

Stratigraphic and Palaeoenvironmental Significance of Bartonian–Priabonian (Middle–Late Eocene) Microfossils from the Başçeşme Formation, Denizli Province, Western Anatolia

MEHMET SERKAN AKKİRAZ¹, FUNDA AKGÜN¹, SEFER ÖRÇEN²,
ANGELA ANNELIESE BRUCH³ & VOLKER MOSBRUGGER³

¹Dokuz Eylül Üniversitesi, Mühendislik Fakültesi, Jeoloji Mühendisliği Bölümü,
Bornova, TR–35100 İzmir, Turkey
(E-mail: serkan.akkiraz@deu.edu.tr)

²Yüzüncü Yıl Üniversitesi, Mühendislik-Mimarlık Fakültesi, Jeoloji Mühendisliği Bölümü,
TR–65080 Van, Turkey

³Institute and Museum of Geology and Palaeontology, Sigwartstr. 10, D–72076 Tübingen, Germany

Abstract: This study explains the stratigraphical and palaeoenvironmental significance of Bartonian–Priabonian (Middle–Late Eocene) fossils, the fauna and flora obtained from the Başçeşme formation of the Çardak–Tokça basin (western Anatolia). The studied sequence is an outcrop from the Başçeşme formation, deposited in a shallow-marine to coastal environment without stratigraphic breaks. Forty genera and 58 species have been recognized in the palynological assemblage of the Başçeşme formation. A well-preserved diverse palynomorph and foraminiferal assemblages yield the Middle–Late Eocene age for the Başçeşme formation. In western Anatolia, mangrove elements *Nypa* and *Pelliciera* have been first recorded in this study. The pollen of *Mauritia* and *Acrostichum* occur in the back-mangrove environment. Lowland–Riparian and montane elements are characterized by dominance of Myricaceae, Betulaceae, *Engelhardia*, Fagaceae, Myrtaceae, Anacardiaceae and Taxodiaceae, *Pinus*, *Abies*, *Picea*, *Cathaya*, *Quercus* and *Castanea*, respectively. Fresh-water elements are represented by Sparganiaceae, *Pediastrum* sp. and *Aglaoreidia cyclops*.

The palynological data for samples taken from the lower part of the section of the Başçeşme formation indicate a back-mangrove environment. The presence of poorly preserved dinoflagellate cysts suggest that sedimentation occurred in a mangrove environment in the upper part of the section. The well-preserved foraminiferal data, along with corals, bivalves and gastropods, indicate that sedimentation ceased in the shallow-marine environment. In this paper, terrestrial climatic conditions of the Başçeşme formation are also discussed on the basis of the coexistence approach.

Key Words: Middle–Late Eocene, mangrove, western Anatolia, benthic foraminifer, palynomorph, palaeoenvironment, palaeoclimate

Denizli Yöresindeki Bartoniyen–Priaboniyen (Orta–Geç Eosen) Mikrofosilleri İçeren Başçeşme Formasyonu'nun Stratigrafik ve Ortamsal Önemi, Batı Anadolu

Özet: Bu çalışma, Çardak–Tokça havzasının (Batı Anadolu) Başçeşme formasyonundan elde edilen Bartoniyen–Priaboniyen (Orta–Geç Eosen) yaşlı, fauna ve floranın stratigrafik ve paleoortamsal önemini açıklar. Çalışılan istif, stratigrafik kesiklik olmaksızın, sığ deniz, kıyı ortamında çökelmiş Başçeşme formasyonundan bir yüzlektir. Başçeşme formasyonunun palinolojik topluluğunda 40 cins ve 58 tür tanımlanmıştır. İyi korunmuş çeşitli palinomorf ve foraminifer toplulukları, Başçeşme formasyonunun yaşını Orta–Geç Eosen olarak vermektedir. Batı Anadolu'da, mangrove elementleri olan *Nypa* ve *Pelliciera* ilk kez bu çalışmada kaydedilmiştir. Mangrov gerisindeki ortamda *Mauritia* ve *Acrostichum* polenleri mevcuttur. Alçak alan–Irmak kenarı elemanları, Myricaceae, Betulaceae, *Engelhardia*, Fagaceae, Myrtaceae, Anacardiaceae ve Taxodiaceae, dağ elemanları ise *Pinus*, *Abies*, *Picea*, *Cathaya*, *Quercus* ve *Castanea* ile karakterize edilir. Tatlısu elemanları Sparganiaceae, *Pediastrum* sp. ve *Aglaoreidia cyclops* ile temsil edilir.

