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Stratigraphic Ranges of the Benthic Foraminifera and Microfacies of the Upper Maastrichtian-Paleocene Shallow Marine Carbonate Successions in the Eastern Pontides (Ne Turkey)

Doğu Pontidler'deki (KD Türkiye) Üst Maastrihtiyen- Paleosen Sığ Denizel Karbonat Istiflerinin Mikrofasiyesleri ve Bentik Foraminiferlerin Stratigrafik Dağılımı

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ABSTRACT

This study is a synthesis and reinterpretation of our previous works on microfacies and benthic foraminiferal assemblages of the Eastern Pontides Upper Maastrichtian-Palaeocene shallow water carbonate sequences. The aim of this study is to introduce relation between stratigraphic distribution of the foraminiferal assemblages and facies. The Upper Maastrichtian-Paleocene (K/T) transition is determined by the last occurence of predominant orbitoidal forms and by the first appearance of associations with miliolids, algae and bryozoans. The stages of the Paleocene are distinguished by means of miliolidal and rotalidal foraminifers. In the Upper Maastrichtian packed biosparite and rudistid-biosparite microfacies are predominant. Dolosparite microfacies can be used as key levels in the Upper Maastrichtian-Paleocene (K/T) transition and transitions between the Paleocene stages. In the Paleocene, biosparite rich in molluscan shell fragments, algal biosparite, miliolid biosparite microfacies are dominant. Many endemic taxa are exist through the Maastrichtian-Paleocene. Stratigraphic ranges of benthic foraminifera are of local importance.

Keywords: Benthic foraminifera, Stratigraphic ranges, Microfacies, Upper Maastrichtian, Paleocene, Eastern Pontides.

ÖZ

Bu çalışma, Doğu Pontidler'deki Üst Maastrihtiyen-Paleosen sığ denizel karbonat istiflerinin mikrofasiyesleri ve bentik foraminiferlerin stratigrafik dağılımları konularında yapılan eski çalışmaların sentezi ve yeniden yorumlanmasıdır. Çalışmanın amacı foraminifer topluluklarının stratigrafik dağılımı ve fasiyesler arasındaki ilişkiyi ortaya koymaktır. Bölgede Üst Maastrihtiyen-Paleosen (K/T) geçişi, baskın olan orbitoidal foraminiferlerin bitişi ve miliolidal foraminiferler, alg, bryozoa birlikteliklerinin başlamasıyla belirlenir. Paleosen katlarının ayırtlanmasında miliolidal ve rotaloidal foraminiferler rol oynar. Üst Maastrihtiyen'de istiflenmiş biosparit ve rudistce zengin biosparit mikrofasiyesleri hakimdir. Üst Maastrihtiyen-Paleosen (K/T) geçişinde ve Paleosen'in katları arasındaki geçişlerde Dolosparit mikrofasiyesi anahtar olarak kullanılabilir. Paleosen'de mollusk kavkı kırıklarınca zengin biyosparit, algce zengin biyosparit, miliolidce zengin biyosparit fasiyesleri egemendir. Çok sayıda endemik tür ve cins mevcuttur. Foraminiferlerin stratigrafik dağılımı bölgeye özgüdür.

Anahtar Kelimeler: *Bentik foraminifer, Stratigrafik dağılım, Mikrofasiyes, Üst Maastrihtiyen, Paleosen, Doğu Pontidler.*

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INTRODUCTION

The Eastern Pontides (Ketin, 1966, Fig. 1), which are bounded by the Black Sea to the North and by the Ankara-Erzincan suture to the South, belong to the Pontide Orogenic Belt or to the Rhodope-Pontide fragment (Şengör and Yılmaz, 1981, Tüysüz, 1993). The northern arm of the Neo-Tethys is located between the Apulian and Rhodope microcontinents (Şengör, 1987, Robertson and Dixon 1984, Dercourt et al. 2000).

The stratigraphic and structural development of the Eastern Pontides was described in Robinson et al. (1995) , Yılmaz et al. (1997) and Rice et al. (2009).

The previous geologic studies concerns with mostly regional stratigraphy and tectonic. Benthic foraminiferal content and microfacies studies had been carried out by us. This study is a synthesis, reinterpretation and revision of our previous works (İnan and Temiz 1992, Meriç and İnan 1993, İnan 1995, 1996a, 1996b, İnan et al. 1996, Meriç and İnan 1998, İnan et al. 1999, Matsumaru and İnan 2000, İnan 2002a, 2002b, İnan et al. 2005, İnan 2007, İnan and İnan 2008, İnan 2009, İnan and İnan 2009).

