The First Record of *Eotrigonobalanus Furcinervis* (Fagaceae) from the Oligocene of the Thrace Basin, Western Turkey

Meral Kaya Sari¹, Bilal Gülen²

¹Atatürk University, Engineering Faculty, Department of Geothecnic, 25240, Erzurum, Turkey
²Bahçelievler Mah. Atatürk Bulvarı, 17/2, 59740, Marmaraerğlisi-Tekirdağ, Turkey

meral.kayasari@atauni.edu.tr

Abstract. *Eotrigonobalanus Furcinervis* was recorded for the first time from the Oligocene sediments of the Thrace Basin. The species was discovered in the upper part of the Danışmen Formation from the Marmaraerğlisi Area, southeastern the Basin. *Eotrigonobalanus Furcinervis* appeared in large numbers early during the early Paleocene–late Oligocene localities in Europe; especially in Thrace of Greece, Bulgaria, Germany, Czech Republic, Hungary and Romania. Therefore, this data is valuable as the first recording for Thrace Basin.

1. Introduction

The study area is around Marmaraerğlisi, located in the southeastern Thrace Tertiary Basin (Figure 1). This study, it is aimed to contribute to the previous paleontological studies in the region.

In and around the study area [1-14] have conducted different geological studies. *Eotrigonobalanus Furcinervis* was found in the Danışmen Formation, in cores taken from drilling works in Yeniçiftlik district of Marmaraerğlisi (Figures 1-3). This species was discovered in the SW Bulgaria [15], Western Bulgaria [16], in Trakia, NE Greece [17], [18], Witznitz-Germany [19], Bohemian Massif [20], [21] the Oligocene volcanic flora of Czech Republic, Rhodope [22] Early Oligocene Flora of Saxony, and Tuzluca Basin (northeastern Anatolia) [23].

This finding is the first evidence of *Eotrigonobalanus Furcinervis* from the Oligocene of the Thrace Basin (Turkey) and is wellcome added to the European and Turkish records of that time.

2. Material and Method

This study was conducted to the paleontological evaluation of the core samples taken from the drillings opened around Marmaraerğlisi.

Fossil material consists of leaf, and although only one leaf was found, this data is precious. This new material, which will enrich the paleobotanical collection, is kept in Bilal Gülen's office.
3. Geological Settlement
The Istranca metagranites form the basis of the region. Paleogene and Neogene sediments unconformably overlie it [26].

The study was carried out within the Danişmen Formation belonging to the Yenimuhacir Group outcropping southeast part of Thrace Basin (Figures 1, 2).

**Danişmen Formation**
Danişmen Formation overlies in a large area extending from S of Uzunköprü to Keşan, Malkara, Tekirdağ, Marmaraereğlisi and Büyükçekmece in the Thrace region [27] [4] (Figure 1). This formation has been described by [26], [6] regressive delta system and represents delta flat facies. The unit is composed of lacustrine, swamp, flood plain, and fluvial deposits. The thickness of the Danişmen Formation, which has shale, claystone, sandstone, conglomerate and lignite lithology, reaches 1000 meters. It is transitional with the Osmancık Formation at its lower boundary and inconsistent with the lacustrine and light-coloured limestones of the Neogene at its upper boundary [5], [25] (Figure 2).

In the Danişmen Formation, fossils belonging to rich vertebrate fauna are found, especially in the lignite veins. According to the vertebrate fauna is given to early-mid Oligocene age [4], [7], [28]. Fish fossils are common in the northern part of Thrace, while silicified tree fossils are common in the southern part of Thrace [2], [10], [25]. Also, in the study by [29], ostracods representing Oligocene age such as Cytheromorpha zinndorfi, Cytheridea pernota, Hemicyprideis montosa, Neocyprideis williamsoniana, N. apostolescui, Cytheridea pernota, Serrocytheridea eberti, Ilyocypris boehli were found.
### Figure 2

Generalized Tertiary stratigraphic section of the Thrace Basin [25].

### 4. Results and discussions

This study observed that the Danişmen Formation consists of silty sandstone, sandstone, clay, lignite interbedded siltstone, vegetal marl-clay intercalation, lithology (Figures 3, 4).
Figure 3. a) The drilling location, b) A view from the drilling operation in the field, c) A view showing the intercalated of sandstone and claystone of the Danişmen Formation from Yeniçiftlik district, Marmaraerğlisi. The direction of view is towards the northeast.

Figure 4. Schematic lithological column of the well

_Eotrigonobalanus furcinervis_ species was detected in the sample taken from 5 m of the Danişmen Formation (Figure 4).

