve *Coxites zubairensis* Alt Zonu'nu içerir. *Moncharmontia apenninica-compressa* ve *Pseudocyclammina sphaeroidea*'nın ilk ortaya çıkışları sırasıyla Geç Turoniyen ve Koniasiyen'i işaret eder.

BDKP'nin Koniasiyen'de yarıpelajik kireçtaşları tarafından örtülmesi, BDKP'de neritik çökelimin Orta Senomaniyen'den Koniasiyen'e kadar sürdüğünü gösterir. Bu veriler, birçok Tetis karbonat platformunun sona ermesine neden olan Senomaniyen-Turoniyen sınırındaki küresel deniz seviyesi yükselmesinin BDKP'de derinleşmeye neden olmadığını gösterir.

Anahtar Sözcükler: bentonik foraminifer, biyostratigrafi, Üst Kretase, Bey Dağları karbonat platformu, batı Toroslar

Introduction

Larger benthonic foraminifera are important tools in dating the Cretaceous platform carbonates, as important pelagic deposit markers such as ammonites and/or planktonic foraminifera are usually absent or very rare in neritic environments (Arnaud *et al.* 1981; Schroeder & Neumann 1985). However, many factors limit the stratigraphic usage of benthonic foraminifera including: (i) benthonic foraminifera are facies dependent and sensitive to environmental changes (e.g., Hallock 1982; Murray 1991), (ii) many Cretaceous carbonate platforms that hosted larger benthonic foraminifera were sensitive to sea-level changes caused by eustacy and/or tectonic movements and so faced local and/or widespread emergence and drowning events (Chiocchini *et al.* 1984).

Hence, the apparent ranges of Late Cretaceous benthonic foraminifera may not correspond to their true evolutionary stratigraphic ranges (first appearance-last appearance) and they should be used for biostratigraphic correlations with great care, even in environments such as long-lasting carbonate platforms (Gusic *et al.* 1988; Caus *et al.* 2003). Although several local Late Cretaceous benthonic foraminiferal biozonations have been proposed, a refined, standard biozonation applicable across the entire Mediterranean region is still lacking.

Over nearly four decades many studies have been carried out on the Bey Dağları Autochthon. Although neritic limestones are widely distributed throughout the Bey Dağları Autochthon, benthonic foraminiferal biostratigraphy of the Upper Cretaceous neritic limestones has been the subject of only a few detailed studies, including Bignot & Poisson (1974), Poisson (1977), Farinacci & Yeniay (1986), Sarı (1999, 2006b).

The objective of this paper is to establish a detailed benthonic foraminiferal zonation of the Upper Cretaceous (Middle Cenomanian–Coniacian) neritic limestones of the BDCP and to correlate it with adjacent carbonate platforms. The study is based on twenty-two stratigraphic sections measured from the northern part of the Bey Dağları Autochthon. Ten representative sections are illustrated and described herein (Figure 1).

Geological Setting of the Bey Dağları Carbonate Platform (BDCP)

The Bey Dağları autochthon extends NE–SW for approximately 150 km from Kaş to Isparta (Figure 1), and represents a segment of the Mesozoic Tethyan platform on which carbonate accumulation persisted from the Triassic to the Early Miocene. This segment was overthrust by the Antalya nappes in the east and by the Lycian nappes in the northwest, and is partially exposed in the Göcek window (Özgül 1976; Poisson 1977; Farinacci & Köylüoğlu 1982; Naz *et al.* 1992; Robertson 1993). Numerous authors (e.g., Şengör & Yılmaz 1981; Farinacci & Köylüoğlu 1982; Poisson *et al.* 1984; Robertson & Dixon 1984; Robertson & Woodcock 1984; Waldron 1984; Farinacci & Yeniay 1986; Robertson *et al.* 1991, 2003; Robertson 1993; Poisson *et al.* 2003) have shown that during the Mesozoic, the autochthonous unit was part of a larger crustal fragment of the African palaeomargin which can be traced from the Taurides and Zagrides in the east, to the Hellenides, Dinarides and Apennines in the west (e.g., Dercourt *et al.* 1993; Stampfli & Mosar 1999; Robertson 2002).

The BDCP was one of many Mesozoic Tethyan carbonate platforms initiated when blocks that had rifted from the northern margin of Gondwana during the mid-Late Triassic (following Late Permian–Early Triassic rifting) and now distributed throughout the southern part of the Eastern Mediterranean region, were immersed (Robertson 2002). The BDCP underwent the entire predictable

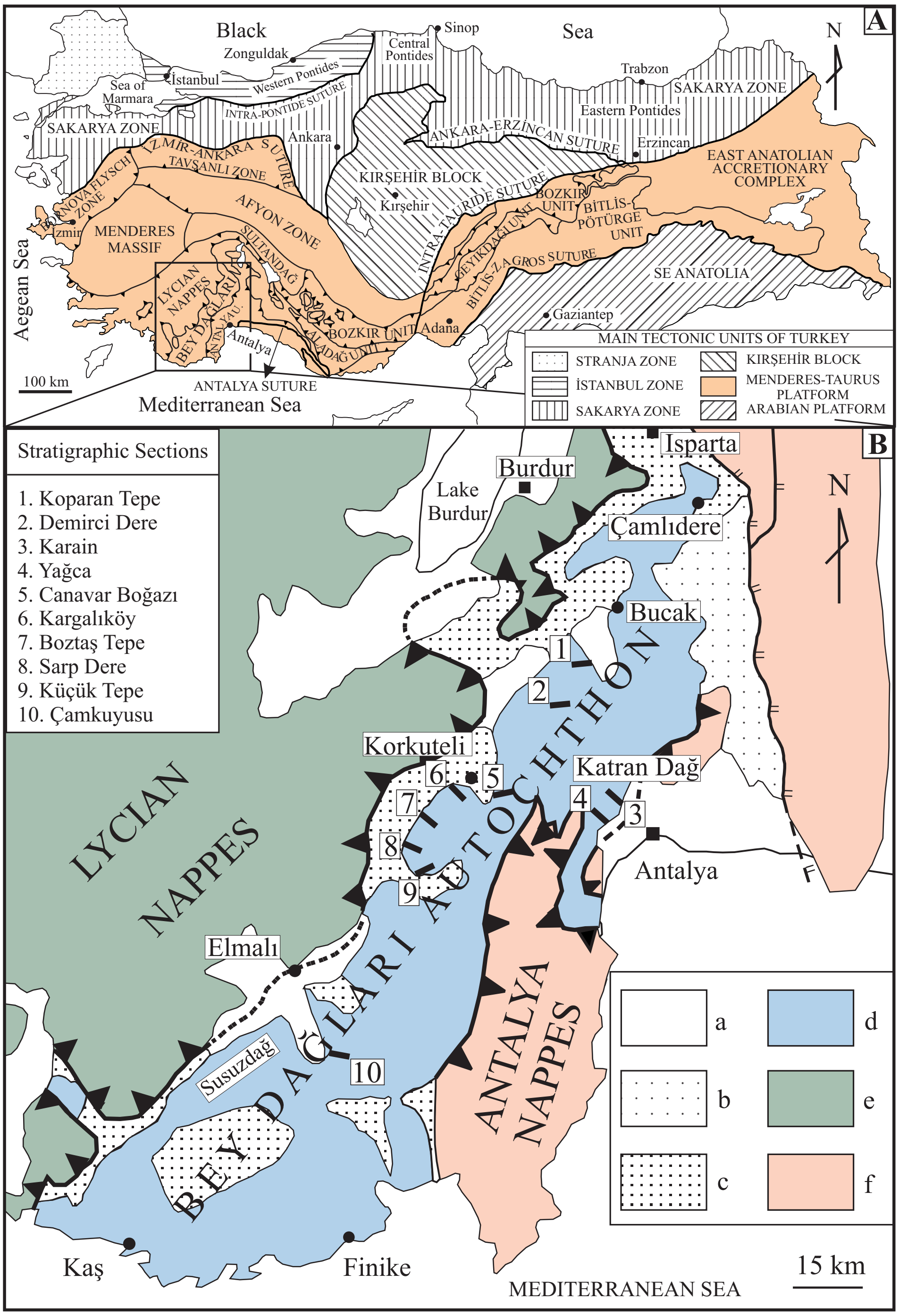


Figure 1. **(A)** Main tectonic units of Turkey (after Görür & Tüysüz 2001), **(B)** main tectonic belts of the western Taurides (simplified from Poisson *et al.* 1984) and locations of measured stratigraphic sections. Key to symbols: a– Upper Miocene–Quaternary post-compressional tectonic formations, b– Neogene formations preceding the Aksu compressional event, c– Lower and Middle Miocene of the Bey Dağları Autochthon, d– Bey Dağları Autochthon (Upper Triassic to Oligocene), e– Antalya nappes, f– Lycian nappes.

geodynamic spectrum of the Wilson cycle: rifting, drifting, transtension, transpression, and collision (Bosellini 1989), and is reconstructed here as an isolated carbonate platform (Figure 2) that was the southernmost representative of the girdle of intraoceanic platforms extending from the western Mediterranean to the eastern Mediterranean Neotethys during the Late Cenomanian (Dercourt *et al*. 2000).

The Bey Dağları autochthon was subjected to different tectonic regimes during the Late Cretaceous, a time of intense tectonic movements in the eastern Mediterranean region. The Late Cretaceous tectonic activities were probably responsible for submerging the carbonate platforms, opening small oceanic basins and the collision of different tectonic units. Many studies have shown that the Upper Cretaceous sequences are characterized by breaks in deposition and important facies variations in both neritic and pelagic carbonates (Poisson 1977; Gutnic *et al*. 1979; Farinacci & Köylüoğlu 1982; Farinacci & Yeniay 1986; Özkan & Köylüoğlu 1988; Naz *et al*. 1992; Sarı 1999, 2006a,b; Sarı & Özer 2001, 2002; Sarı *et al*. 2004).

Materials and Methods

Eight hundred and sixty-one thin sections of the limestone samples were collected from the twenty-two measured stratigraphic sections and examined in order to establish the biostratigraphic framework, and to date and detect the depositional environments of the BDCP neritic limestones. Ten representative stratigraphic sections were selected to construct the biostratigraphical framework; other sections were characterized by either relatively poor benthonic foraminiferal assemblages, or generally similar distributions (Figure 1).

Benthonic foraminiferal biozonation is established based on the first and last occurrence datums of the taxa in accordance with the rules recommended by the North American Stratigraphic Code (North American Commission on Stratigraphic Nomenclature) (NASC 1983) and the International Stratigraphic Guide (ISG) (Salvador 1994).

Previous Studies

Several studies have dealt with the benthonic foraminiferal biostratigraphy of the Upper Cretaceous neritic limestones of the Bey Dağları autochthon. Altınlı (1944) was the first to record the presence of Cenomanian benthonic foraminifera in the area between Burdur and Isparta. Subsequently, Blumenthal (1960-1963) found *Actaeonella* and *Orbitolina* in Pınarbaşı and assigned these levels to the Aptian and Cenomanian–Turonian. Colin (1962), Tolun (1965) and Lefevre (1966) described the Cenomanian limestones with few benthonic foraminifera.

Poisson (1967) was the first author to describe a detailed benthonic foraminifera assemblage from the Korkuteli area, noting that the assemblage comprising *C. gradata*, *D. schlumbergeri*, *P.* cf. *reicheli*, *O.* cf. *ovum* and *Cuneolina* sp. indicated a Late Cenomanian age.

Bignot & Poisson (1974) described a rich benthonic foraminifera assemblage in the Katran Dağ area. They identified two different horizons, one with *P. laurinensis*, and the other one with *S. viallii*. They noted that the two species were not found together and they were content to accept that the level with *S. viallii* underlay the level with *P. laurinensis* on the basis of previous data from the Mediterranean region, namely that *P. laurinensis*, associated with *C. gradata* and *C. fraasi*, is accepted as an indicator of the Late Cenomanian in Italy (De Castro 1965, 1966), Croatia (Husinec 2002), Portugal (Berthou & Philip 1972), Greece (Guernet 1971; Bignot *et al*. 1971; Fleury 1972), Lebanon (Saint-Marc 1969, 1970) and probably in Iran (Sampo 1969). *Sellialveolina viallii* was found to appear before the first occurrences of *P. laurinensis* and *C. fraasi* in Italy (Sartoni & Crescenti 1962; Colalongo 1963; Devoto 1964; Farinacci & Radoicic 1965; de Castro 1966; Angelucci & Devoto 1966), Croatia (Radoicic 1960), Greece (Fleury 1972), Lebanon (Saint-Marc 1969, 1970) and Tunisia (Bismuth *et al*. 1967).

Poisson (1977) noted the presence of the Cenomanian assemblages through the stratigraphic sections in his detailed thesis.

Farinacci & Yeniay (1986) also found rich benthonic foraminiferal assemblages through the

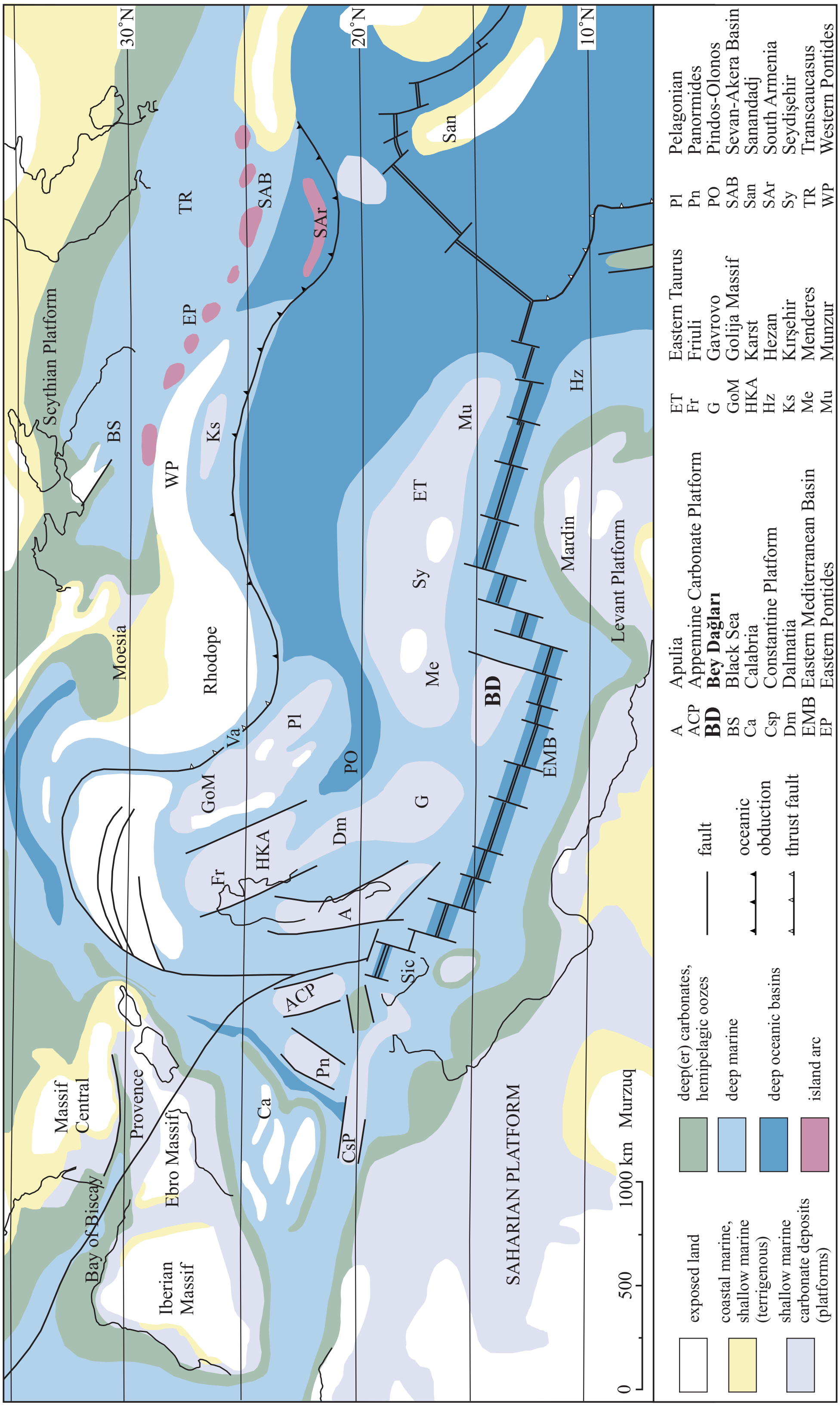


Figure 2. Late Cenomanian palaeogeography of the Mediterranean Tethys (simplified and modified from Dercourt *et al.* 2000). Note that Bey Dağları (BD) is restored as an isolated carbonate platform surrounded by pelagic basins.

eight stratigraphic sections scattered throughout the autochthon. They noted that the assemblages indicated Cenomanian age and were overlain by the Lower Turonian with abundant rudist fragments, calcisphaerulids and planktonic foraminifera.