The purpose of this paper is to describe the stratigraphic distribution of some benthic foraminifers in the Upper Maastrichtian and Paleocene of the Eastern Pontides. Well- exposed outcrop sections with characteristic benthic foraminifera permit the litho-bio-, chronostratigraphic and microfacies correlation in the Niksar (Erencik section), Karaçam hıghland (Sırakayalar section), Gölköy (Gölköy section), Koyulhisar (Kuzulu section) and Düzköy (Çalköy section) to be studied in detail (Figures1-3).

LIHOSTRATIRAPHY

The locations of the five studied shallow marine carbonate successions straddling the Cretaceous Tertiary transition are shown on Figure 1. The main lithologies comprise massive to thick-bedded (70-100 cm), grey limestones, locally dolomitized and brecciated, with argillaceous and sandy intercalations. Rich benthic foraminiferal content of these locations makes identifcation of stage boundaries easily.The Kuzulu and Çalköy sections range from the Upper Maastrichtian to Thanetian. The Gölköy section comprises the Upper Maastrichtian to Selandian. The Erencik (Niksar) and Sırakayalar (Karaçam Highland) sections represent only the Upper Maastrichtian-Danian transition (İnan, 2002, İnan et al. 2005, İnan 2007, İnan and İnan 2008, İnan 2009)

The Erencik Formation outcrops in the Erencik formation outcropped in the Erencik Hill at the southeast of Niksar (Tokat) was first introduced by İnan and Temiz (1992). The Erencik section was proposed as the type-section of the formation. This ormation is composed mainly of argillaceous limestones and conformably overlies the Upper Maastrichtian Kırandağ Formation, which consists of mudstone, marl and limestone alternation or laterally intertongues with it. The formation represents the Upper Maastrichtian-Danian (İnan and Temiz 1992, İnan et al. 2005, İnan 2009).

The Sırakayalar detrital limestone member of the Kırandağ Formation in the Karaçam hıghland was first described by Seymen (1975). Foraminiferal content of the unit is documented by İnan et al. (1996) and the unit is assigned to the Upper Maastrichtian-Danian.

The Gölköy formation, first described by Terlemez and Yılmaz (1980), consists of alternating limestone and marl. This formation conformably overlies the Upper Maastrichtian Fatsa Formation, composed of volcano-sedimentary rocks. The type-section of this unit is the Gölköy section (Meriç and İnan 1998, Sirel 1998). The age of the unit is interpreted as the late Maastrichtian-Selandian (İnan et al. 2005, İnan and İnan 2008, İnan 2009).

In the Koyulhisar area, the İğdir limestone member represented by reef limestones of the Reşadiye Formation was first described by Terlemez and Yılmaz (1980), and was subsequently named the İğdir Formation by Toprak et al. (1988). The type-section of the unit is the Kuzulu section (İnan, 1995). The İğdir formation consists of limestones and argillaceous limestones. It conformably overlies the Upper Maastrichtian Kapaklı formation, which is composed of