Elde edilen palinolojik veriler, Başçeşme formasyonunun alt kesimlerinden alınan örneklerin mangrov gerisi ortamı belirttiğini göstermektedir. İstifin üst kesimlerinde kötü korunmuş dinoflagellatların varlığı tortullaşmanın

mangrove ortamında gerçekleştiğini göstermektedir. Mercan, bivalvia ve gastropodlu iyi korunmuş foraminifer verileri, tortulaşmanın sığ denizel ortamda son bulunduğunu göstermektedir. Bu makalede, 'coexistence approach' yöntemine dayalı, Başçeşme formasyonunun karasal iklimsel koşulları da tartışılmıştır.

Anahtar Sözcükler: Orta-Geç Eosen, mangrov, Batı Anadolu, bentik foraminifer, palinomorf, paleoortam, paleoiklim

Introduction

The Palaeocene–Eocene sedimentary successions of western Anatolia are claimed to have developed on the different tectonostratigraphic units, such as the Lycian Nappes (Poisson 1976; Yalçınkaya *et al.* 1986; Göktaş *et al.* 1989; Özkaya 1991; Şenel 1991, 1997; Collins & Robertson 1997, 1998, 1999; Bozkurt & Park 1999; Sözbilir *et al.* 2001; Sözbilir 2002), the Menderes Massif (e.g., Poisson 1976; Özkaya 1990, 1991; Bozkurt & Park 1994; Özer *et al.* 2001; Koralay *et al.* 2004) and the Bey Dağları carbonate platform (Özkaya 1991; Collins & Robertson 1998; Sarı & Özer 2002) (Figure 1a, b). The non-metamorphosed Palaeocene–Eocene sedimentary successions of western Anatolia generally consist of conglomerate, sandstone, turbiditic sandstone–mudstone alternations, bioclastic limestone lenses, blocks of limestones and volcanic rocks, and these have been interpreted to be of the supra-allochthonous basin type, and to have developed over the Lycian Nappe package (Sözbilir 2002). Limited coal-bearing Eocene outcrops have been observed in western Anatolia. The coal-bearing Eocene sediments of the Çardak-Tokça basin, which stratigraphically overlie the Lycian Nappes, are exposed 35 km east of Denizli (Figure 1a, b).

Micropalaeontological and stratigraphical studies on the Eocene formations of the Çardak-Tokça basin have been either neglected or carried out by Mineral Research of Exploration Institute (M.T.A.). The unpublished report of Göktaş *et al.* (1989) was the first comprehensive stratigraphic and palaeontological study of the Tertiary sediments of the Çardak-Tokça basin. The Başçeşme formation was formerly subdivided into four members (from bottom to top), the Dazlak, Beşparmak reef, Maden and Asar members. That study reported that the age of the Başçeşme formation is Late Eocene (Priabonian) on the basis of unillustrated benthic foraminifers, mollusks and corals. Şahbaz & Görmüş (1992) examined the stratigraphic and sedimentological properties of the conglomerates that crop out as the Çardak-Tokça basin fill and recognized three different

types of conglomerates, these belonging to the Eocene, Lower Oligocene and Oligocene, respectively. Şenel (1997) collected the findings of Göktaş *et al.* (1989) and reinterpreted the age of the Başçeşme formation as Late Lutetian–Priabonian. Sözbilir *et al.* (2001) studied the stratigraphic and tectonic properties of the Eocene in the Baklan succession, located 10 km from the study area, (Figure 1b) and reported a well-preserved marine fauna which yields a Bartonian (Middle Eocene) age.

This study focuses on the Başçeşme formation, composed of both marine and coal-bearing lacustrine sediments. The objective of this paper is to provide for the first time palynological and foraminiferal evidence from the Maden and the Asar members of the Başçeşme formation, to obtain precise ages, to ascertain depositional environments, to begin to understand qualitative palaeoclimatic conditions for these units, and also to analyze the similarities to and differences from correlative Eocene basins in Turkey.

Stratigraphy

In the area, pre-Eocene basement consists of the Triassic–Lower Eocene Lycian Nappes and generally comprises metaconglomerate, metasandstone, recrystallized limestone, metavolcanites, dolomite, dolomitic limestones, and ophiolitic-rock matrix and blocks (Göktaş *et al.* 1989). The Başçeşme formation unconformably overlies the Lycian Nappes and is made up of four different members which are terrestrial and shallow marine in character; these are (from bottom to top) the Dazlak, Beşparmak reef, Maden and Asar members (Göktaş *et al.* 1989; Şenel 1997) (Figures 1b & 2). In the study area, the Dazlak, Maden and Asar members occur the sequence (Figure 2). Here, their lithological properties are described briefly, in ascending order.

The Dazlak member, which is barren of microfossils, generally comprises a reddish conglomerate and sandstone alternation of transgressive character. The