**Morphology:** The leaf is superficial, long, 15 mm wide, and maybe around 8 cm long as incomplete.
**Age:** Oligocene.

**Systematic Palaeobotany**

Superorder ROSANAE Takht. 1967  
Order FAGALES Engl. 1892  
Family FAGACEAE Dumort. 1829 nom. cons.  

*Eotrigonobalanus* Walther et Kvaček in [30]

*Eotrigonobalanus furcinervis* (Rossm. 1840) Walther and Kvaček 1989 (Figure 5)

1840 *Phyllites furcinervis* Rossm. [35]: 33–35; pl. 6, figure 25; pl. 7, figures 32–36 [Staré Sedlo (Altsattel)].

1852 *Quercus goepperti* C.O. Weber [36], 171, 172; pl. 19, figure 2 [Quegstein, Allrott].

1934 *Laurus phoeboides* Ettingsh. [37]: 74; text-figure 6; pl. 14, figure 3 [Altenrath].

1940 *Quercus goepperti* C.O. Weber-Weyland [38]: 105 (list), 109, 110; text-figures 1–14 [Altenrath, Stallberg, Allrott, Quegstein].

1950 *Laurophyllum phoeboides* (Ettingsh.) [39]: 61, 62; text-figures 22, 23; pl. 15, figures 1–8 [Altenrath, Stallberg].

1989 *Eotrigonobalanus furcinervis* (Rossm.) Kvaček and Walther: 581–593; pls 33–36; pl. 38, figure 3; pls 39–46; pl. 47, figures 1–3.

1996 *Eotrigonobalanus furcinervis* (Rossm.) Walther and Kvaček ssp. *flagellinervis* (Rossm.) Knobloch and Kvaček in [40]: 66–76; pl. 26, figure 7; pl. 28, figures 5, 6; pl. 29, figures 1–3; pl. 30, figures 1–5; pl. 31, figs 1–6; pl. 32, figures 1–4, text-figures 16e–h, 21, 22c, 25a–f, 24a–c, 25a, b, 25 a–f, 27a–d, 28a, 29a–g [various localities of the Staré Sedlo Formation].

2006 *Eotrigonobalanus furcinervis* (Rossm. 1840) Walther and Kvaček 1989 cf. forma *haselbachensis* Kvaček and Walther 1989 – Winterscheid: 122–124; pl. 2, figure 4; pl. 3, figures 1–3; pl. 5, figure 1 [Altenrath, Stallberg, Allrott, Quegstein]

*Eotrigonobalanus* is a well-known extinct genus of highly heterogeneous leaf forms occurring mainly in the middle Eocene to the early Oligocene deposits of Europe and extending into the Miocene [30], [31], [32]. At the same time, it has been one of the essential elements in forming Paleogene forests in Europe [21], [33]. All records reported so far indicate that this taxon occurred in the Lower Rhine Embankment only in the pre-volcanic late Oligocene siliciclastic facies of the Siebengebirge and as a common element of the riparian forests there [34].

This new leaf material obtained in this study will contribute to the discovery of newer taxa and specimens. The new findings will increase our knowledge of the Thrace Basin Oligocene flora and vegetation from different geological eras.
Figure 5. Photograph of type fossil specimen: *Eotrigonobalanus furcinervis* (Rossm.) Walter and Kvaček (x2)

Acknowledgment
The authors would like to thank Thomas DENK, which helped in the identification of the leaf.