Recently Sarı (2006b) established the Upper Cretaceous biostratigraphy of the BDCP based on benthonic foraminifera, planktonic foraminifera and rudists.

Upper Cretaceous Litho-biostratigraphy and Depositional Environment of the BDCP

The Upper Cretaceous sequence of the northern area of the autochthon is represented by two formations (Figure 3). The Bey Dağları Formation comprises thick neritic limestones at the base and thin hemipelagic limestones at the top. Approximately 700-m-thick, the Middle Cenomanian–Coniacian neritic part consists of shallow-water platform limestones, that were deposited in peritidal environments. The neritic limestones are capped by a 26-m-thick succession of Coniacian–Santonian hemipelagic limestones. Thin- to medium-bedded cherty pelagic limestones of the Late Campanian–Late Maastrichtian Akdağ Formation reach a total thickness of 100 m, and disconformably overlie various stratigraphic levels of the underlying Bey Dağları Formation. The pelagic marls of the Palaeogene locally begin with conglomerate bases, and disconformably overlie the different stratigraphic levels of the Upper Cretaceous sequence (Figure 3).

Neritic limestones of the Katran Dağ area are represented by the rudist-rich (mainly caprinids) Middle to Late Cenomanian Yağca Köy Formation, which is disconformably overlain by pelagic deposits of the Karakirse Formation. The lowest part of the Karakirse Formation comprises large pebbles and blocks derived from the underlying rudist-rich limestones of the Yağca Köy Formation.

Benthonic foraminifera and rudists are the only fossil components used to date the neritic limestones of the BDCP. The lower part of the neritic Middle–Upper Cenomanian limestones is relatively rich in benthonic foraminifera. They are abundant, but characterized by poor generic diversity probably due to restricted environment. The upper part, which corresponds to the Turonian–Coniacian interval, has a poor assemblage.

Two rudist formations were observed in the neritic limestones. The lower level, in the Middle–Upper Cenomanian of the Sarp Dere Section, is represented by scarce and unidentifiable caprinids associated with radiolitids (caprinid lithosome). The upper level is dominated by hippuritids and found near the top of the platform limestones (hippuritid lithosome). The fauna is represented by the dominance of *V. praegiganteus*, which is accompanied by rare *V. inferus*, *H socialis*, *H. resecta* and radiolitids in the Korkuteli area. The $^{87}Sr/^{86}Sr$ values of well preserved low-Mg calcite of the shells of *V. praegiganteus* show that the age of this level is Late Turonian (Sarı *et al*. 2004). The upper rudist level, which prominently occurs in the Korkuteli area, is observed patchily throughout the northernmost part of the platform. The occurrence of *M. heraki*, *D. bassani*, *B. angulosus* in the Koparan Tepe section also supports the Late Turonian age obtained by Sr-isotope analysis.

The post-Late Turonian faunal change (probably in the Coniacian) from predominantly rudists and benthonic foraminifera to planktonic foraminifera, indicates an incipient drowning of the platform and subsequent establishment of hemipelagic conditions on the platform that lasted until the end of the Santonian. The limestones deposited in hemipelagic conditions are massive, cream-coloured, fractured and contain rare planktonic foraminifera and abundant calcispheres. Both the neritic and hemipelagic limestones are massive and cream-coloured and similar in appearance (i.e. textures on broken, fresh surface are the same), hence they are hard to differentiate in the field. A special microfacies, containing abundant crinoids enclosed by syntaxial cement, has been observed between the neritic and hemipelagic facies in some stratigraphic sections. The crinoid grains enclosed by syntaxial cement are characteristic features of the drowning phase (Flügel 2004). Besides, there is no evidence to support an intense karstification before inundation. The maximum thickness of the hemipelagic levels was measured in the Kocaboğaz Dere section and is 26 m (Sarı 2006b).

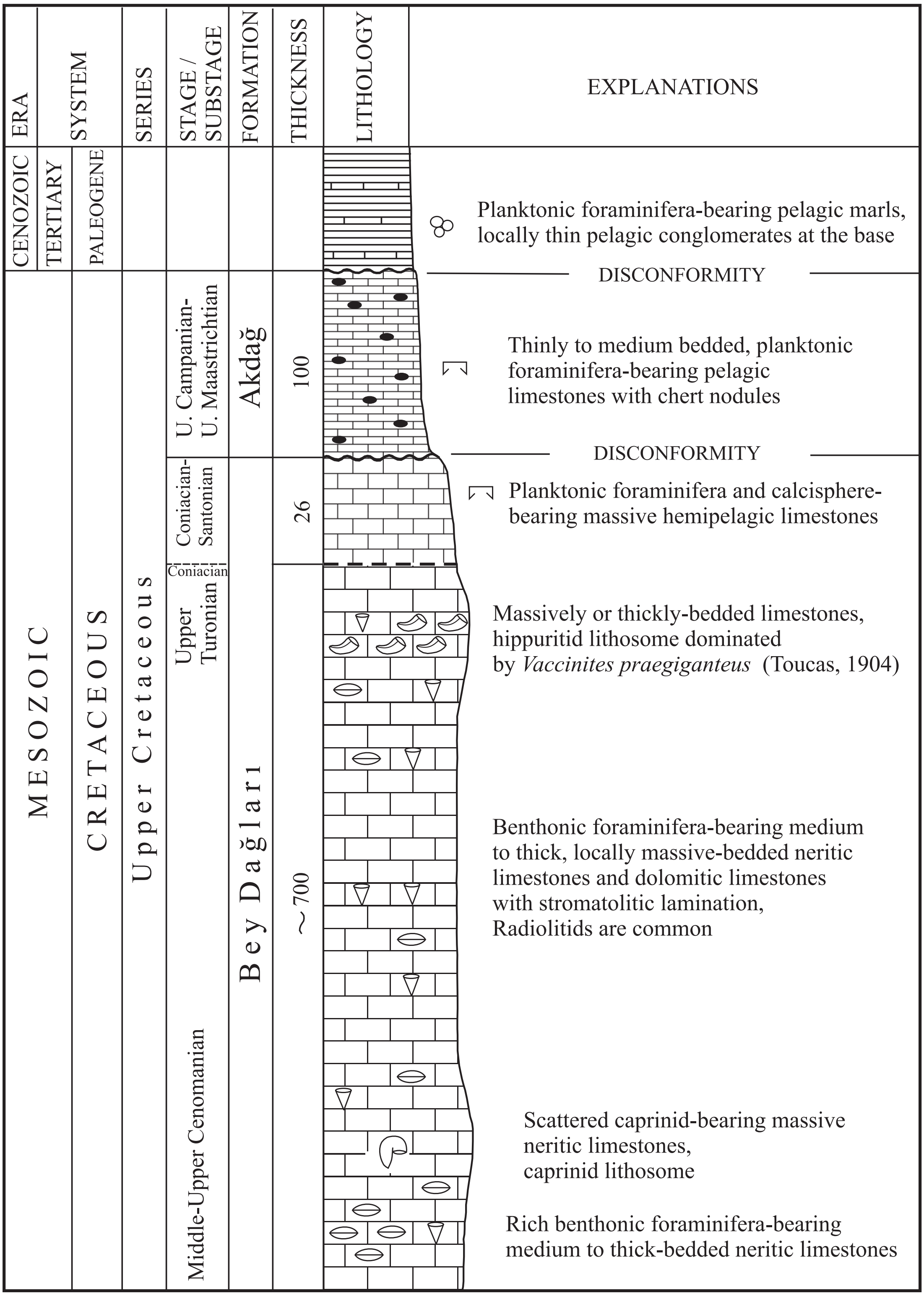


Figure 3. Generalized stratigraphic column of the northern part of the Bey Dağları Autochthon. (see Figure 4 for explanations).

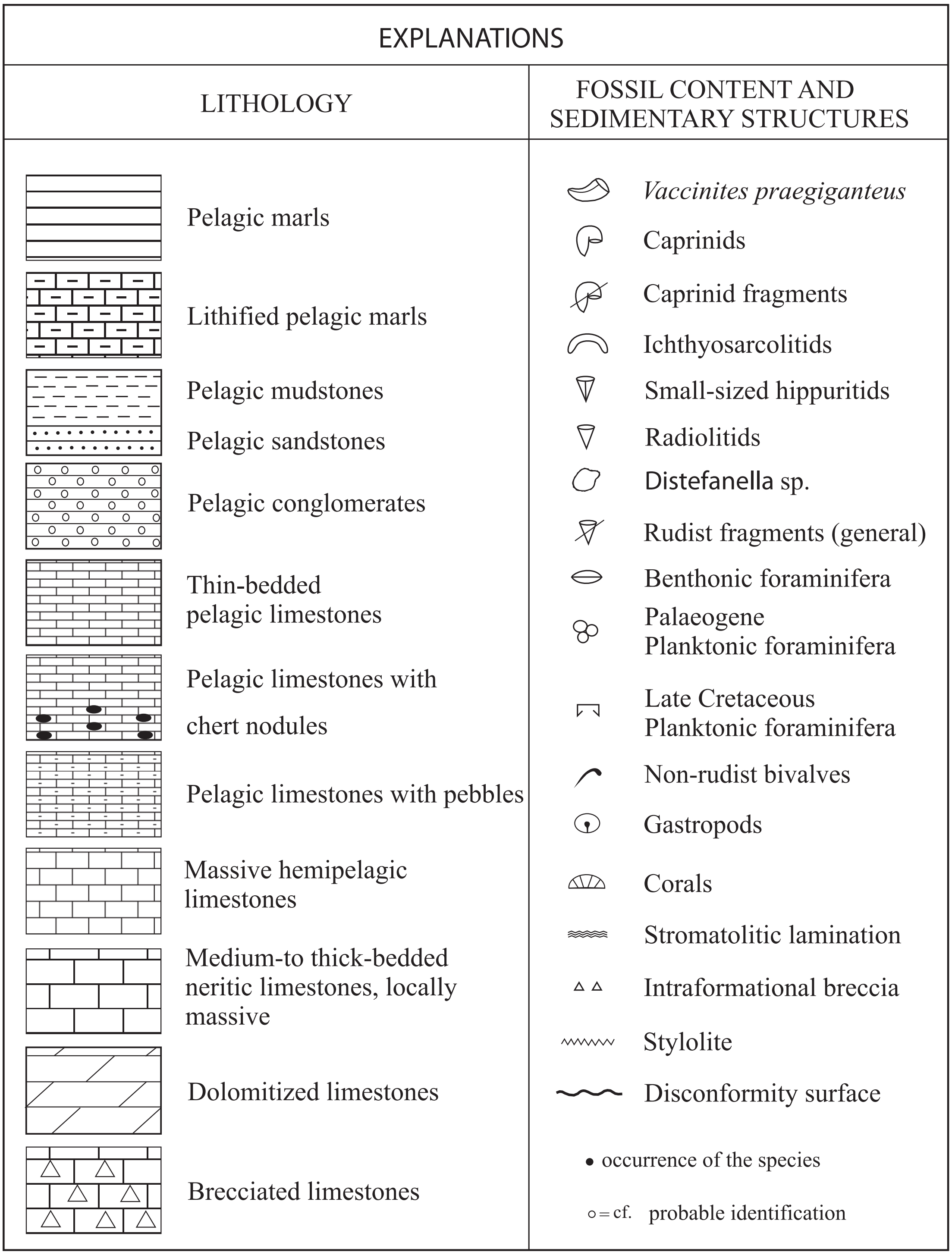


Figure 4. Lithology, fossil and sedimentary structure explanation for all measured stratigraphic sections.

Neritic limestones of the Bey Dağları Formation mainly accumulated in a platform interior environment that existed from Middle Cenomanian to Coniacian. Microfacies analyses of neritic limestones have indicated peritidal (tidal flat, ponds and channels), subtidal, shelf (restricted circulation), shelf lagoon (open circulation), winnowed edge, organic build up and foreslope environments (Sarı & Özer 2001; Sarı 2006b). These are represented by several major facies, including (a) laminated peloidal packstone and fenestral mudstone microfacies, (b) alternating cryptalgal and laminated peloidal packstone microfacies, (c) sparse benthonic foraminifera-bearing non-laminated peloidal packstone/grainstone microfacies, (d) rich benthonic foraminifera-bearing wackestone/packstone microfacies, (e) Rudist fragments-bearing packstone microfacies (Sarı & Özer 2001; Sarı 2006b). The planktonic foraminifera-bearing Coniacian–Santonian massive limestones were deposited in hemipelagic environments (Sarı 2006a,b).

The neritic limestones of the Katran Dağ area (Karain and Yağca sections) are represented by the Yağca Köy Formation and have different facies characteristics from the other stratigraphic sections probably as a result of a different palaeogeographic evolution. The sequence in the Katran Dağ area comprises Middle Cenomanian caprinid-rich neritic limestones and is dominated by the winnowed bioclastic rudstone/grainstone microfacies with rich rudist fragments and rare corals and gastropods. Coarse bioclastic grains are well-rounded, coated with micrite envelopes and replaced by sparry calcite. The microfacies indicates the dominance of the winnowed platform edge environment, where lime mud is removed because of constant wave action, at or above wave base (Wilson 1975; Flügel 2004). The rudstone/grainstone microfacies occasionally alternate with the 'coral framestone', 'floatstone with rudist fragments and intraclasts' and 'packstone with benthonic foraminifera and rare intraclasts' microfacies (Sarı 2006b).

Measured Stratigraphic Sections

As almost each stratigraphic section represents different biostratigraphic data, biostratigraphic characteristics of each section will be presented separately from north to south of the area investigated (see Figure 1 for location of the sections).

Koparan Tepe Section

The occurrence of *C. lehneri* in the 36-m-thick lower part of the 230-m-thick succession suggests a Middle Cenomanian age (Figures 5 & 6). The middle part of the section is mostly represented by scarce occurrences of the Cenomanian taxa *P. reicheli*, *V. radoicicae*, *P. dubia*, *B. peneropliformis*, *M. cretacea*, *P. parvus*, *T. avnimelechi* and *B. bentori* (Figure 6). The occurrence of *C. fraasi* in sample no. 03-381 suggests a Late Cenomanian age (Figure 6). The last occurrence of the Cenomanian assemblage is seen in sample no. 03-322. The occurrence of *C. zubairensis* in sample no. 03-324 indicates that the age of this level is also Late Cenomanian. The uppermost part of the section is characterized by the Upper Turonian rudist level (hippuritid lithosome) dominated by *V. praegiganteus*. The 62-m-thick interval between the last occurrences of the Cenomanian assemblage and the first occurrence of the rudists may correspond to the Turonian. The benthonic foraminifera in this interval are very rare and include *B. capitata*, which is restricted to this interval. *Nummoloculina regularis* is found in the middle part of this interval (sample no. 03-313). Association of *P. reicheli*, *V. radoicicae* and *B. peneropliformis* with *C. lehneri* in the lower part of the section suggests the occurrence of these species in the Middle Cenomanian (Figure 5). *Pseudorhapydionina laurinensis* appears seven metres above the horizon where *C. fraasi* disappears. *C. gradata*, *T. avnimelechi*, *N. regularis* and *B. bentori* appear in the uppermost part of the Upper Cenomanian in this section (sample no. 03-324-03-322). The absence of bauxitic and lateritic levels, as well as pelagic deposits suggests that platform conditions persisted from the Middle Cenomanian to the Late Turonian at least in this part of the platform.