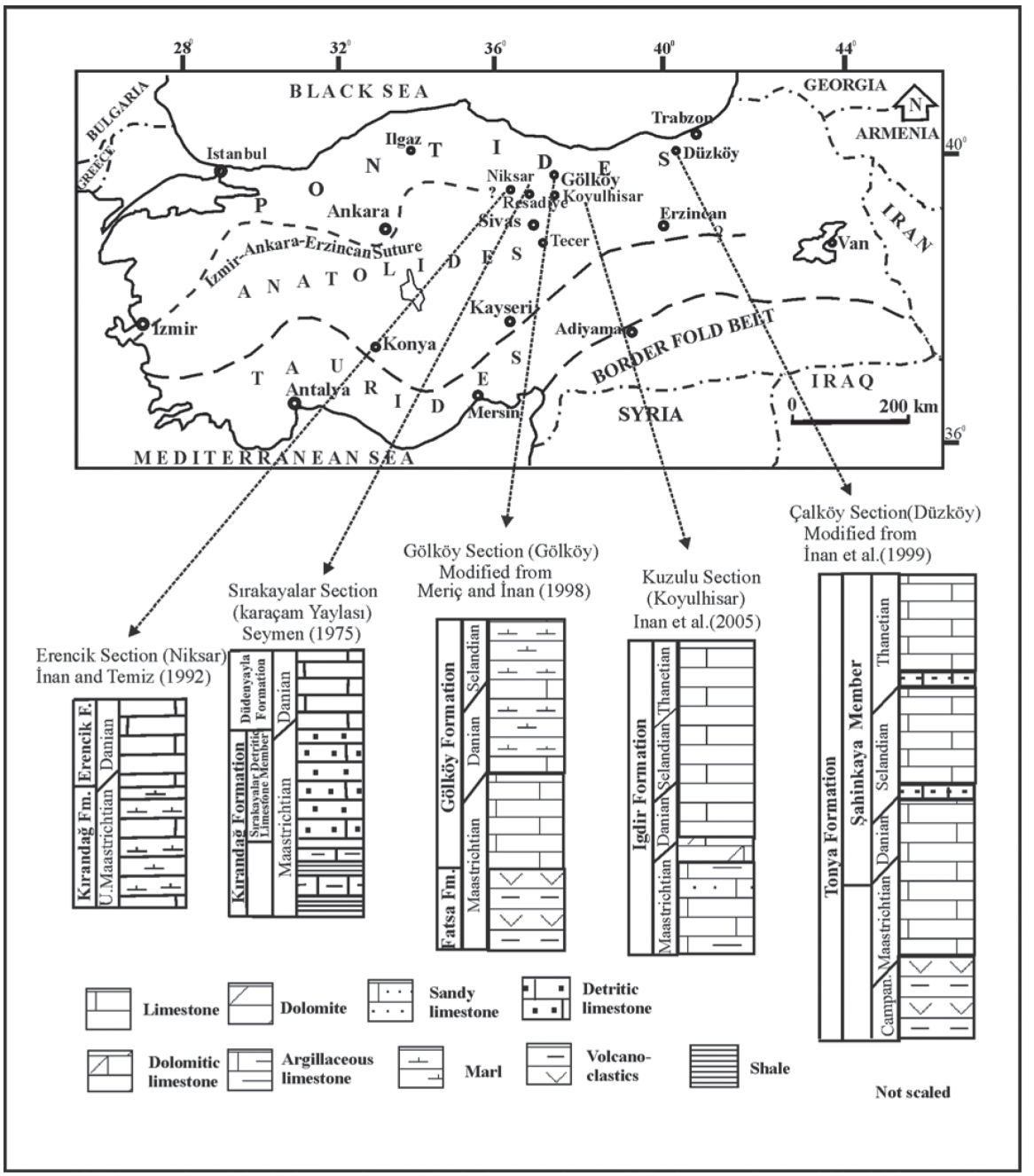

Figure 1. Major tectonic units of Türkiye (Ketin, 1966) and location map of outcrop sections analyzed (Composited and modified from İnan et al., 2005, İnan and İnan, 2008).

Şekil 1. Türkiye'nin başlıca tektonik birimleri (Ketin, 1966) ve incelenen kesitlerin yer bulduru haritası (İnan ve diğ. 2005, İnan ve İnan 2008'den birleştirilmiştir)

limestone, marl, tuff and mudstone alternation. The İğdir formation grades vertically and laterally into the Gölköy Formation. The formation is dated as Late Maastrichtian-Thanetian (İnan 1995, İnan et al. 2005, İnan and İnan 2008, İnan 2009).

In the Düzköy area, the Şahinkaya detrital limestone member of the Tonya formation was first described by Korkmaz (1993). The Çalköy section was proposed as the type section and assigned to the Upper Maastrichtian-Thanetian (İnan et al. 1999, İnan and İnan, 2008, İnan 2009).