Demirci Dere Section

The 7-m-thick neritic limestones underlying pelagic limestones include *C. zubairensis*, suggesting a Late

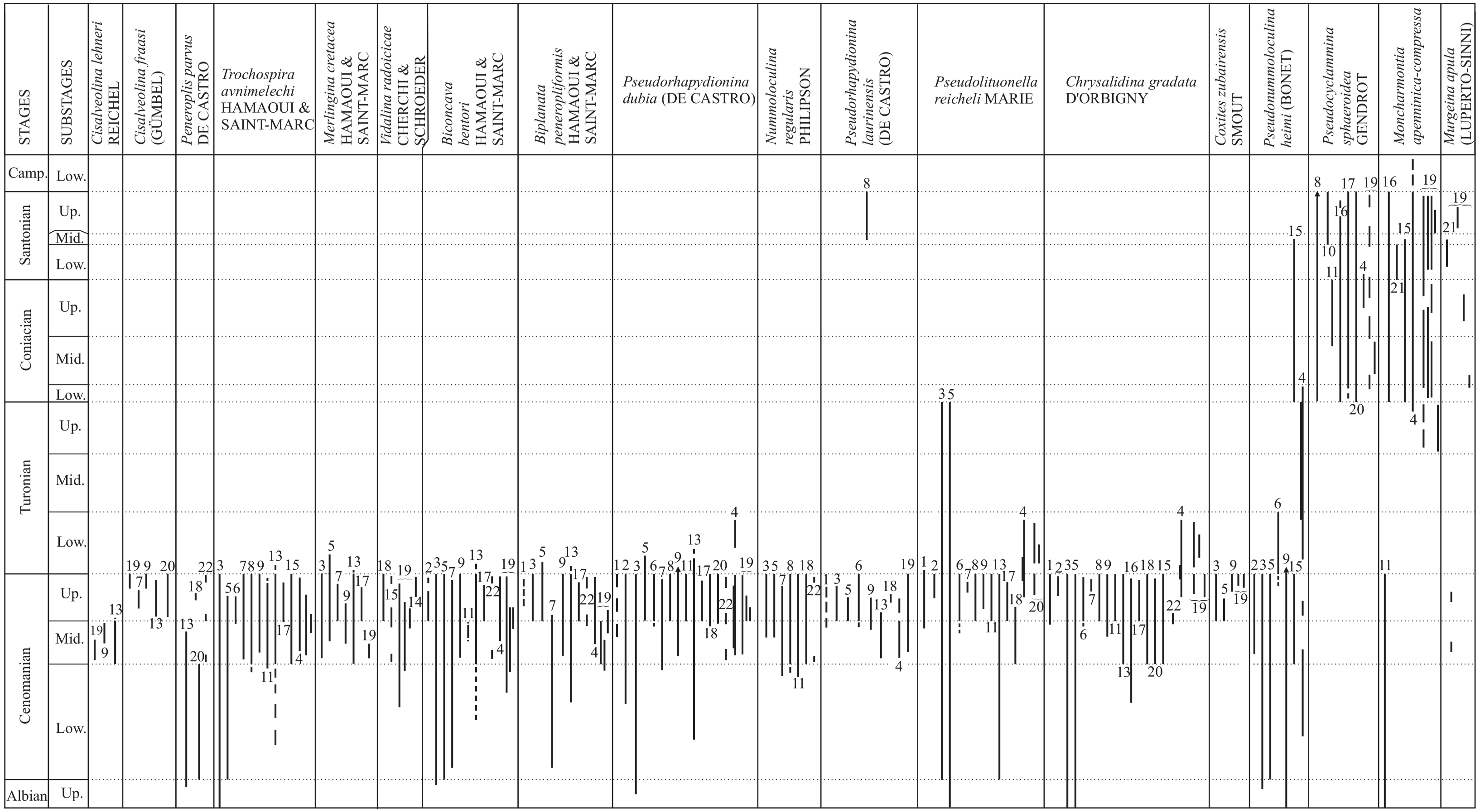


Figure 5. Correlation of stratigraphic distributions of selected benthonic foraminifera from different Tethyan localities, including the Bey Dağları carbonate platform (this study). Data were derived from the following sources; 1– Fleury (1971) Greece, 2– Berthou (1973) Portugal, 3– Saint-Marc (1977) Mesogea, 4– Chiocchini & Mancinelli (1977) Italy, 5– Saint-Marc (1981) Lebanon, 6– Gargouri-Razgallah (1983) Tunisia, 7– Berthou (1984) Portugal, 8– Bilotte (1984) France & Spain, 9– Chiocchini *et al.* (1984) Italy, 10– Tronchetti (1984) France, 11– Bilotte (1985) France & Spain, 12– Moullade *et al.* (1985) Mesogea, 13– Schroeder & Neumann (1985) Mediterranean region, 14– Cherchi & Schroeder (1985) Italy, 15– Gusic *et al.* (1988) Croatia, 16– Fucek *et al.* (1990) Croatia, 17– Grosheny & Tronchetti (1993) France, 18– Velic & Vlahovic (1994) Croatia, 19– Chiocchini *et al.* (1994) Italy, 20– Bilotte (1998) Tethyan & Adriatic, 21– Chiocchini & Mancinelli (2001) Italy, 22– Taslı *et al.* (2006) Turkey (Time scale is adapted from Gradstein *et al.* 1994).

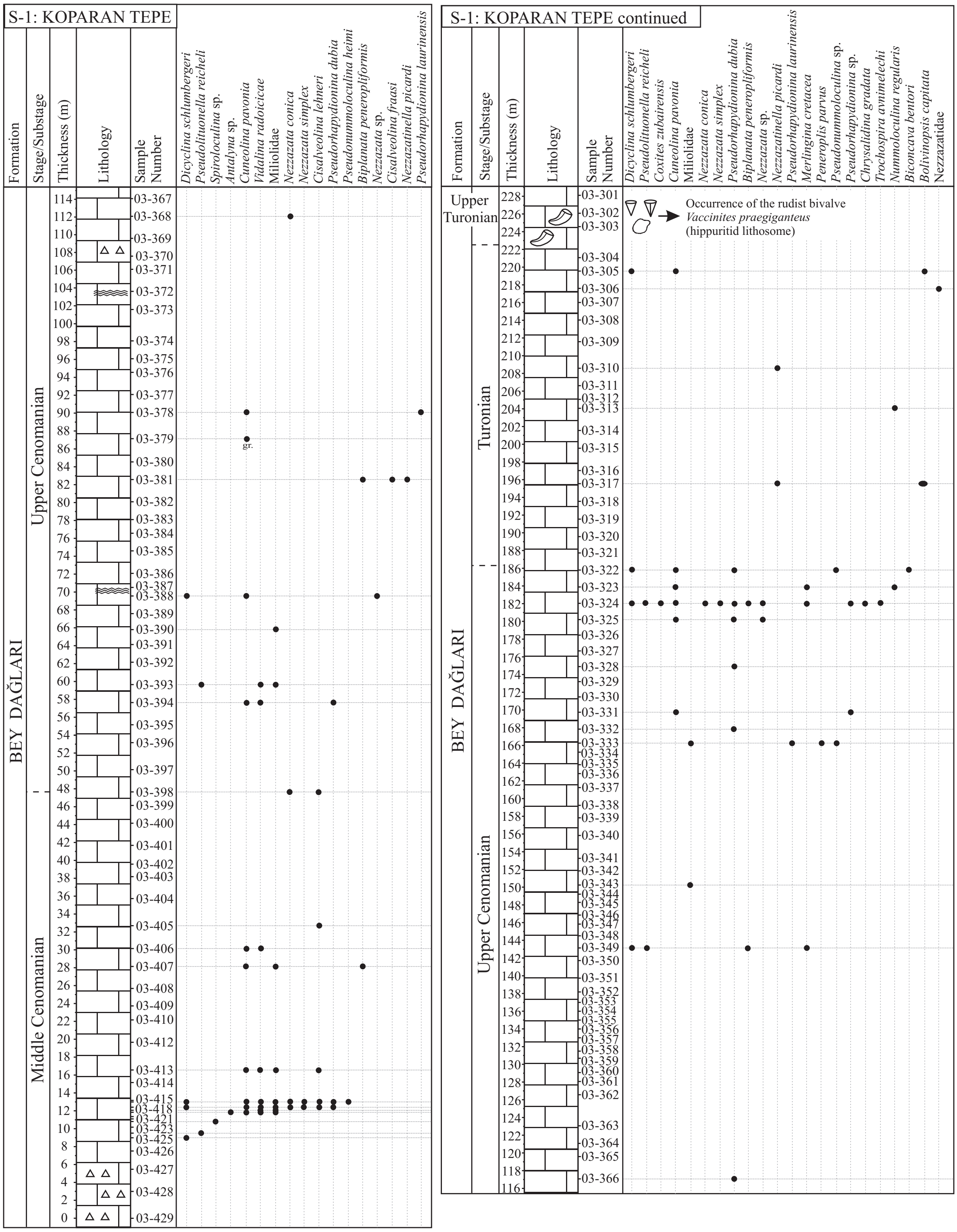


Figure 6. Stratigraphic distribution of microfossils within the Koparan Tepe section (see Figure 4 for explanations and Figure 1 for location of the section).

Cenomanian age for this section (Figures 5 & 7). *Chrysalidina gradata* in sample no. 03-475 accompanies *C. zubairensis*. The 5.5-m-thick lower part of the neritic limestones is brecciated and includes rudist shell fragments at the lowest part of the section. The 1.5-m-thick uppermost part consists of thick-bedded limestones. Thin-bedded (10–15 cm) pelagic limestones, including sand to fine pebble-size intraclasts derived from various stratigraphic levels of neritic, hemipelagic and pelagic limestones, disconformably overlies neritic limestones on a prominent erosional surface. The planktonic foraminifera associations indicate that the lower pelagic limestones are Late Campanian in age (Sarı 2006b).

Karain Section

This section is represented by a rich caprinid, ichthyosarcolitid and radiolitid fauna (caprinid lithosome) suggesting a Middle to Late Cenomanian age. Rudists are associated with corals and gastropods, as well as scarce benthonic foraminifera (Figure 8). The uppermost part of the 120-m-thick sequence is characterized by the occurrence of *Orbitolina* sp. in three samples. The presence of *M. cretacea* and *P. laurinensis* in sample no. 03-634 close to the central part of the succession indicates an age not older than the Middle Cenomanian (Figure 5).

The rudist fauna comprising *I. bicarinatus*, *I. triangularis*, *C. schiosensis, N. gigantea*, *S.* cf. *schiosensis, S. woodwardi*, *Durania* sp., *Radiolites* sp., *Sauvagesia* sp., and unidentifiable radiolitids, was studied by Özer (1988), who also reported it from Serinhisar (Denizli) in Turkey (Özer 1998). The fauna has been reported from many Middle–Upper Cenomanian outcrops in the circum-Mediterranean region (e.g., Plenicar 1963; Sliskovic 1968; Polsak & Mamuzic 1969; Bilotte 1985; Accordi *et al.* 1989; Lupu 1992; Cherchi *et al.* 1993).

Yağca Section

The neritic limestones in the lowest part of this section, which are the lateral equivalent of limestones observed in the Karain section, are characterized by rather scarce foraminifera and a

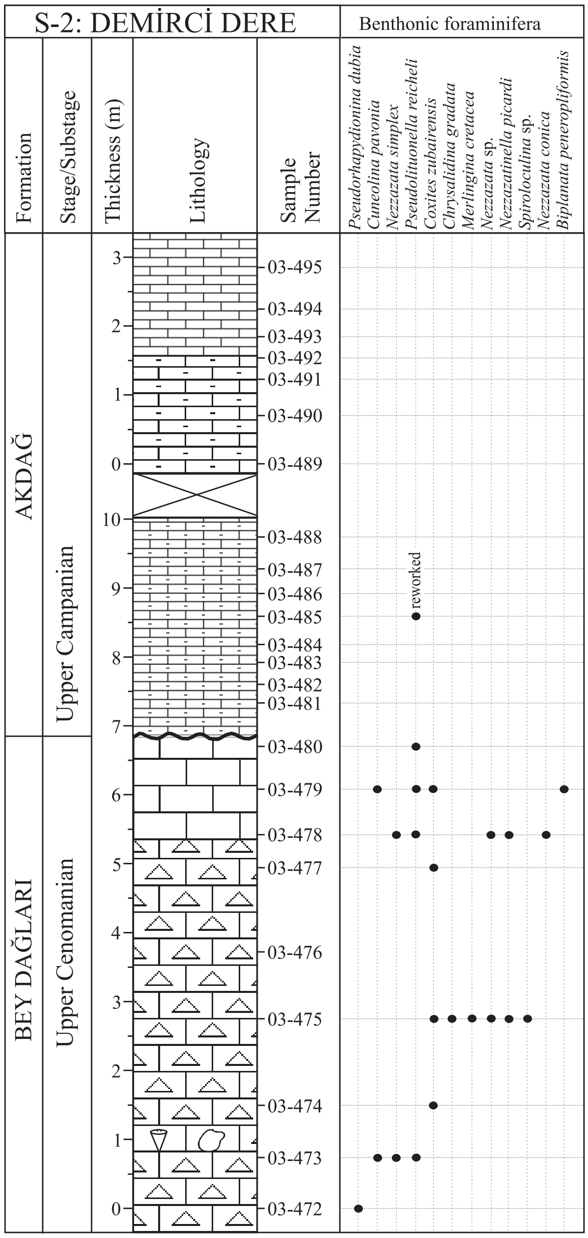


Figure 7. Stratigraphic distribution of microfossils within the Demirci Dere section (see Figure 4 for explanations and Figure 1 for location of the section).

rich rudist assemblage similar to the Karain section. A different Cenomanian assemblage is observed in the pebbles of the Karakirse Formation (Figure 9). Pebbles and blocks of neritic limestones are embedded in pelagic matrix with planktonic foraminifera, which indicates a latest Campanian–Early Maastrichtian age (Sarı 2006b).

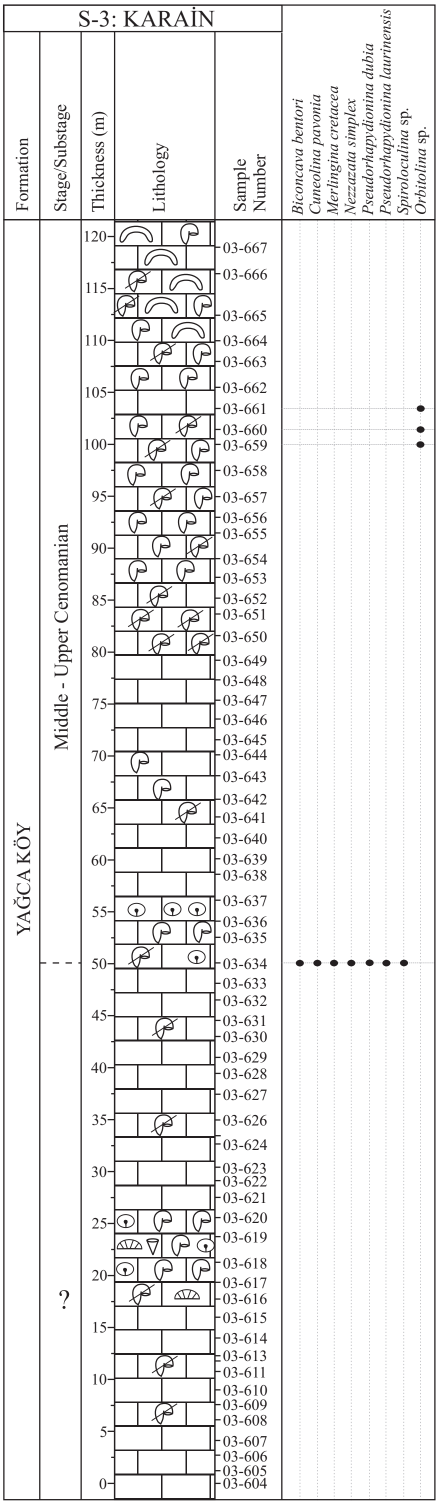


Figure 8. Stratigraphic distribution of microfossils within the Karain section (see Figure 4 for explanations and Figure 1 for location of the section).

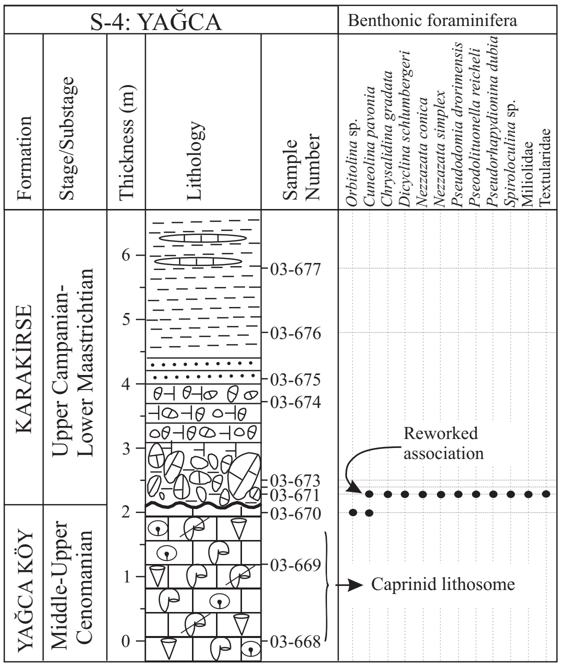


Figure 9. Stratigraphic distribution of microfossils within the Yağca section (see Figure 4 for explanations and Figure 1 for location of the section).

Canavar Boğazı Section

The neritic part of this section is mainly represented by scarce benthonic foraminifera. *Pseudorhapydionina laurinensis,* known as a Middle–Late Cenomanian species, is present in samples no. 07-627 and 97-630 (Figures 5 & 10). The occurrence of *P. reicheli, P. dubia, B. peneropliformis, N. regularis* and *C. gradata* in the uppermost part of the neritic limestones indicates that the neritic part of this section is no younger than Late Cenomanian. The uppermost part of the neritic succession, represented by the occurrence of unidentifiable radiolitid fragments, is disconformably overlain by pelagic limestones. The planktonic foraminifera assemblage observed in the pelagic limestones suggests a Late Campanian age (Sarı 2006b).

Kargalıköy Section

This section is represented by cream-coloured, well-bedded (30–60 cm), indurated neritic limestones of the Bey Dağları Formation. This is one of the most

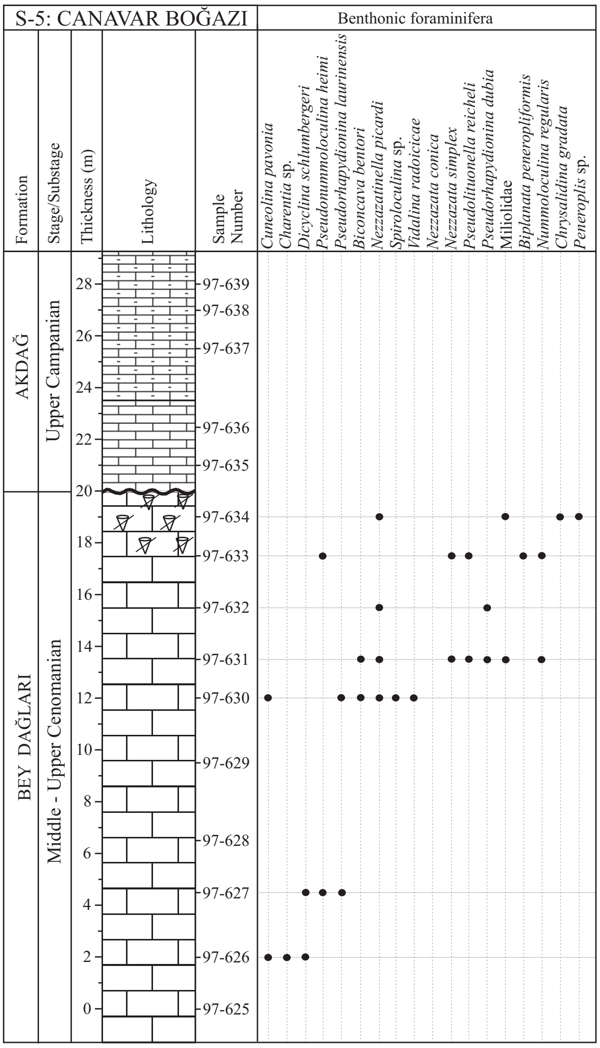


Figure 10. Stratigraphic distribution of microfossils within the Canavar Boğazı section (see Figure 4 for explanations and Figure 1 for location of the section).

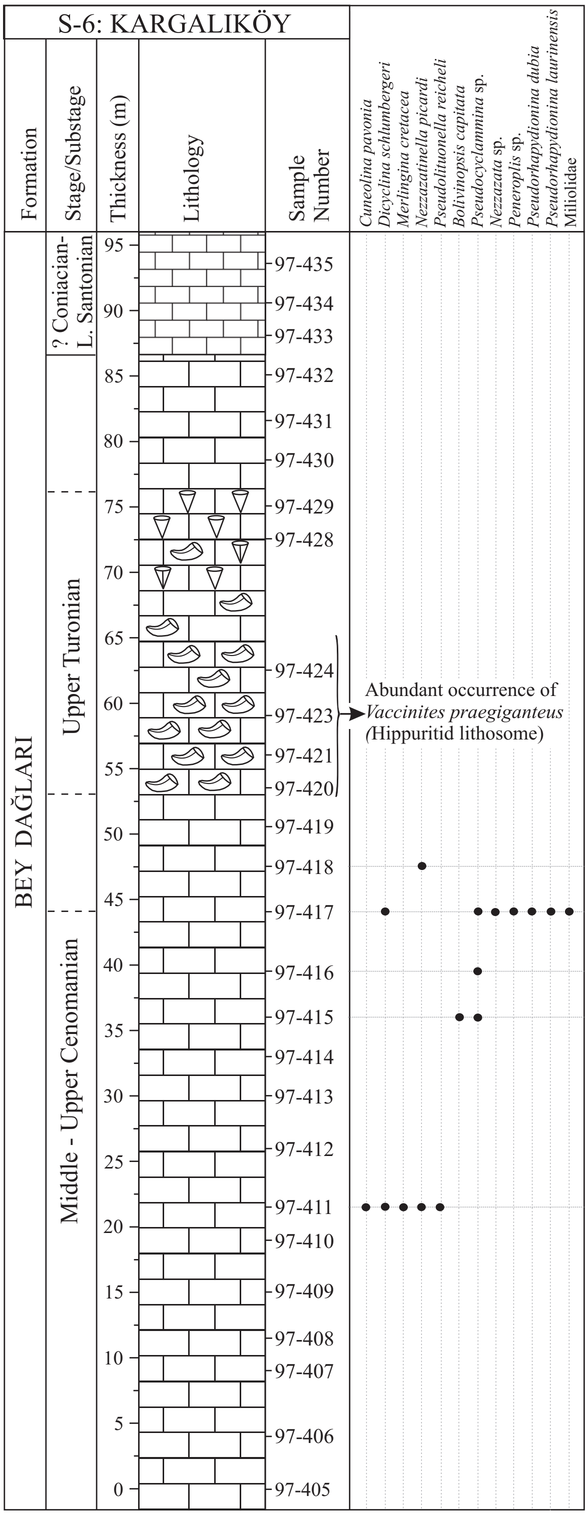


Figure 11. Stratigraphic distribution of microfossils within the Kargalıköy section (see Figure 4 for explanations and Figure 1 for location of the section).

important sections as it contains the remarkable road-cut outcrop of the Upper Turonian rudist level (hippuritid lithosome) (Figure 11). The lower part of the 20-m-thick lithosome is dominated by *V. praegiganteus*, associated with rare *V. inferus*, small-sized hippuritids and radiolitids. Analysis of well-preserved low-Mg calcite of shells of *V. praegiganteus* for $^{87}Sr/^{86}Sr$ values yielded a Late Turonian age (Sarı *et al.* 2004). The abundance of *V. praegiganteus* as well as other rudists decreases towards the upper part of the lithosome, in which small-sized hippuritids and radiolitids are common. The lower part of the section has a Middle–Late Cenomanian foraminiferal assemblage. There is no palaeontological data for the level between the last occurrence of the Cenomanian assemblage and the first occurrence of rudists. The uppermost part of the neritic succession between the last occurrence of the rudists and the first occurrence of the ?Coniacian–Santonian planktonic foraminifera is also barren and may questionably correspond to the latest Turonian or Coniacian. The rare planktonic foraminifera content of the 10-m-thick hemipelagic level at the uppermost part of the section may suggest a Coniacian-Santonian age (Sarı 2006b). The boundary relationship between the neritic and the hemipelagic limestones in this section is not clear.

Boztaş Tepe Section

This section includes an assemblage containing *P. dubia*, *P. laurinensis* and *C. gradata* at the base of the section (Figure 12). This association indicates a Middle to Late Cenomanian age. The rest of the succession has long-ranging taxa. The first occurrence of *M. apenninica-compressa* in sample no. 97-193 indicates the Coniacian (Figure 5). The uppermost part of the section is made up of massive neritic limestones that are cut by an erosional surface and overlain by pelagic conglomerates. The planktonic foraminifera observed in the matrix of the conglomerates with pelagic matrix and the overlying pelagic limestones indicate the Middle Eocene (Sarı 2006b). The absence of any pelagic interlayer or any sedimentary structures showing subaerial exposure throughout the 625-m-thick sequence indicates that the platform environment was not interrupted in this part of the platform.

Sarp Dere Section

Only in the Sarp Dere section were the caprinids (rudists) determined in the whole Bey Dağları Autochthon outside the Katran Dağ area. Caprinids observed in the middle part of the section as scarce unidentifiable individuals associated with rare radiolitids (Figure 13) indicate a Cenomanian age. The poor benthonic foraminifal assemblage determined in the lowest part of the section is

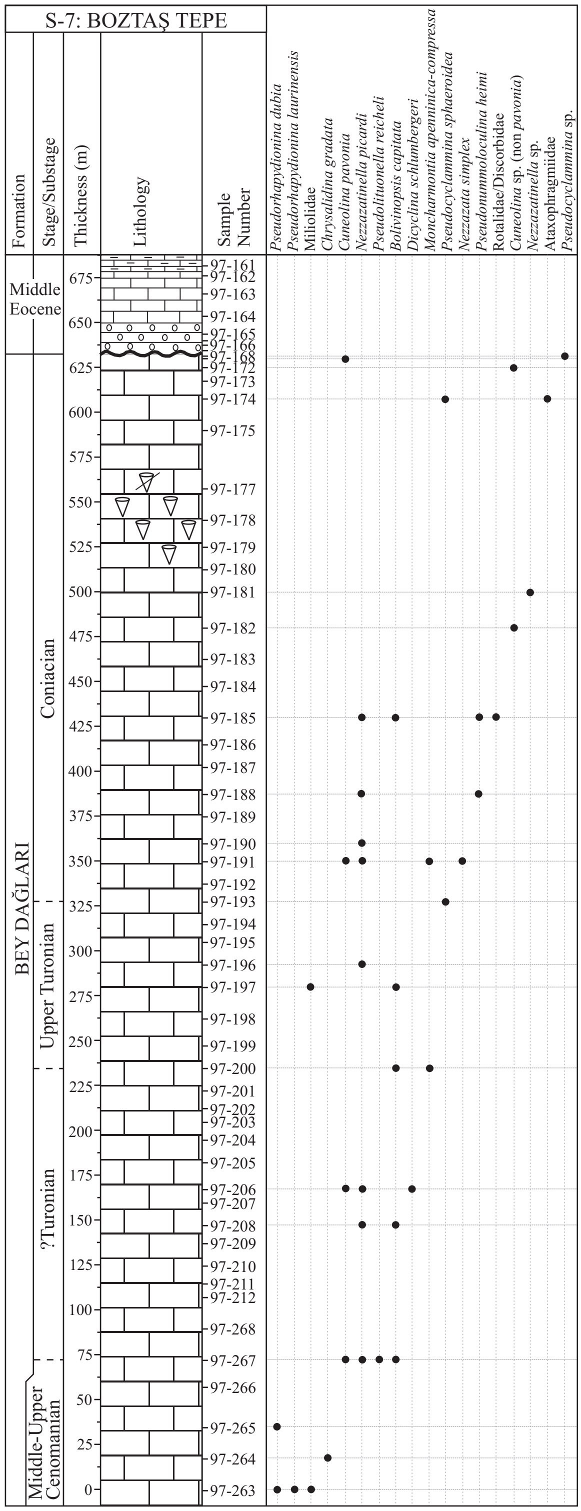


Figure 12. Stratigraphic distribution of microfossils within the Boztaş Tepe section (see Figure 4 for explanations and Figure 1 for location of the section).

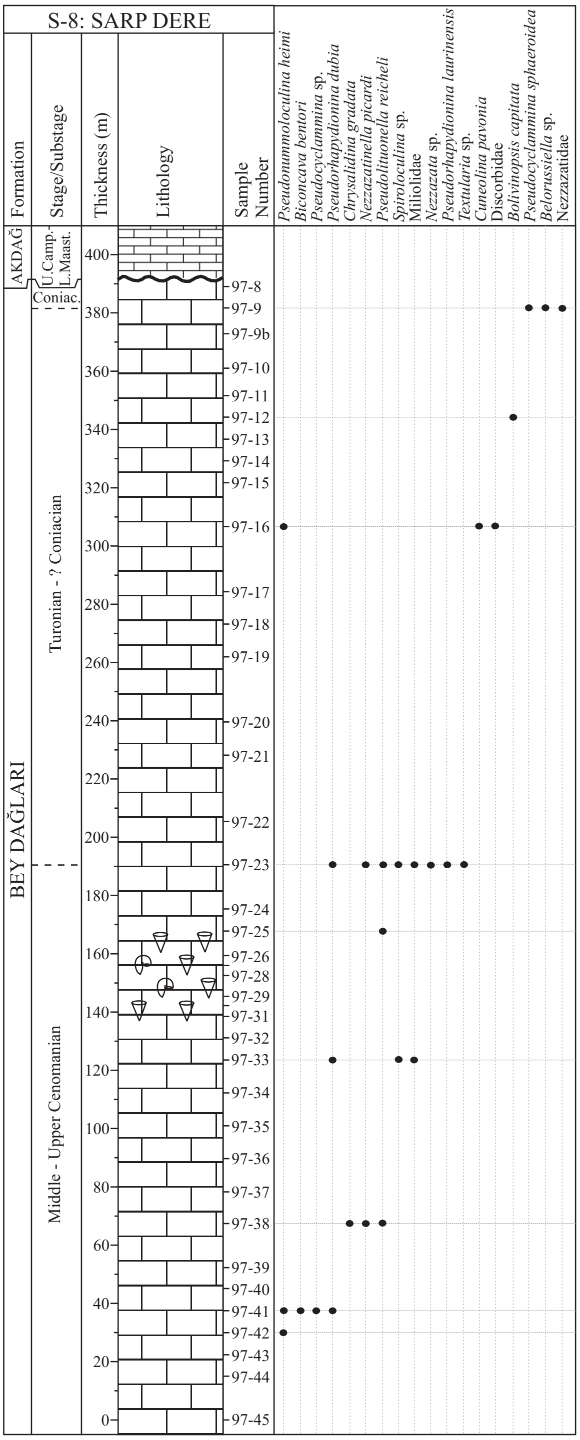


Figure 13. Stratigraphic distribution of microfossils within the Sarp Dere section (see Figure 4 for explanations and Figure 1 for location of the section).

typically Middle–Late Cenomanian Bey Dağları assemblage, as observed in the other stratigraphic sections. The appearance of *P. sphaeroidea* in sample no. 97-9 in the uppermost part of the succession indicates a Coniacian age. The top surface of the neritic limestones is erosional and they are overlain by thin-bedded pelagic limestones of the Akdağ Formation containing a rich planktonic foraminiferal assemblage suggesting a Late Campanian–Early Maastrichtian age (Sarı 2006a).

Küçük Tepe Section

Samples from the lower part of this section contain Middle–Late Cenomanian assemblages (Figure 14). The occurrence of *P. sphaeroidea* in sample no. 97-68 allows the Turonian–Coniacian boundary to be drawn. The uppermost neritic limestones, represented by a rudist level with abundant radiolitids, are disconformably overlain by pelagic limestones of the Akdağ Formation containing rich planktonic foraminifera assemblages suggesting a Late Campanian–Early Maastrichtian age (Sarı 2006a).

Çamkuyusu Section

The approximately 400-m-thick lower part of the sequence is almost barren and only sample no. 04-41 contains a poor assemblage, including a few species; *C. gradata*, *N. picardi* and *P. reicheli*. The lower part of the second half includes a relatively rich assemblage. The last occurrences of *C. gradata* and *P. reicheli* in sample no. 04-65 determine the Cenomanian–Turonian boundary. The first occurrence of *P. sphaeroidea* in sample no. 04-69 suggests a Coniacian age. The approximately 200-m-thick upper part of the section is represented only by long-ranging taxa. The sequence includes rare non-diagnostic rudists and non-rudist bivalves throughout.