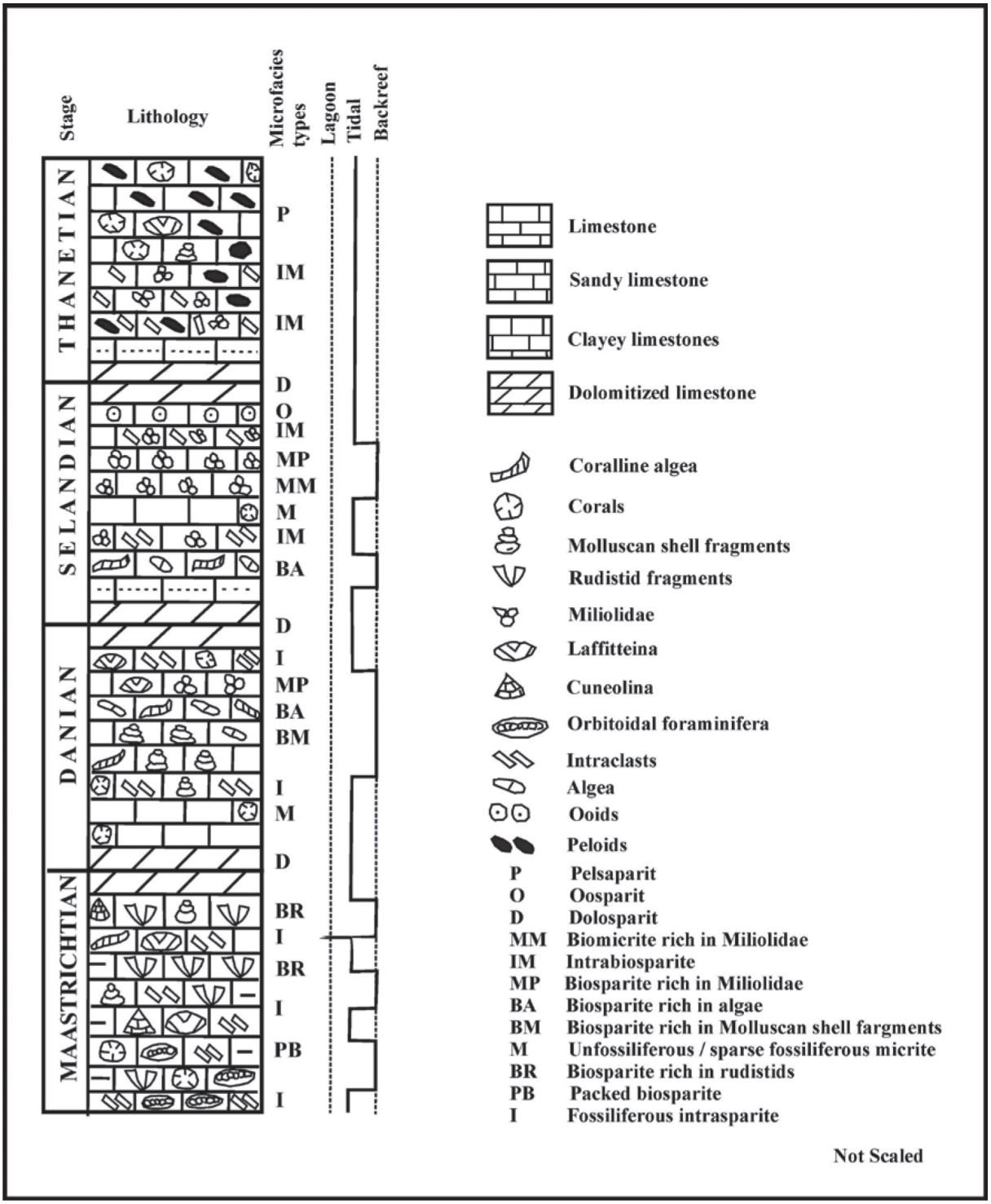

Figure 2. Detailed log of the composite section showing the distribution of main lithologies, fossil occurences and microfacies types representative of the Maastrichtian-Paleocene carbonate successions in the Eastern Pontides.

Şekil 2. Doğu Pontidler'deki Maastrihtiyen-Paleosen karbonat istiflerinin başlıca mikrofasiyes tipleri, fosiller ve başlıca litolojilerin dağılımını gösteren ayrıntılı bileşik kesit.