Benthonic Foraminiferal Biostratigraphy

Detailed investigations of ten measured stratigraphic sections from the BDCP (Figures 6 through 15) show that the lower part of the platform limestones (Middle–Upper Cenomanian) is represented by

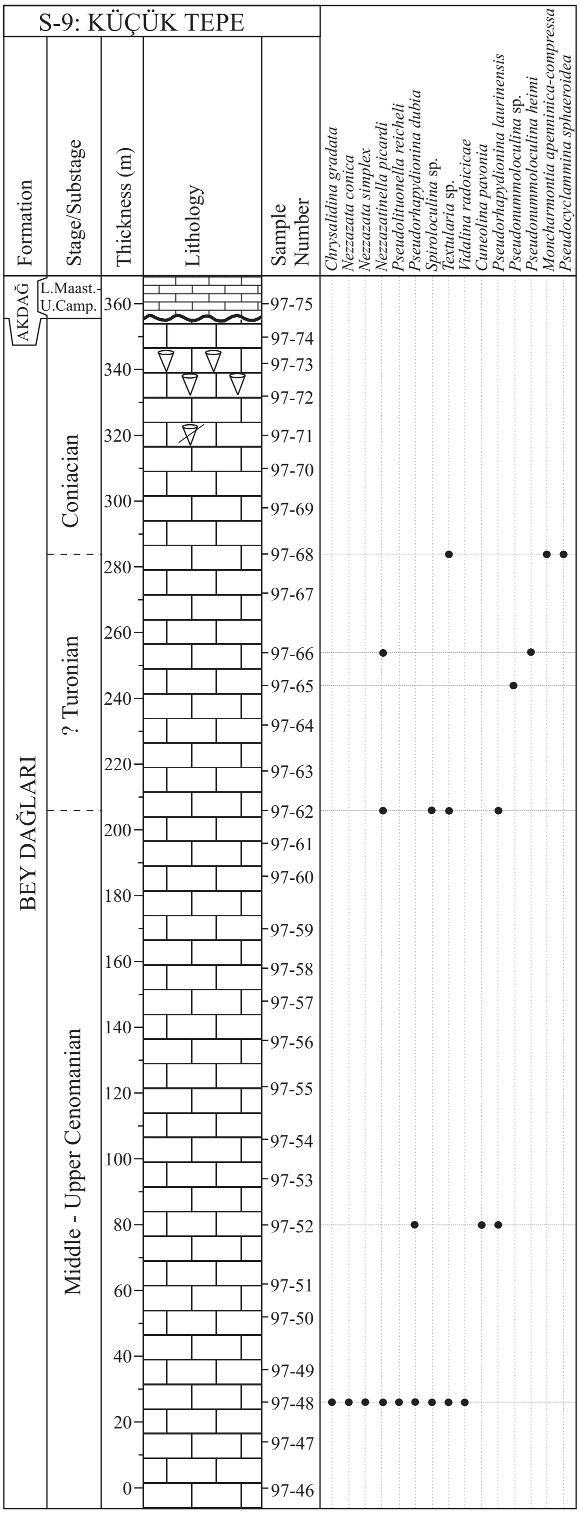


Figure 14. Stratigraphic distribution of microfossils within the Küçük Tepe section (see Figure 4 for explanations and Figure 1 for location of the section).

relatively rich benthonic foraminiferal assemblages, while the upper part (Turonian–Coniacian) contains poor assemblages. These data are consistent with other previously described Mediterranean successions (Figure 5). Numerous studies of the Upper Cretaceous benthonic foraminiferal biostratigraphy have been carried out in the Mediterranean region since the beginning of the second half of the last century. The data were compiled by Arnaud *et al*. (1981) and Schroeder & Neumann (1985). Bilotte (1998) presented the distributions of important Tethyan benthonic foraminiferal species. Correlation of the stratigraphic distribution of the important benthonic foraminiferal species, derived from 22 published papers, is summarized in Figure 5. The species in this chart are only those that were also observed in the BDCP. Correlation of the biozonations offered for the Upper Cretaceous neritic successions of the BDCP is given in Figure 16.

Benthonic foraminiferal assemblages determined in the BDCP successions are dominated by long-ranging species. The presence of shorter-ranging, stratigraphical index species, the first (FO) and/or the last occurrence (LO) of the taxa and the co-existence of two or more taxa are all important in finer biostratigraphic subdivision. The benthonic foraminiferal biozones were established using recommendations of the NASC (1983) and the ISG (Salvador 1994).

Psedolituonella reicheli-P. dubia Concurrent Range Zone has been defined from the Middle–Upper Cenomanian platform limestones. The biozone includes the *C. lehneri* Subzone and *C. zubairensis* subzone, which correspond to the Middle and Upper Cenomanian respectively (Figure 17). The biozones identified in this study are briefly described below from oldest to youngest (Plates 1 to 4):

P. reicheli-P. dubia *Concurrent Range Zone.* This biozone is determined from the FO of *P. reicheli* and the LO of *P. dubia* (Figure 17). *Pseudolituonella reicheli* and *P. dubia* are selected as biozone markers, because they are the commonest species observed in the BDCP and are also widely recorded from the Cenomanian shallow-water limestones of the circum-Mediterranean region. The biozone is

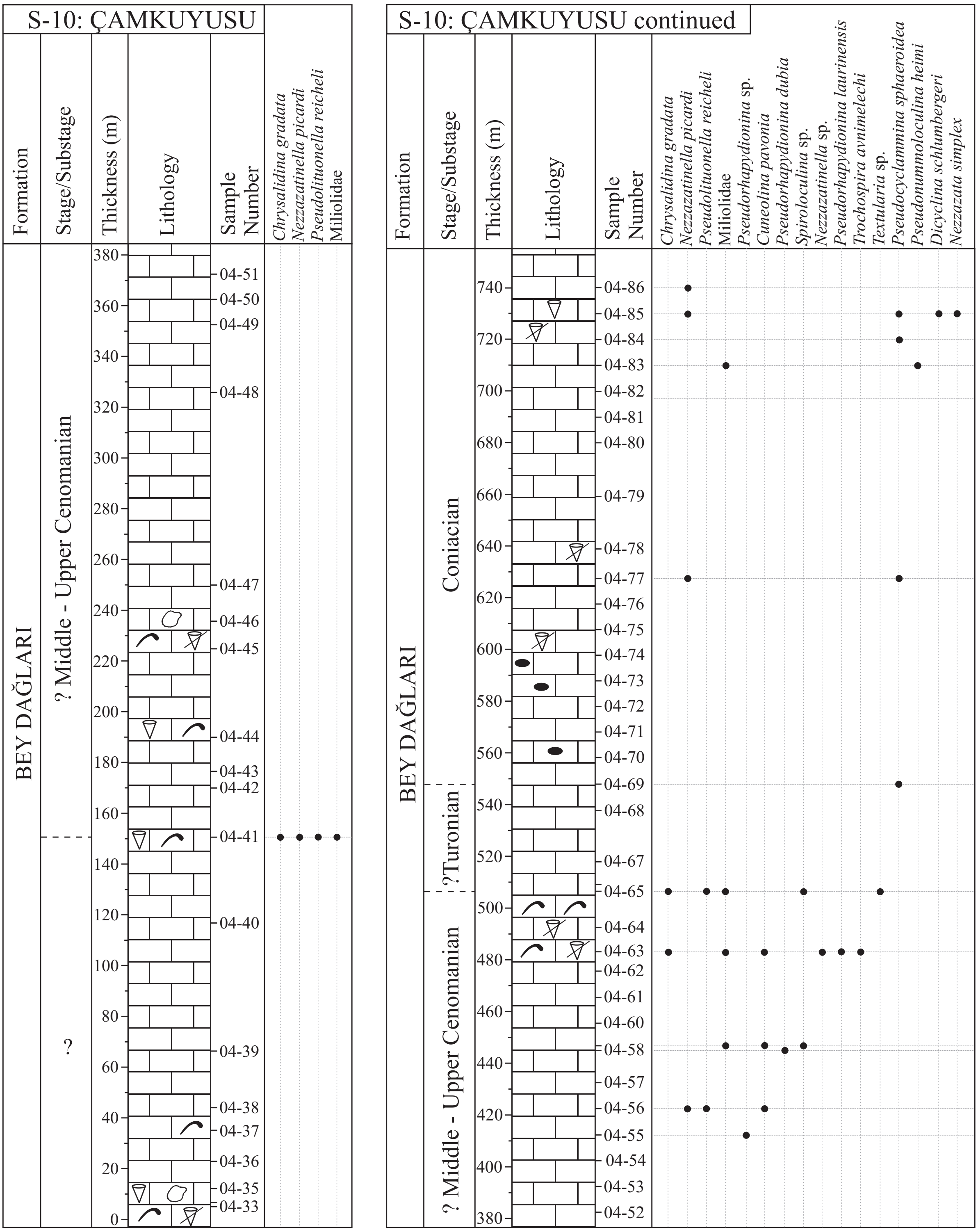


Figure 15. Stratigraphic distribution of microfossils within the Çamkuyusu section (see Figure 4 for explanations and Figure 1 for location of the section).

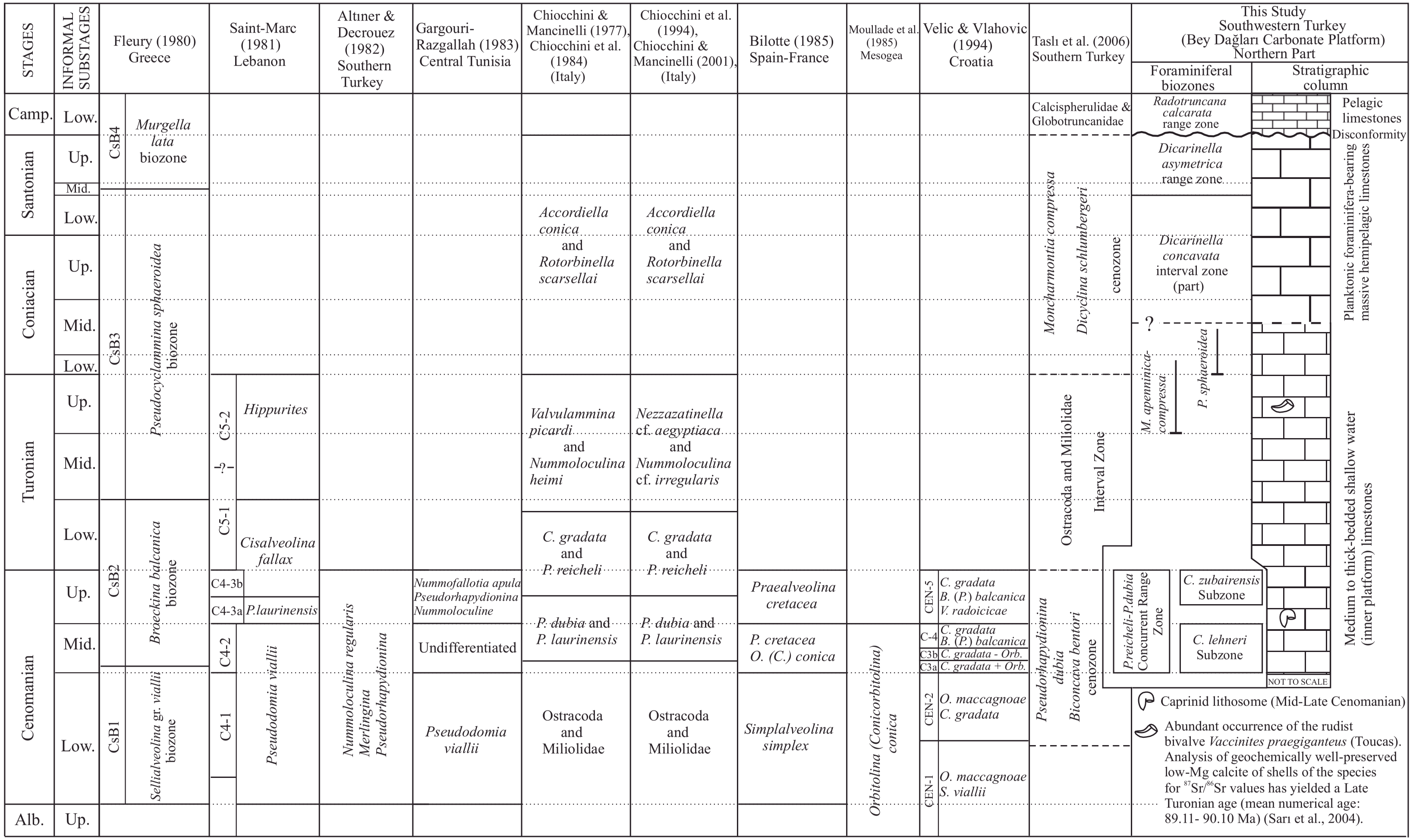


Figure 16. Chart showing the benthonic foraminiferal biozonations previously offered for the peri-Mediterranean Upper Cretaceous platform limestones and correlation of these biozonations with the established Upper Cretaceous benthonic foraminiferal biozonation for the northern part of the Bey Dağları Carbonate Platform. (Time scale is adapted from Gradstein et al. 1994).

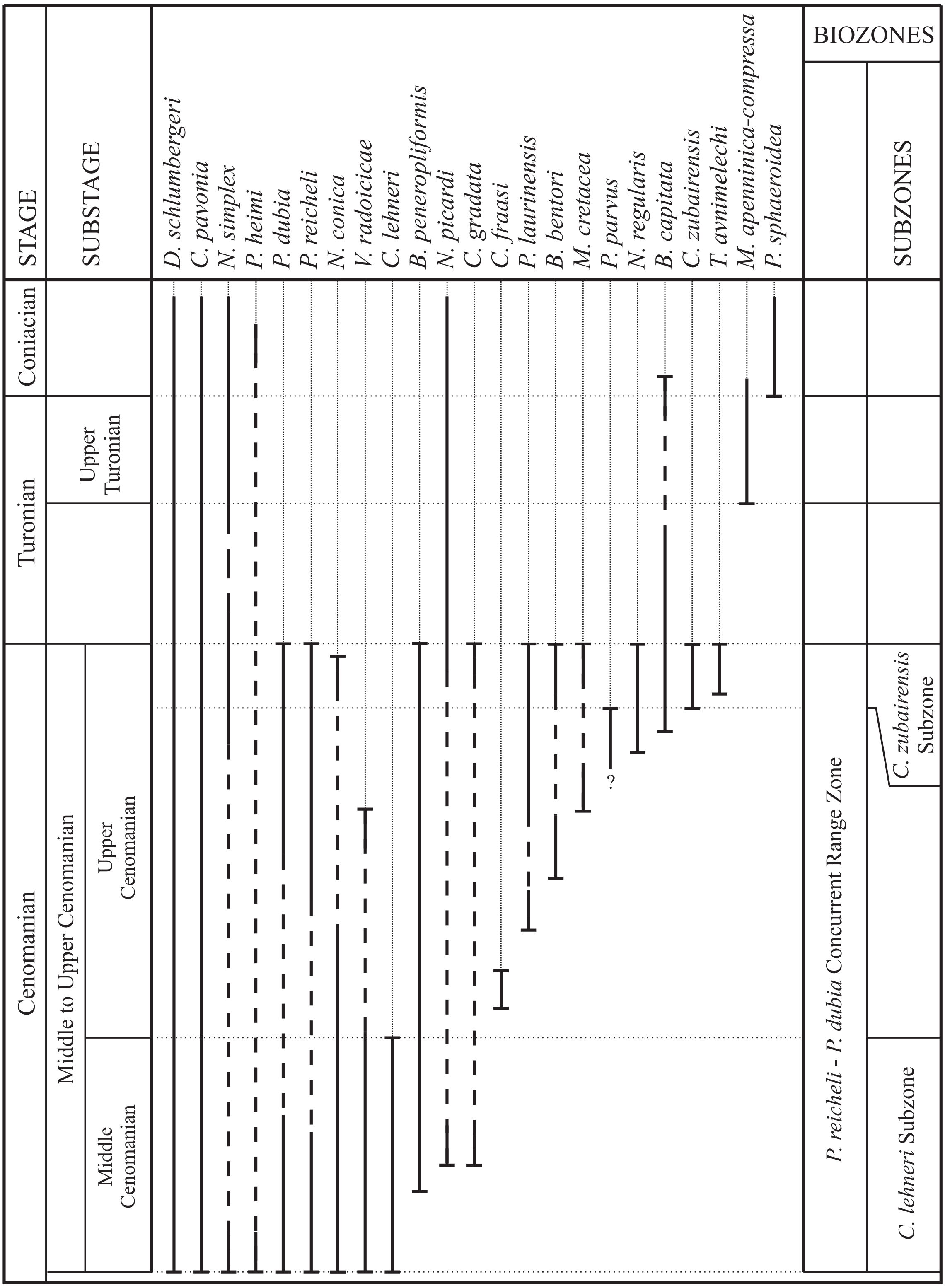


Figure 17. Local ranges of the benthonic foraminifera observed in the Upper Cretaceous carbonate successions of the BDCP.

defined from the Koparan Tepe section, in which it is 176.5 metres thick (Figure 7). The FO and the LO of *P. reicheli* are documented in samples no. 03-424 and 03-324, respectively. This species is rare throughout the section. The FO and the LO of *P. dubia* are observed in samples no. 03-417 and 03-322 respectively.

The *Pseudolituonella reicheli-P. dubia* Concurrent Range Zone includes many Cenomanian (i.e., *P. parvus, T. avnimelechi, V. radoicicae, B. bentori, B. peneropliformis, N. regularis, P. reicheli* and *C. gradata*) and Middle–Late Cenomanian (i.e., *M. cretacea, P. laurinensis, C. lehneri, C. fraasi* and *C. zubairensis*) species. Long-ranging species such as *D. schlumbergeri, C. pavonia, N. simplex, P. heimi* and *N. picardi* also occur within this biozone (Figures 6 & 17). The lower and the upper boundaries of the biozone cannot be recognized properly in other stratigraphic sections due to the rareness of the species and/or reduced thickness of neritic limestones in some stratigraphic sections. The *P. reicheli-P. dubia* Concurrent Range Zone includes two subzones:

Cisalveolina lehneri s*ubzone*: This biozone is defined by the total range of the nominate taxon in the Koparan Tepe section, where it is 35.5 metres thick (Figures 6 & 17). The species has its FO and LO in samples no. 03-417 and 03-398, respectively (Figure 6). The biozone includes *D. schlumbergeri, P. reicheli, C. pavonia, V. radoicicae, N. conica, N. simplex, P. dubia, P. heimi* and *B. peneropliformis* (Figures 6 & 17). *Cisalveolina lehneri* is recorded from Middle Cenomanian successions in the circum-Mediterranean region (Chiocchini *et al*. 1984, 1994; Schroeder & Neumann 1985). Hence, the age of the interval corresponding to this biozone should be Middle Cenomanian in the Koparan Tepe section (Figure 6).

Coxites zubairensis S*ubzone*: This biozone is defined from the FO to the LO of the nominate taxon in the Demirci Dere section, in which the biozone is 4.5 metres thick (Figures 7 & 17). The biozone contains *C. pavonia, N. simplex, P. reicheli, C. gradata, M. cretacea, N. picardi, N. conica* and *B. peneropliformis* in this section (Figure 7): *Coxites zubairensis* is also present in sample no. 03-324 in the Koparan Tepe section. The species is associated with *D. schlumbergeri, P. reicheli, N. conica, N. simplex, P. dubia, B. peneropliformis, M. cretacea, C. gradata* and *T. avnimelechi* (Figure 6). *Coxites zubairensis* is recorded from the Upper Cenomanian successions of the circum-Mediterranean region (Saint-Marc 1977, 1981; Chiocchini *et al.* 1984, 1994): hence the age of this biozone in the Demirci Dere section is Late Cenomanian in (Figure 7).

Other Stratigraphically Importat Taxa: The FO of the two important species *M. apenninica-compressa* and *P. sphaeroidea* is also used to date the post-Cenomanian limestones of the BDCP (Figure 17). The FO of *M. apenninica-compressa* is accepted as Late Turonian (de Castro 1966; Gusic & Jelaska 1990; Chiocchini & Mancinelli 1977; Chiocchini *et al*. 1994; Korbar & Husinec 2003). *Moncharmontia apenninica-compressa* was observed in two stratigraphic sections in this study. The FO of the species in sample no. 97-200 in the Boztaş Tepe section indicates a Late Turonian age (Figure 12). The species is associated with P. sphaeroidea in sample no. 97-68 from the Küçük Tepe section (Figure 14).

The FO of *Pseudocyclammina sphaeroidea* is used by some to mark the Turonian–Coniacian boundary (Bilotte 1984, 1998; Fucek *et al*. 1990), while others place it within the Coniacian (Chiocchini & Mancinelli 1977; Bilotte 1985; Grosheny & Tronchetti 1993; Chiocchini *et al*. 1994). *P. sphaeroidea* was observed in four stratigraphic sections where its FO determines the Turonian–Coniacian boundary (Figures 12–15 & 17)

In addition to the biozones and the 'index' species, the LOs of some taxa are also useful to determine the Cenomanian–Turonian boundary in the absence of zone marker species. Many taxa are accepted as Cenomanian species in the peri-Mediterranean region (Figure 5) of which some, such as *B. peneropliformis, C. gradata, P. laurinesis, B. bentori, M. cretacea, N. regularis and T. Avnimelechi*, have been observed in the Bey Dağları successions and are used to mark the Cenomanian–Turonian boundary. *M. cretacea* and *P. laurinensis* are known Middle–Late Cenomanian species (Figure 17).

Conclusions

Detailed investigations of the ten measured stratigraphic sections logged from the inner platform limestones have yielded new data to construct the Upper Cretaceous (Middle Cenomanian–Coniacian) benthonic foraminiferal biostratigraphy of the Bey Dağları carbonate platform (BDCP). These data have been integrated with the data obtained from rudists and planktonic foraminifera biostratigraphy and Sr-isotope stratigraphy. The lower part of the platform limestones (Middle–Upper Cenomanian) is represented by relatively rich benthonic foraminiferal assemblages, while the upper part (Turonian–Coniacian) contains poor assemblages. These data are consistent with several other Mediterranean successions. The benthonic foraminiferal assemblages determined in the BDCP are dominated by long-ranging species. The shorter-ranging, stratigraphical index species have been selected to establish biostratigraphic framework and to date the Upper Cretaceous platform limestones of the BDCP, based on the distributions of these species in the circum-Mediterranean region.

The benthonic foraminiferal assemblages identified from the neritic limestones have allowed establishment of one biozone and two subzones. The *P. reicheli-P. dubia* Concurrent Range Zone is defined from the Middle–Upper Cenomanian part of the succession and includes two subzones. The *C. lehneri* and *C. zubairensis* subzones are characterized by the range of the nominate taxa and correspond to the Middle Cenomanian and Upper Cenomanian, respectively. *Moncharmontia apenninica-compressa* and *P. sphaeroidea* are the stratigraphically important taxa for the post Cenomanian part of the Bey Dağları successions and they indicate the beginning of the Upper Turonian and the Coniacian, respectively.

All the data mentioned above show that the neritic accumulation on the BDCP continuously persisted from the Middle Cenomanian to the Coniacian.

Acknowledgements

We thank Antun Husinec for his invaluable review that improved the manuscript considerably. İsmail İşintek is thanked for his advice and discussions on benthonic foraminiferal biozonations. The fieldwork help of Akif Sarı, Ümit Kasım, Evren Yücel and Görkem Oskay is also appreciated. This work was financially supported by a TÜBİTAK project no. 102Y062, which is also gratefully acknowledged. English of the final text is edited by John A. Winchester.

References

Accordi, G., Carbone, F. & Sirna, G. 1989. Some affinities between the Ionian Islands and the Apulian Upper Cretaceous rudist facies. *In*: Battista Carulli, G. (ed), *Evolution of the Karstic Carbonate Platform: Relation with Other Periadriatic Carbonate Platforms.* Memorie della Società geologica Italiana **40**, 163–173.

Altinli, E. 1944. Stratigraphic investigation of Antalya region. *İstanbul Üniversitesi Fen Fakültesi Mecmuası* seri B, **IX**, [in Turkish].

Angelucci, A. & Devoto, S. 1966. Géologie del Monte Caccume (Frosinone). *Geologica Romana* **5**, 177–195.

Arnaud, A., Berthou, P.Y., Brun, L., Cherchi, A., Chiocchini, M., De Castro, P., Fourcade, E., Garcia Quintana, A., Hamaoui, M., Lamolda, M., Luperto-Sinni, E., Neumann, M., Prestat, B., Schroeder, R. & Tronchetti, G. 1981. Tableau de répartition stratigraphique des grands foraminifères caractéristiques du Crétacé moyen de la Région Méditerranéenne. *Cretaceous Research* **2**, 383–393.

Berthou, P.Y. 1973. *Le Cénomanien de l'Estrémadure portugaise.* Mémoria do Servicos Geologicos de Portugal, Nova Série **23**.

Berthou, P.Y. 1984. Répartition stratigraphique actualisée des principaux foraminifères benthiques du Crétacé moyen et supérieur du bassin occidental Portugais. *Benthos'83, 2nd International Symposium on Benthic Foraminifera* (Pau, April 1983), 45–4.

Berthou, P.Y. & Philip, J. 1972. La limite Cénomanien–uronien dans les formations récifales do domaine Mésogéen. *Compte Rendu Sommaire et Bulletin de la Société Géologique France* **6**, 238–39.

Bignot, G., Fleury, J.J. & Guernet, C. 1971. *Sur la stratigraphie du Crétacé supérieur et du flysch en Eubée moyenne.* Compte Rendu Sommaire et Bulletin de la Société Géologique de France série 7 **13** (5–6).

Bignot, G. & Poisson, A. 1974. Le Cénomanien du flanc oriental du Katran Dağ (Sam dağ) pres d'Antalya (Turquie). *MTA Bulletin* **82**, 71–77.

Bilotte, M. 1984. Les grands Foraminiféres benthiques du Crétacé supérieur pyrénéen. Biostratigraphie. Refléxions sur les correlations mésogéennes. *Benthos'83, 2nd International Symposium on Benthic Foraminifera* (Pau, April 1983), 61–67.

Bilotte, M. 1985. Le Crétacé supérieur des plates-formes est-pyrénéenes. *Strata* **2**, 1–438.

Bilotte, M. 1998. Larger benthonic foraminifera–Upper Cretaceous, chart of Cretaceous biochronostratigraphy. *In*: de Graciansky, P.-C., Hardenbol, J. & Vail, P.R. (eds), *Mesozoic and Cenozoic Sequence Stratigraphy of European Basins*. Society of Economic Palaeontologists and Mineralogists, Special Publications **60**, .

Bismuth, H., Bonnefous, J. & Dufaure, Ph. 1967. Mesozoic microfacies of Tunusia. *In*: *Guidebook to the Geology and Historia of Tunusia.* Petroleum Exploration Society of Libya, 159–214.

Blumenthal, M. 1960–1963. Le système structural du TaurusSud-Anatolien. *Mémoires Hors-Série de la Société Géologique de France (Livre Mém. Paul Fallot)*, 611–662.

Bosellini, A. 1989. Dynamics of Tethyan carbonate platforms. *In*: Crevello, P.D., Wilson, J.L., Sarg, J.F. & Read, J.F. (eds), *Controls on Carbonate Platform and Basin Development*. Society of Economic Palaeontologists and Mineralogists, Special Publications **44**, 3–13.

Caus, E., Bernaus, J.M., Boix, C., Calonge, A. & Perez, R. 2003. Upper Cretaceous shallow benthic biozones (KSBZ): a preliminary report. *Abstracts of AAPG International Conference Barcelona, Spain*, 1–3.

Cherchi, A. & Schroeder, R. 1985. *Vidalina radoicicicae* n.sp. and *Pseudorhapydionina* (?) *anglonensis* n. sp. (Foram.) from the Upper Cenomanian of Anglona region (NW Sardinia). *Bolletino della Societa Paleontologica Italiana* **24**, 185–188.

Cherchi, A., Ruberti, D. & Sirna, G. 1993. Osservazioni biostratigrafiche sul Cretaceo del Matese centro-settentrionale (Italia centrale). *Bollettino del Servizio geologico d'Italia Roma* **110**, 91–110.

Chiocchini, M. & Mancinelli, A. 1977. Microbiostratigrafia del Mesozoico in facies di plattaforma carbonatica dei Monti Aurunci (Lazio meridionale). *Studi Geologici Camerti* **3**, 109–152.

Chiocchini, M. & Mancinelli, A. 2001. *Sivasella monolateralis* Sirel and Gündüz, 1978 (Foraminiferida) in the Maastrichtian of Latium (Italy). *Revue de Micropaléontologie* **44**, 267–277.

Chiocchini, M., Mancinelli, A. & Romano, A. 1984. Stratigraphic distribution of benthic Foraminifera in the Aptian, Albian and Cenomanian carbonate sequence of the Aurunci and Ausoni Mountains (Southern Latium, Italy). *Benthos'83, 2nd International Symposium on Benthic Foraminifera* (Pau, April 1983), 167–181.

Chiocchini, M., Farinacci, A., Mancinelli, A., Molinari, V. & Potetti, M. 1994. Biostratigrafia a foraminiferi, dasicladali e calpionelle delle successioni carbonatiche mesozoiche dell'Appennino centrale *In*: Mancinelli, A. (ed), *Biostratigrafia del l'Italia centrale.* Studi Geologici Camerti, Camerino, special volume, 9–129.

Colalongo, M.L. 1963. *Sellialveolina viallii* n. gen. n. sp., di Alveolinidae cenomaniano dell'Appennino meridionale, *Giornale di Geologia* **30**, 361–373.

Colin, H.J. 1962. Geological researches carried out in the Fethiye-Kaş-Antalya-Finike areas (southwest Anatolia). *MTA Bulletin* **59**, 19–62 [in Turkish].

De Castro, P. 1965. Su alcune Soritidae (Foraminiferida) del Cretacico della Campania. *Bolletino della Società dei Naturalisti in Napoli* **74**, 317–372.

De Castro, P. 1966. Contributo alla conoscenza delle Alveoline albiano cenomaniane della Campania. *Bolletino della Società dei Naturalisti in Napoli* **75**, 219–275.

Dercourt, J., Ricou, L.E., Vrielynck, B. (eds), 1993. *Atlas Tethys Palaeoenvironmental Maps.* Gauthier-Villars, Paris.

Dercourt, J., Gaetani, M., Vrielynck, B., Barrier, E., Biju-Duval, B., Brunet, M.F., Cadet, J.P., Crasquin, S. & Sandulescu, M. 2000. *Atlas Peri-Tethys. Palaeogeographic Maps. Late Cenomanian.* Commission Carte Géologique du Monde-Commission Geological Map of the World, Paris.

Devoto, C. 1964. Zone ad Alveolinidae nel Cretaceo e Paleocene del Lazio ed Abruzzo centro-meridionali. *Geologica Romana* **3**, 405–414.

Farinacci, A. & Köylüoğlu, M. 1982. Evolution of the Jurassic–Cretaceous Taurus Shelf (southern Turkey). *Bolletino della Societa Paleontologica Italiana* **21**, 267–276.

Farinacci, A. & Radoicic, R. 1965. Correlazione fra serie giuresi e cretacea dell'Appennino centrale e delle Dinaridi esterne. *La Ricerca Scientifica* **34 (II A)**, 269–300.

Farinacci, A. & Yeniay, G. 1986. Biostratigraphy and event-analysis of the Cenomanian-Maastrichtian carbonates of the Bey Dağları (Western Taurus, Turkey). *Geologica Romana* **25**, 257–284.

Fleury, J.J. 1971. Le Cénomanien a Foraminifères benthoniques du massif du Varassova (zone du Gavrovo, Akarnanie, Grèce continentale). *Revue de Micropaléontologie* **14**, 181–194.

Fleury, J.J. 1972. Le Cénomanien à Foraminifères benthoniques du massif de Vrassova (zone du Gavrovo, Akarnania). *Revue de Micropaléontologie* **14**, 181–194.

Flügel, E. 2004. *Microfacies of Carbonate Rocks: Analysis, Interpretation and Application*. Springer-Verlag.