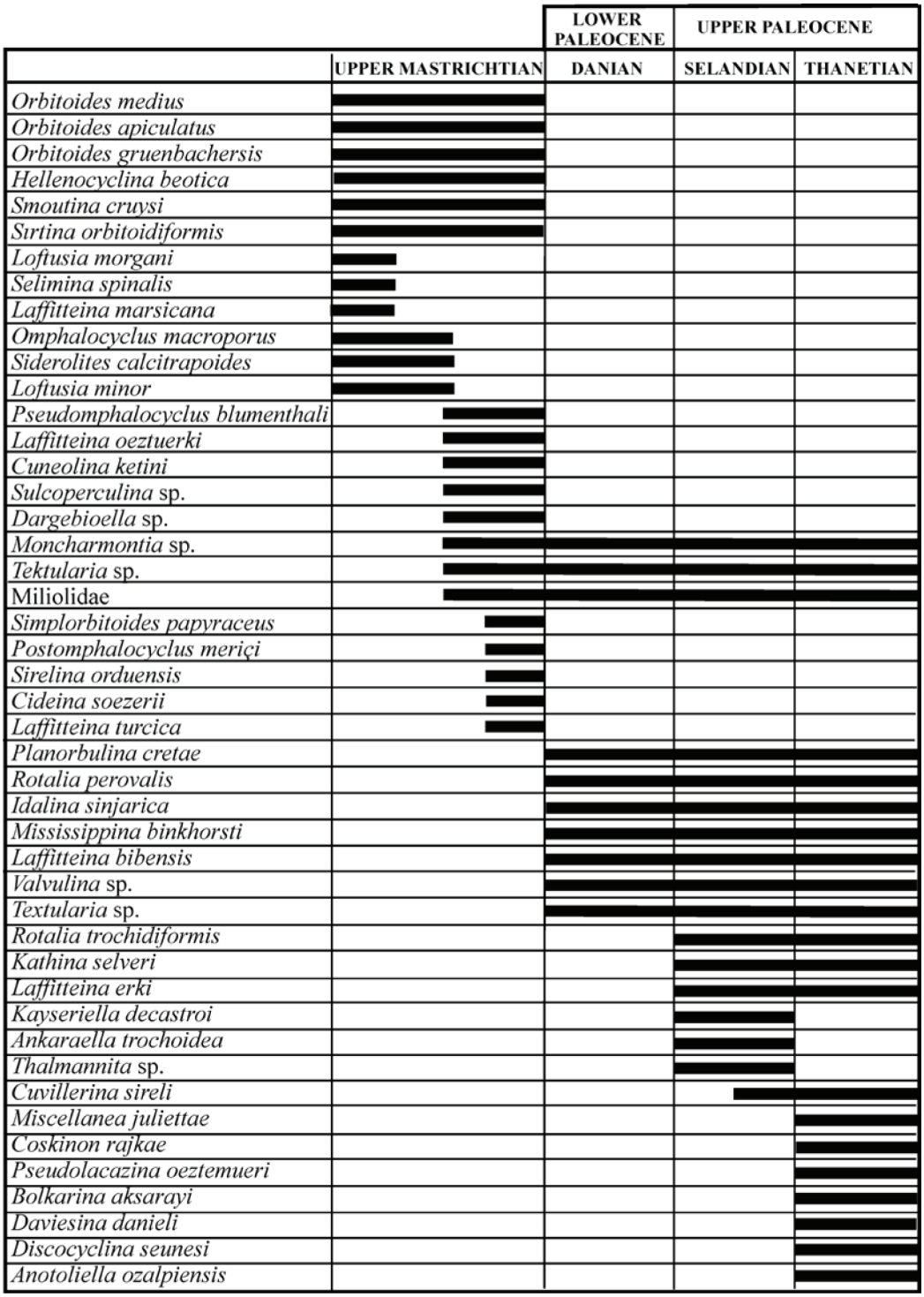

Figure 3. Composite stratigraphic range chart of some Maastrichtian-Paleocene benthic foraminifera of the shallow marine carbonate successions in the Eastern Pontides (Composited and modified from İnan et al., 2005, İnan and İnan, 2008).

Şekil 3. Doğu Pontidler'deki sığ denizel karbonat istiflerinin bazı Maastrihtiyen-Paleosen bentik foraminiferlerinin bileşik stratigrafik menzil kartı (İnan ve diğ. 2005, İnan ve İnan 2008'den birleştirilmiştir).

STRATIRAPHIC RANGES OF THE BENTHIC FORAMINIFERA AND MICROFACIES

The above Maastrichtian-Paleocene carbonate-dominated sequences have been interpreted as shallow, open marine shelf and restricted lagoonal deposits (İnan et al. 2005, İnan and İnan 2008, İnan 2009). In this study, a composite section showing the predominant microfacies of shallow marine carbonate successions of the Upper Maastrichtian- Paleocene in the Eastern Pontides is given in Figure 2.

The fossiliferous intrasparite, packed biosparite, rudistid-rich biosparite and dolosparite microfacies of the Upper Maastrichtian (Figure 2) contain rich benthic foraminiferal assemblages, the ranges of which are shown on Figure 3, based on the works of Meriç and İnan (1993), İnan (1996a, 1996b), İnan et al. (1996), Matsumaru and İnan (2000), Meriç and İnan (1998), İnan et al.. (2005) and İnan (2007).

Three or four Upper Maastrichtian assemblages may be distinguished, based on ranges of larger benthic foraminifera. *Orbitoides medius, Orbitoides apiculatus, Orbitoides gruenbachensis, Hellenocyclina beotica, Smoutina cruysi, Sirtina orbitoidiformis* occur through the Upper Maastrichtian; *Omphalocyclus macroporus, Siderolites calcitrapoides, Loftusia minor* ranges into the middle part of the Upper Maastrichtian; *Loftusia morgani, Selimina spinalis, Laffitteina marsicana* occur in the lower part of the Upper Maastrichtian; *Pseudomphalocyclus blumenthali, Laffitteina oeztuerki, Cuneolina ketini, Sulcoperculina* sp., *Dargenionella* sp. range from the middle to the top of the Upper Maastrichtian; *Postomphalocyclus meriçi, Cideina soezerii, Sirelina orduensis, Simplorbitoides papyraceus* and *Laffitteina turcica* occur only in the top of the Upper Maastrichtian. *Moncharmontia* sp., *Textularia* sp. and Miliolidae accompany these Maastrichtian associations but their ranges reach until the end of the Thanetian (Fig. 3).

The unfossiliferous micrite, fossiliferous intrasparite, biosparite rich in molluscan shells, biosparite rich in algae, biosparite rich in miliolidae and dolosparite microfacies of the Danian (Figure 2) contain a benthic foraminiferal assemblage represented by *Planorbulina cretae, Rotalia perovalis, Idalina sinjarica, Laffitteina bibensis, Missisippina binkhorsti, Anomalina* sp., *Eponides* sp., *Gyroidina* sp., *Lenticulina* sp. and *Valvulina* sp. (İnan et al. 2005, İnan 2007, İnan and İnan 2008). This association ranges into the Selandian and Thanetian (Figure 3).

In the algal biosparite, sparse fossiliferous micrite, miliolid biomicrite and biosparite, intrabiosparite, oobiosparite and dolosparite microfacies of the Selandian (Figure 2), the first appearances of *Rotalia trochidiformis, Kathina selveri, Laffitteina erki* and *Cuvillierina sireli* are indicative of the lower boundary of the Selandian, but these also occur in the Thanetian. The stratigraphical ranges of *Kayseriella decastroi, Ankaraella trochoidea* and *Thalmannita* sp. appear to be limited to the Selandian (Figure 3; İnan 2007, İnan and İnan 2008, İnan 2009).

The first appearance datums of *Miscellanea julietae, Coskinon rajkae, Pseudolacazina oeztemueri, Bolkarina aksarayi, Daviesina danieli, Discocyclina seunesi, Anatoliella ozalpiensis* and *Keramosphaera* sp. in the intrabiosparite and pelsparite microfacies of the Thanetian are indicative of the lower boundary of the Thanetian.

Species of *Laffitteina* can be used as index fossils for subdivision of the Upper Maastrichtian-Paleocene in the Eastern Pontides (İnan 1995, İnan 1996b , İnan 2002a, 2002b, İnan et al. 2005, İnan 2007, İnan and İnan 2008, İnan 2009). *Laffitteina marsicana* ranges through the lower to middle part of the Upper Maastrichtian. The last occurence of *Laffitteina oeztuerki* and *Laffitteina turcica* marks the end of the Maastrichtian. *Laffitteina oeztuerki* first appears in the middle part of the Upper Maastrichtian and disappears in the upper part of the Upper Maastrichtian. *Laffitteina turcica* occurs only in the uppermost Maastrichtian. *Laffitteina bibensis* appears in the Lower Paleocene (Danian). The first occurence of *Laffitteina erki* indicates the Selandian. *Laffitteina bibensis* and *Laffitteina erki* are associated in the Selandian and Thanetian (Figure 3).

In the Upper Maastrichtian, endemic taxa such as *Postomphalocyclus meriçi, Selimina spinalis, Cideina soezerii, Sirelina orduensis, Laffitteina turcica, Laffitteina oeztuerki* occur (İnan and İnan 2009) .