Fucek, L., Gusic, I., Jelaska, V., Korolija, B. & Ostric, N. 1990. Stratigrafija gornjokrednih naslaga jugoistocnog dijela Dugog otoka i njihova korelacija s istovremenim naslagama otoka Braca. *Geoloski Vjesnik* **43**, 23–33.

Gargouri-Razgallah, S. 1983. *Le Cenomanien de Tunisie centrale: étude paléoécologique, stratigraphique, micropaléontologique et paléogéographique*. Thése Docteur dés-Sciences, UnivérsitéClaude Bernard, Lyon.

Görür, N. & Tüysüz, O. 2001. Cretaceous to Miocene Palaeogeographic evolution of Turkey: Implications for hydrocarbon potential. *Journal of Petroleum Geology* **24**, 1–28.

Gradstein, F. N., Agterberg, F.P., Ogg, J.G., Hardenbol, J., Van Veen, P., Thiery, J. & Huang, Z. 1994. A Mesozoic Time Scale. *Journal of Geophysical Research* **99**, 24,051–24,074.

Grosheny, D. & Tronchetti, G. 1993. La crise Cénomanien–Turonien: Réponse compare des assemblages de foraminifers benthiques de plate-forme carbonate et de basin dans le Sud-Est de la France. *Cretaceous Research* **14**, 397–408.

Guernet, C. 1971. *Etudes géologiques en Eubée et Dans les régions voisines, Grèce*. Thèse, Paris.

Gusic, I. & Jelaska, V. 1990. *Stratigrafija gornjokrednih naslaga otoka Braca u okviru geodinaske evolucije Jadranske karbonatne platforme*. Djela Jugoslavenske akademije znanosti i umjetnosti **69**, Institut za geoloska istrazivanja, Zagreb.

Gusic, I., Jelaska, V. & Velic, I. 1988. Foraminiferal assemblages, facies, and environments in the Upper Cretaceous of the island of Brac, Yugoslavia. *Revue de Palébiologie* **2**, Benthos'86, 447–456.

Gutnic, M., Monod, O., Poisson, A. & Dumont, J.F. 1979. Géologie des Taurides occidentales (Turquie). *Mémoires de la Société Géologique de France* **137**, 1–112.

Hallock, P. 1982. Evolution and extinction in larger foraminifera. *Third North American Paleontological Convention, Proceedings*, 1. North American Paleontological Convention, Montreal, 221–225.

Husinec, A. 2002. *Stratigrafija mezozojskih naslaga otoka Mljeta u okviru geodinamske evolucije ju_znoga dijela Jadranske karbonatne platforme*. PhD Thesis, Zagreb University [unpublished, with an English summary].

Korbar, T. & Husinec, A. 2003. Biostratigraphy of Turonian to (?) Coniacian platform carbonates: A case study from the Island of Cres (Northern Adriatic, Croatia). *Geologia Croatica* **56**, 173–185.

Lefevre, R. 1966. Données nouvelles sur la stratigraphie du Crétacé supérieur dans le massif des Bey-Dağları (Taurus Lycien, Turquie). *Comptes Rendus de l'Academie des Sciences. Paris, série D. t.* **263**, 1029–1032.

Lupu, D. 1992. Le faciès à rudistes du Cénomanien de Hateg (Carpathes méridionales, Roumanie). *Geologica Romana* **28**, 351–358.

Moullade, M., Peybernes, B., Rey, J. & Saint-Marc, P. 1985. Biostratigraphic interest and paleobiogeographic distribution of Early and Mid-Cretaceous Mesogean Orbitolinids (Foraminiferida). *Journal of Foraminiferal Research* **15**, 149–158.

Murray, J.W. 1991. *Ecology and Palaeoecology of Benthic Foraminifera*. Longman Scientific and Technical, Avon.

Naz, H., Alkan, H. & Erk, S. 1992. Facies and sequence characteristics of the Late Cretaceous–Paleocene drowning on the West Taurus Carbonate Platform, SW Türkiye. *Proceedings of the 9th Petroleum Congress of Turkey*, 121–134.

North American Commission on Stratigraphic Nomenclature 1983. *North American Stratigraphic Code*. American Association of Petroleum Geologists Bulletin **67**, 841–875.

Özer, S. 1988. Description de quelques Rudistes à canaux dans le Cénomanien de Turquie. *Géologie Méditerranéenne* **15**, 159–167.

Özer, S. 1998. Rudist-bearing Upper Cretaceous metamorphic sequences of the Menderes Massif (western Turkey) *In*: Masse, J.P. & Skelton, P.W. (eds), *Quatrième Congrès international sur les Rudistes*. Geobios, Mémoire spécial **22,** 235–249.

Özgül, N. 1976. Some geological aspects of the Taurus orogenic belt-Turkey. *Bulletin of the Geological Society of Turkey* **19**, 65–78 [in Turkish with English abstract].

Özgül, N. 1984. Stratigraphy and tectonic evolution of the central Taurus. *In*: Tekeli, O. & Göncüoğlu, M.C. (eds), *Geology of the Taurus Belt, Proceedings*, 77–90.

Özkan S. & Köylüoğlu, M. 1988. Campanian–Maastrichtian planktonic foraminiferal biostratigraphy of the Beydağları Autochtonous Unit, Western Taurids, Turkey. *Middle East Technical University, Journal of Pure and Applied Sciences* **21**, 377–388.

Plenicar, M. 1963. Caprinidae and the genus Radiolitella from the Upper Cretaceous strata of southwestern Slovenia. *Slovenska Akademija Znanosti in Umetnosti, Razred za prirodoslovne in medicinske Vede, Razprave* **7**, 559–587.

Poisson, A. 1967. Données nouvelles sur le Crétacé superieur et le Tertiaire du Taurus au NW d'Antalya (Turquie). *Comptes Rendus de l'Academie des Sciences. Paris* **264**, 2443–2446.

Poisson, A. 1977. *Recherches géologiques dans les Taurides occidentals (Turquie).* Thèse Doct. d'Etat, Universitié de Paris-Sud, Orsay.

Poisson, A., Akay, E., Dumont, J.F. & Uysal, Ş. 1984. The Isparta angle: a Mesozoic paleorift in the Western Taurides. *In*: Tekeli, O. & Göncüoğlu, M.C. (eds), *Geology of the Taurus Belt, Proceedings*, 11–26.

Poisson, A., Yağmurlu, F., Bozcu, M. & Şentürk, M. 2003. New insights on the tectonic setting and evolution of the Isparta Angle, SW Turkey. *Geological Journal* **38**, 257–282.

Polsak, A. & Mamuzic, P. 1969. Les nouveaux gisements de rudistes dans le Crétacé supérieur des Dinarides externes. *Geoloski Vjesnik* **22**, 229–245.

Radoicic, R. 1960. *Microfaciès du Crétacé et du Paléogène des Dinarides externes de Yugıslavie*. Paléontologie des Dinarides Yougoslaves, Série A: Micropaléontologie **4**.

Robertson, A.H.F. 1993. Mesozoic–Tertiary sedimentary and tectonic evolution of Neotethyan carbonate platforms, margins and small ocean basins in the Antalya Complex, southwest Turkey. *International Association of Sedimentologists, Special Publication* **20**, 415–465.

Robertson, A.H.F. 2002. Overview of the genesis and emplacement of Mesozoic ophiolites in the Eastern Mediterranean Tethyan region. *Lithos* **65**, 1–67.

Robertson, A.H.F. & Dixon, J.E. 1984. Introduction: aspects of the geological evolution of the Eastern Mediterranean *In*: Dixon, J.E. & Robertson, A.H.F. (eds), *The Geological Evolution of the Eastern Mediterranean.* Geological Society, London, Special Publications **17**, 1–74.

ROBERTSON, A.H.F. & WOODCOCK, N.H. 1984. The SW segment of the Antalya Complex, Turkey as a Mesozoic–Tertiary Tethyan continental margin. *In*: DIXON, J.E. & ROBERTSON, A.H.F. (eds), *The Geological Evolution of the Eastern Mediterranean.* Geological Society, London, Special Publications **17**, 251–272.

ROBERTSON, A.H.F., CLIFT, P.D., DEGNAN, P.J. & JONES, G. 1991. Palaeogeographic and palaeotectonic evolution of the Eastern Mediterranean Neotethys. *Palaeogeography, Palaeoclimatology, Palaeoecology* **87**, 289–343.

ROBERTSON, A.H.F., POISSON, A. & AKINCI, Ö. 2003. Developments in research concerning Mesozoic–Tertiary Tethys and neotectonics in the Isparta Angle, SW Turkey. *Geological Journal* **38**, 195–234.

SAINT-MARC, P. 1969. Etude géologique de la région d'Hermel (Liban septentrional). *Bulletin de la Société Géologique de France, série 7* **2**, 379–387.

SAINT-MARC, P. 1970. Sur quelques Foraminières cénomaniens et turoniens du Liban. *Revue de Micropaléontologie* **13**, 85–94.

SAINT-MARC, P. 1977. Répartition stratigraphique des grands Foraminifères benthiques de l'Aptien, de l'Albien, du Cénomanien et du Turonien dans les régions méditerranéennes. *Revista Espanola Micropaleontologia* **9**, 317–325.

SAINT-MARC, P. 1981. LEBANON *IN*: REYMENT, R.A. & BENGTSON, P. (eds), *Aspects of mid-Cretaceous Regional Geology*, 103–131.

SALVADOR, A. 1994. *International Stratigraphic Guide - A Guide to Stratigraphic Classification, Terminology and Procedure*. 2nd edition. The International Union of Geological Sciences and the Geological Society of America, Boulder.

SAMPO, M. 1969. *Microfacies and Microfossils of the Zagros Area, Southwestern Iran (from pre-Permian to Miocene)*. International Sedimentary Petrographical Series **12**.

SARI, B. 1999. *Biostratigraphy of the Upper Cretaceous Sequences in the Korkuteli Area (Western Taurides)*. MSc Thesis, Dokuz Eylül University, İzmir, Turkey [unpublished].

SARI, B. 2006a. Upper Cretaceous planktonic foraminiferal biostratigraphy of the Bey Dağları autochthon in the Korkuteli Area, Western Taurides, Turkey. *Journal of Foraminiferal Research* **36**, 241–261.

SARI, B. 2006b. *Foraminifera-rudist Biostratigraphy, Sr-C-Isotope Stratigraphy and Microfacies Analysis of the Upper Cretaceous Sequences of the Bey Dağları Autochthon (Western Taurides, Turkey)*. PhD Thesis, Dokuz Eylül University, İzmir, Turkey [unpublished].

SARI, B. & ÖZER, S. 2001. Facies characteristics of the Cenomanian–Maastrichtian sequence of the Beydağları carbonate platform in the Korkuteli area (western Taurides). *International Geology Review* **43**, 830–839.

SARI, B. & ÖZER, S. 2002. Upper Cretaceous stratigraphy of the Beydağları carbonate platform, Korkuteli area (Western Taurides, Turkey). *Turkish Journal of Earth Sciences* **11**, 39–59.

SARI, B., STEUBER, T. & ÖZER, S. 2004. First record of Upper Turonian rudists (Mollusca, Hippuritoidea) in the Bey Dağları carbonate platform, Western Taurides (Turkey): taxonomy and strontium isotope stratigraphy of *Vaccinites praegiganteus* (Toucas, 1904). *Cretaceous Research* **25**, 235–248.

SARTONI, M. & CRESCENTI, U. 1962. Ricerche biostratigrafiche nel Mesozoico dell'Appennino meridionale. *Giornale di Geologia, ser. 2,* **29**, 161–302.

SCHROEDER, R. & NEUMANN, M. 1985. *Les grands Foraminifères du Crétacé moyen de la région méditerranéenne*. Géobios, Mémoire Spécial **7**.

ŞENGÖR, A.M.C. & YILMAZ, Y. 1981. Tethyan evolution of Turkey: a plate tectonic approach. *Tectonophysics* **75**, 181–241.

SLISKOVIC, T. 1968. Biostratigraphie du Crétacé supérieur de l'Herzégovine méridional. *Bulletin du Musée de la République Socialiste de Bosnie-Herzégovine à Sarajevo, Sciences naturelles Sarajevo* **7**, 5–66.

STAMPFLI, G.M. & MOSAR, J. 1999. The making and becoming of Apulia. *Memorie di Scienze Geologiche* **51**, 141–154.

TASLI, K., ÖZER, E. & KOÇ, H. 2006. Benthic foraminiferal assemblages of the Cretaceous platform carbonate succession in the Yavca area (Bolkar Mountains, S Turkey): biostratigraphy and paleoenvironments. *Géobios* **39**, 521–533.

TOLUN, N. 1965. *Geological Investigations of 1:25000 Scale Antalya-P24a2 and P24a3 Quadrangles*. Mineral Research and Exploration Institute, Report no. **3627**, Ankara [unpublished, in Turkish].

TRONCHETTI, G. 1984. Influence du substrat et de la salinité dans la répartition des Foraminifères benthiques: exemple du Crétacé moyen et supérieur de Provence (SE France). *Benthos'83, 2nd International Symposium on Benthic Foraminifera* (Pau, April 1983), 567–571.

VELIC, I. & VLAHOVIC, I. 1994. Foraminiferal assemblages in the Cenomanian of the Buzet-Savudrija Area (Northwestern Istria, Croatia). *Geologia Croatica* **47**, 25–43.

WALDRON, J.W.F. 1984. Evolution of carbonate platforms on a margin of the Neotethys ocean: Isparta Angle, south-western Turkey. *Eclogae Geologicae Helvetiae* **77**, 553–581.

WILSON, J.L. 1975. *Carbonate Facies in Geologic History*. Springer-Verlag.

PLATE I

1- *Cisalveolina lehneri*; Koparan Tepe section; sample no. 03-416.
2- *Cisalveolina lehneri*; Koparan Tepe section; sample no. 03-413.
3- *Cisalveolina lehneri*; Koparan Tepe section; sample no. 03-413.
4- *Cisalveolina fraasi*; Koparan Tepe section; sample no. 03-381.
5- *Cisalveolina fraasi*; Koparan Tepe section; sample no. 03-381.
6- *Orbitolina* sp.; Karain section; sample no. 03-660.
7- *Vidalina radoicicae*; Koparan Tepe section; sample no. 03-418.
8- *Vidalina radoicicae*; Koparan Tepe section; sample no. 03-416.
9- *Bolivinopsis capitata*; Koparan Tepe section; sample no. 03-296.