Porcellanous forms are represented by *Kayseriella*, *Ankaraella* and *Idalina*. Both foraminiferal content of the Paleocene and their stratigraphic distributions (İnan and inan, 2008) differ from that was proposed for Tethyan Paleocene by Serra-Kiel et al. (1998).

CONCLUSION

In the Eastern Pontides, the Upper Maasrtichtian-Paleocene successions contain common microfacies and benthic foraminifera. In the Upper Maastrichtian, many endemic taxa such as *Postomphalocyclus meriçi, Selimina spinalis, Cideina soezerii, Sirelina orduensis* and species of *Laffitteina* are exist. In the Paleocene, benthic foraminifera such as *Kayseriella* and *Ankaraella* have a local stratigraphic ranges differ from the other Tethyan realm.

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REFERENCES

Dercourt, J., Gaetanı,M., Vrıelynck,B., Barrıer, E., Bıju-Duval, B., Brunet,M.F., Cadet, J.P., Crasquın, S., Sandulescu, M. (Eds)2000. Peri- Tethys atlas; palaeogeographical maps; explanatory notes. Paris, France: Commission for the Geologic Map of the World, 268 pp.

İnan,N., 1995. The importance of the genus Laffitteina (Foraminifera) at the Cretaceous /Tertiary transition. İnternational Symposium on the Geology of the Black Sea region, Ankara, 109-118.

İnan,N.,1996a. Selimina spinalis n.gen.n.sp., a new Upper Maastrichtian Foraminifer from Northeastern Turkey. 1996, Revue de Paléobiologie, 15/1, 215-223.

İnan,N.,1996b. The geographic extension and stratigraphic distribution of Laffitteina species in Turkey. Geological Bulletin of Turkey, 39/1, 41-51.

İnan,N.,2002a, Laffitteina turcica (Foraminifera) a new species from the Maastrichtian of central Anatolia (Sivas- Turkey). Micropaleontology, 48, 93-95.

İnan, N.,2002b. Doğu Pontidler'de bentik K/T geçişlerinin genel özellikleri : Erencik formasyonu (Niksar), İğdir formasyonu (Koyulhisar) ve Şahinkaya üyesi (Tonya). Türkiye Stratigrafi Komitesi 3. Çalıştayı, Orta ve Doğu Karadeniz Bölgesinin Litostratigrafi Adlamaları. Özler 30-31. Ankara.

İnan,N.,2007. Doğu Pontidler'de, Üst Maastrihtiyen, Daniyen, Selandiyen, Tanesiyen kat sınırlarının biyostratigrafik verileri. Türkiye Stratigrafi Komitesi 7. Çalıştayı, Türkiye'de Kat Sınırı Çalışmaları Özler 22-24. Ankara.

İnan,N.,2009. Benthic Foraminiferal Assemblages and Microfacies of K/T Transition in the Shallow Marine Carbonate Successions in the Eastern Pontides. 2.International Symposium on the Geology of the Black Sea Region (ISGB), Abstract Book, p. 93-94. Ankara

İnan,N. And Temiz, H., 1992. Niksar (Tokat) yöresinde Kretase/ Tersiyer geçişinin litostratigrafik ve biyostratigrafik özellikleri . Türkiye Jeoloji Bülteni, 35/2, 39-49.

İnan,N., Meriç, E. and Özgen, N., 1996. A Different asexual reproduction ın Simplorbites papyraceus (Boubée) samples of Karaçam Hıghland (Niksar-Turkiye): A1X Indıvıduals . Revue de Paléobiologie , 15/2, 449-459.

İnan,N., İnan, S. and Kurt, İ., 1999. Doğu Pontidlerde uyumlu bentik K/T geçişi: Tonya formasyonunun (GB Trabzon) Şahinkaya Üyesi. Türkiye Jeoloji Bülteni, 42/2, 63-67.

İnan, N., Taslı, K. and İnan, S., 2005. Laffitteina from the Maastrichtian-Paleocene shallow marine carbonate successions of the Eastern Pontides (NE Turkey): biozonation and microfacies. Journal of Asian Earth Sciences, 25, 367-378.

İnan,N. and İnan, S., 2008. Selandian (Upper Paleocene) Benthic foraminiferal assemblages and their stratigraphic ranges in the Northeastern Part of Turkey. Yerbilimleri, 29/3, 147-158.

İnan, N. and İnan, S., 2009, Endemic foraminifera of the LateMaastrichtian from the northern branch of the Neotethys, NE Turkey. Micropaleontology, 55/5, 514-522

Ketin, İ., 1966. Anadolu'nun Tektonik Birlikleri. M.T.A.Dergisi, 66, 20-34.

Korkmaz, S., 1993. Tonya- Düzköy (GB Trabzon) Yöresinin Stratigrafisi. Türkiye Jeoloji Bülteni 36, 151-158.

Matsumaru, K. and İnan, N., 2000. Some benthic foraminifera of K/T transition beds in conform outcrops in Turkey. Saitama University, Faculte Education. 49/1, 39-49.

Meriç, E. ve İnan, N., 1993. Cideina soezerii (Sirel) Yüzlekler- tanım-lektotip- paratipler ve tartışma. Türkiye Jeoloji Bülteni 36/1, 45-49.

Meriç, E. and İnan,N., 1998. Sirelina orduensis (Foraminifer) a new genus and species from the maastrichtian of north-east Anatolia (Gölköy-Ordu): Micropaleontology 44/2, 195-200.

Rice, S.P., Robertson, A.H.F., Ustaömer, T., İnan, N. and Taslı, K., 2009. Late Cretaceous-Early Eocene tectonic developmnet of the Tethyan suture zone in the Erzincan area, Eastern Pontides, Turkey. *Geological* Magazine. 146/4, 567-590.

Robertson, A.H.F. and Dıxon, J.E., 1984. Introduction: aspects of the geological evolution of the Eastern Mediterranean. In The Geological Evolution of the Eastern Mediterranean (eds J. E. Dixon & A. H. F. Robertson.), pp. 1–74. Geological Society of London, Special Publication no. 17.

Robinson, A.G.,Banks, C.J., Rutherford, M.M., Hırst, J.P.P., 1995. Stratigraphic and structural development of the eastern Pontides. Journal of the Geological Society London. 152, 861-872.

Serra-Kiel, J., Hottinger, L., Caus, E., Drobne, K., Ferrandez, C., Jauhri, A.K., Less, G., Pavlovec, R., Pignatti, J., Samso, J.M., Schaub, H., Sirel, E., Strougo, A., Tambareau, Y., Tosquella, J., Zakrevskaya, E., 1998. Larger foraminiferal biostratigraphy of the Tethyan Paleocene and Eocene. Bulletin de la Société Géologique de France, 169/2, 281-299.

Seymen, İ., 1975. Kelkit vadisi kesiminde Kuzey Anadolu Fay Zonunun Tektonik Özelliği . Unpublished phD Thesis, İstanbul Üniversitesi, p.87.

Sirel, E., 1998. Foraminiferal Description and biostratigraphy of the Paleocene-Lower Eocene shallow water limestones and discussion on the Cretaceous-Tertiary boundary in Turkey. General Directorate of the Mineral Research and Exploration Monography Series No.2.

Şengör, A.M.C., 1987. Tectonics of the Tethysides: orogenic collage development in a collisional setting. Annual Review Earth Planet Science, 15, 213-244

Şengör, A.M.C. and Yılmaz, Y., 1981. Tethyan evolution of Turkey: A plate tectonic approach. Tectonophysics, 75, 181–241.

Terlemez, İ. and Yılmaz, A., 1980. Ünye-Ordu-Koyulhisar-Reşadiye arasında kalan yörenin stratigrafisi. Türkiye Jeoloji Kurumu Bülteni, 23, 179-192.

Toprak, V., Sirel, E. and Özkan, S., 1988. Koyulhisar (Sivas) dolayında Kretase/Paleosen geçişi. Akdeniz Üniversitesi Isparta Mühendislik Fakültesi Dergisi, 4, 396-407.

Tüysüz, O., 1993. A geo-traverse from the Black Sea to the Central Anatolia: Tectonic evolution of Northern Neo Tethys . Journal of the Turkish Association of Petroleum Geologists. 5/1, 1-33.

Yılmaz, Y., Tüysüz, O., Yiğitbaş, E.E., Genç, S.C., Şengör, A.M.C., 1997. In: Robinson, A. G., (Ed.), Geology and tectonic evolution of the Pontides, Regional and petroleum geology of the Black Sea and surroundig region. Bulletin of the American Assoc. Petrol. Geol., Mem. 68, 183-226.