The bar below each photomicrographs is 500 µm. g

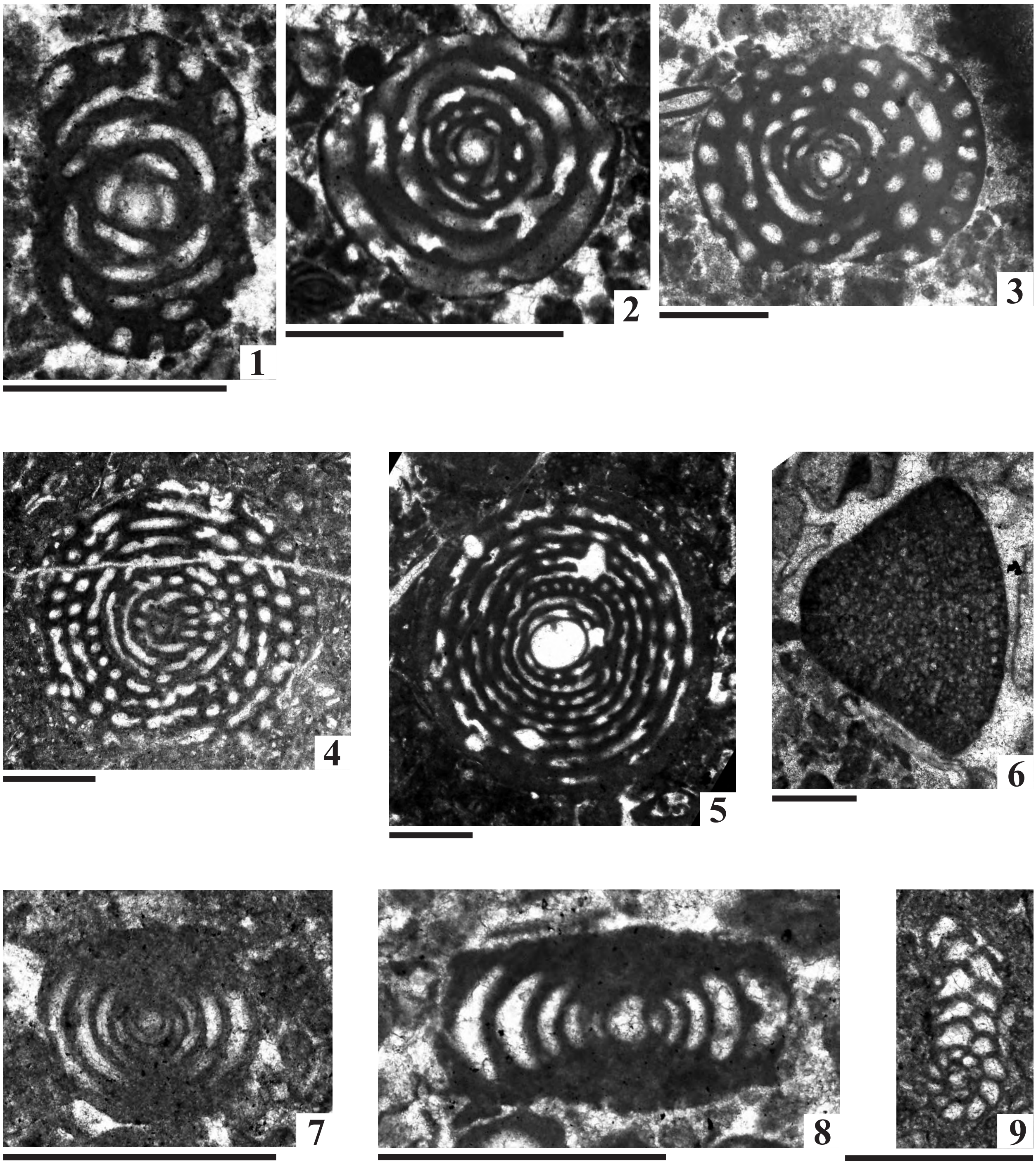

1
2
3
4
5
6
7
8
9

PLATE II

1- *Biplanata peneropliformis*; Koparan Tepe section; sample no. 03-349.
2- *Biplanata peneropliformis*; Canavar Boğazı section; sample no. 97-633.
3- *Merlingina cretacea*; Koparan Tepe section; sample no. 03-324.
4- *Merlingina cretacea*; Koparan Tepe section; sample no. 03-324.
5- *Biconcava bentori*; Canavar Boğazı section; sample no. 97-631.
6- *Biconcava bentori*; Koparan Tepe section; sample no. 03-322.
7- *Nezzazata simplex*; Koparan Tepe section; sample no. 03-416.
8- *Nezzazata simplex*; Koparan Tepe section; sample no. 03-416.
9- *Nezzazata simplex*; Demirci Dere section; sample no. 03-478.
10- *Nezzazata conica*; Yağca Section; sample no. 03-671 (from a reworked association).
11- *Trochospira avnimelechi*; Koparan Tepe section; sample no. 03-324.
12- *Nezzazatinella picardi*; Koparan Tepe section; sample no. 03-310.
13- *Nezzazatinella picardi*; Boztaş Tepe section; sample no. 97-185.

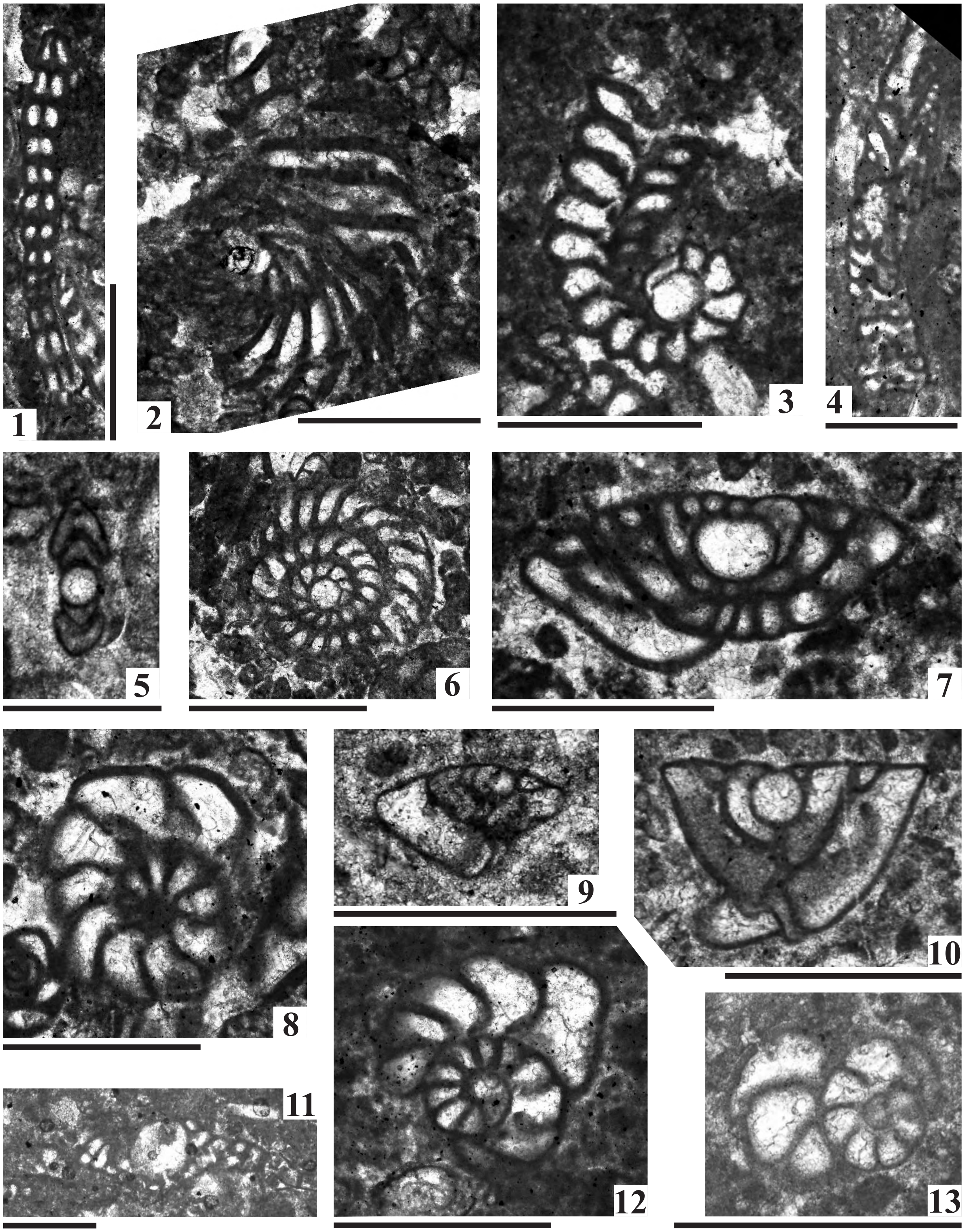

1
2
3
4
5
6
7
8
9
10
11
12
13

PLATE 3

1- *Chrysalidina gradata*; Canavar Boğazı section; sample no. 97-634.
2- *Chrysalidina gradata*; Sarp Dere section; sample no. 97-38.
3- *Pseudorhapydionina laurinensis*; Koparan Tepe section; sample no. 03-378.
4- *Pseudorhapydionina laurinensis*; Canavar Boğazı section; sample no. 97-627.
5- *Pseudorhapydionina laurinensis*; Canavar Boğazı section; sample no. 97-627.
6- *Pseudorhapydionina dubia*; Koparan Tepe section; sample no. 03-416.
7- *Cuneolina pavonia*; Koparan Tepe section; sample no. 03-419.
8- *Dicyclina schlumbergeri*; Yağca Section; sample no. 03-671 (from a reworked association).
9- *Dicyclina schlumbergeri*; Yağca Section; sample no. 03-671 (from a reworked association).
10- *Pseudolituonella reicheli*; sample 03-478.

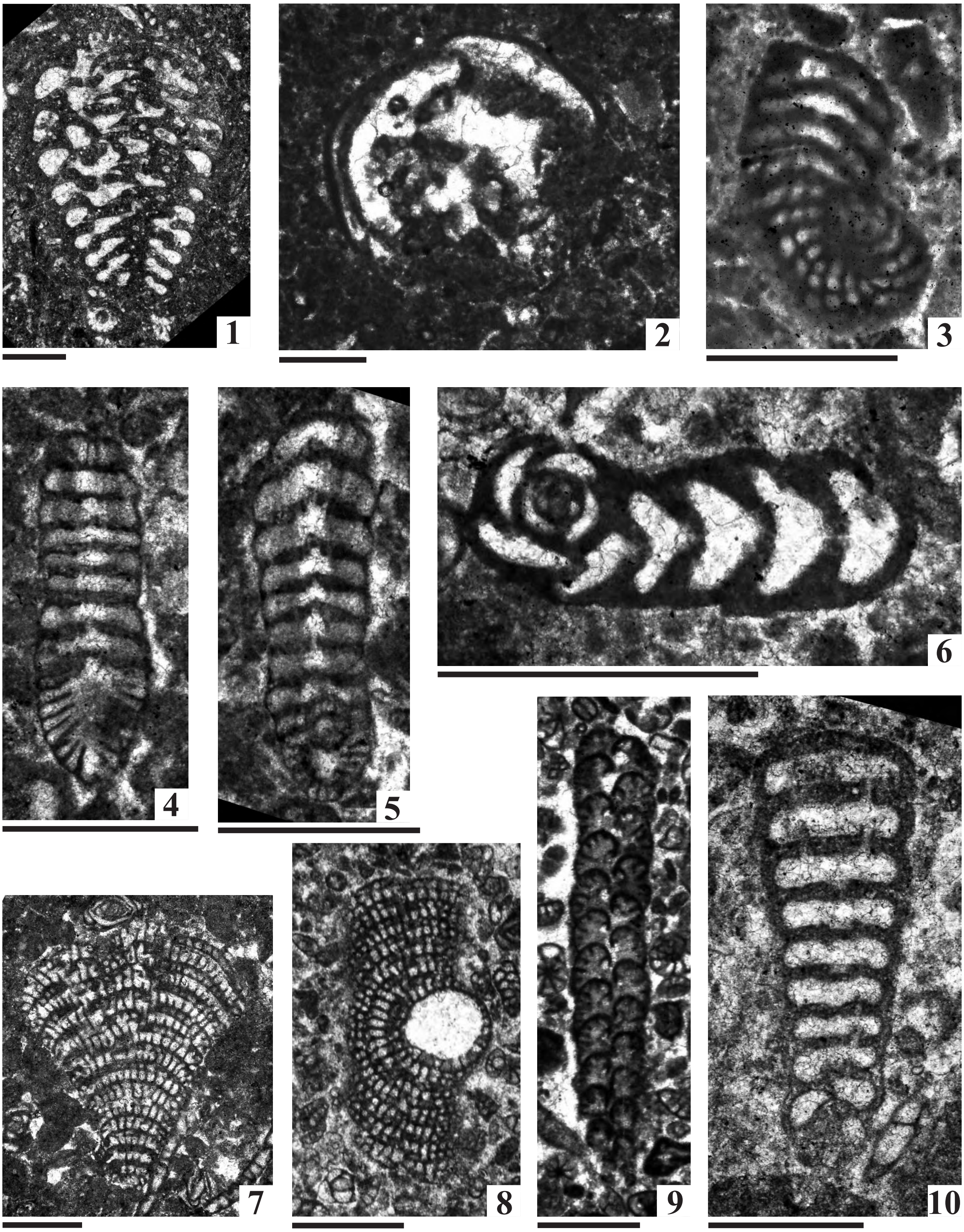
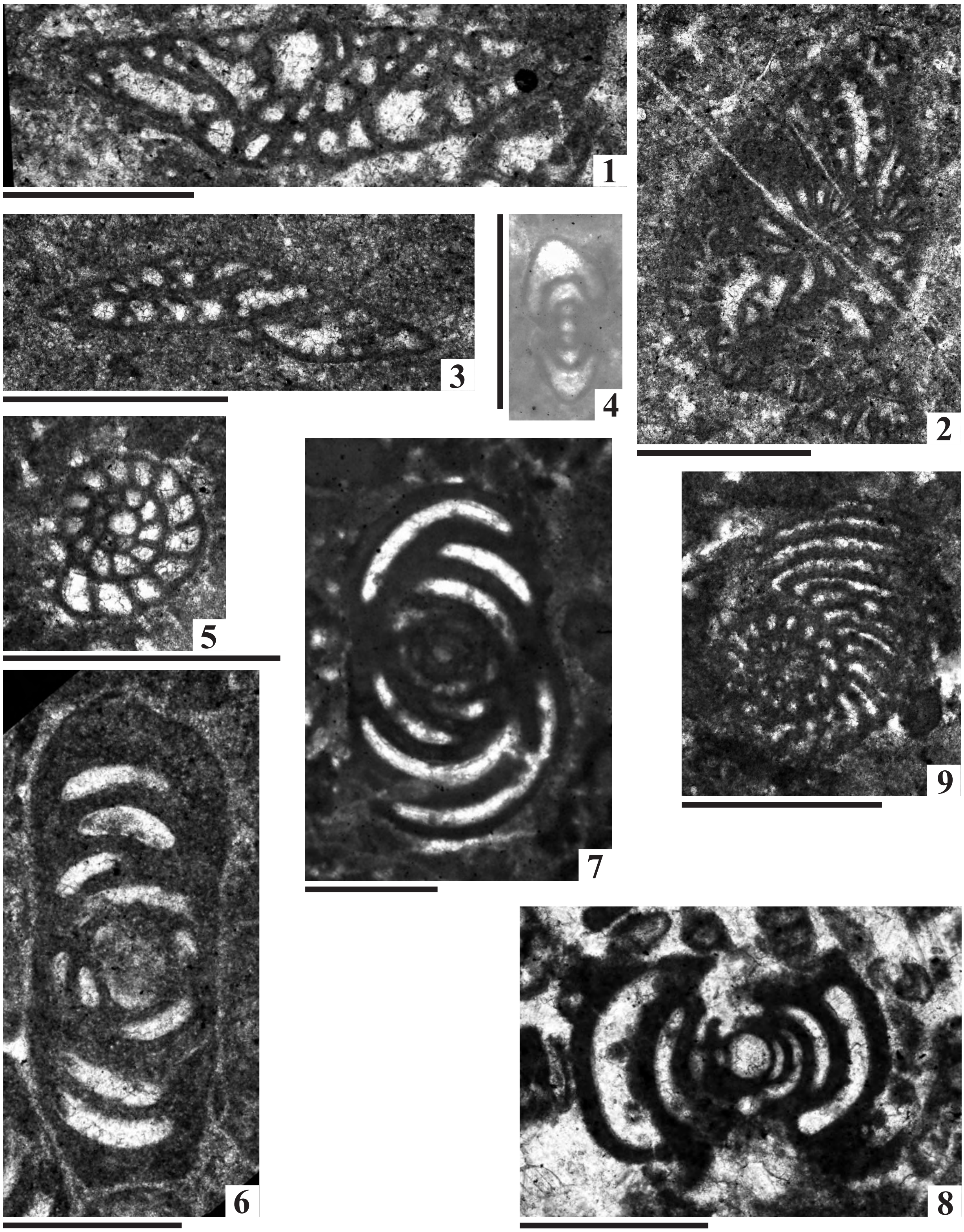

1
2
3
4
5
6
7
8
9
10

PLATE 4

1- *Coxites zubairensis*; Koparan Tepe section; sample no. 03-324.
2- *Coxites zubairensis*; Demirci Dere section; sample no. 03-474.
3- *Coxites zubairensis*; Demirci Dere section; sample no. 03-479.
4- *Moncharmontia apenninica-compressa*; sample 97-191.
5- *Moncharmontia apenninica-compressa*; sample 97-200.
6- *Pseudonummoluculina heimi*; Canavar Boğazı section; sample no. 97-627.
7- *Pseudonummoluculina heimi*; Koparan Tepe section; sample no. 03-368.
8- Nummoloculina regularis; Koparan Tepe section; sample no. 03-416.
9- *Pseudocyclammina sphaeroidea*; Boztaş Tepe section; sample no. 97-193.


1
2
3
4
5
6
7
8
9