References
[1] M. Akartuna, “Çatalca-Karacaköy bölgesinin jeolojisi,” *İstanbul Üniversitesi Fen Fakültesi Monografileri*, c. 13, 88s, 1953.
[2] N. Rückert-Ülkümen, “Trakya ve Çanakkale muntkalarında bulunan Neojen balıkları formasyonları hakkında,” *İstan. Üniv. Fen Fak. Monografileri*, c. 16, 80 s., 1960.
[3] N. Sönmez-Gökçen, “Notice sur le nouvel age determine par les Ostracodes de la serie a Congeria du Neogene des environs de Çatalca (Thrace),” *MTA Bulletin*, no. 63, 1964.
[4] R.F. Lebküchner, “Orta Trakya Oligosen’inin jeolojisi hakkında,” *Maden Tetakik ve Arama Enstitüsü Dergisi*, c. 83, s. 1-29, 1974.
[5] S. Kasar, K. Bürkan, M. Siyako and O. Demir, “Tekirdağ- Şarköy-Keşan-Enez bölgesinin jeolojisi ve hidrokarbon olanıqları,” *Türkiye Petrolleri Anonim Ortaklıği Arama Grubu Rapor no. 1771*, 71 s., 1983. (unpublished).
[6] M. Umut, M. İmik, Z. Kurt, İ. Özcan, H. Sarkinaya ve G. Saraç, “Tekirdağ, Silivri (İstanbul), Pınarhisar alanının jeolojisi,” *Maden Tetakik ve Arama Genel Müdürlüğü Rapor No. 7349*, 1983. (unpublished).
[7] G. Saraç, “Kuzey Trakya bölgesinde Edirne-Kırklareli- Saray-Çorlu-Uzunköprü-Derekebir yörelerinin memeli paleoafaunası,” *Ankara Üniversitesi Fen Bilimleri Enstitüsü Jeoloji Müh. Anabilim Dalı Yüksek Lisans Tezi*, 1987. (unpublished).
[8] Y. İslamoğlu ve G. Taner, “Pınarhisar (Kırklareli) ve Çevresinin Tersiyer Mollüsk Faunası ve Stratigrafisi,” *MTA Dergisi*, c.117, s. 149-169, 1995.
[9] M. Z. Aksoy, “Trakya Havzası Oligosen yaşlı deltilvik istifinin yer altı verileri kullanılarak ayrıntılı sedimentolojik incelenmesi,” *Ç.Ü. Fen Bilimleri Enstitüsü, Doktora Tezi*, 200 s., 1998.
[10] M. Siyako, “Trakya ve yakın çevresinin Tersiyer stratigrafisi,” *Türkiye Petrolleri Anonim Ortaklıği Arama Grubu Rapor no. 4608*, 104 s, 2005. (unpublished)
[11] N. Rückert-Ülkümen, İ. Özkar-Öngen ve B. Çevik-Onner, “Doğu Paratetis’in Ergene Havzası’ndaki paleobiyocografik özelliklerini,” *İstanbul Yerbilimleri Dergisi*, c. 22/2, s. 119-140, 2009.
[12] Ü. Şafak, “Tekirdağ Yöresi Oligosen-Miyo-Pliyosen Çökellerinin (Hacisungur Sondajı) Ostrakod Faunası ve Ortamalı Özellikleri,” Ç.Ü. Müh.-Mim Fak. Dergisi, c. 30/2, s. 317-335, 2015.

[13] D. Perinçek, N. Ataş, Ş. Karatut, E. Erensoy, “Geological factors controlling potential of lignite beds within the Danışmen Formation in the Trace Basin,” Bulletin of the Mineral Research and Exploration, (Bull.Min.Res.Exp), vol. 150, S. 77-108, 2015.

[14] Ü. Şafak ve M. Güldürek, “Edirne- (Trakya) Bölgesi Paleojen-Neojen Çökellerinin (Edirne-Keşan, Uzunköprü, Meriç, Süloğu sondajları) mikropaleontolojik incelenmesi,” Ç.Ü.Müh. Mim. Fak Dergisi, Cilt 31 (1), Sayı 2, s. 17-33, 2016.

[15] V. Bozukov ve R. Ivanova, “New fossil taxa in the Neogene flora from the region of Carmen and Satovcha villages (SW Bulgaria),” Bulgarian Geological Society, National Conference with international participation “Geosciences 2014”, pp.55-56, 2014.

[16] M. Vatsev, V. Bozukov ve N. A Simov, “New Late Eocene flora locality in Western Bulgaria near Zgurovo Village (Kyustendil District).” — In: Yanev Y. (ed.) Geosciences 2017. Peer reviewed short communications of the National Conference with international participation, Bulgarian geological society, pp. 103-104, 2017.

[17] I. Petrescu, E. Velitzelos ve J. Stavropodis, “The occurrence of the genus Lithocarponxylon Petrescu 1978 (Fagaceae) in the tertiary of Greece,” Ann Géol Pays Hell, vol. 29, pp. 366-379, 1978.

[18] E. Velitzelos, Z. Kvaček ve H. Walther, “Erster Nachweis von Etrigonobalanus furcinervis (Rossmaesler) Walther ve Kvaček (Fagaceae) in Griechenland/Evros,” Feddes Repertorium, vol. 110, pp. 347-356, 1999.

[19] H. Walther ve R. Zetter, “Zur Entwicklung der paläogenen Fagaceae Mitteleuropas,” Palaeontogr. B, vol. 230, pp. 183–194, 1993.

[20] Z. Kvaček ve V. Teodoridis, “Tertiary Macrofloras of the Bohemian Massif: a review with correlations within Boreal and Central Europe,” Bulletin of Geosciences, vol. 82, 4, pp. 383-408, 2007.

[21] Z. Kvaček ve H. Walther, “The Oligocene volcanic flora of Kundratice near Litoměřice, České středohoří Volcanic complex (Czech Republic),” Acta Musei nationalis Pragae, Series B – historia naturalis, vol. 54, pp. 1–43, 1998.

[22] H. Walther ve Z. Kvaček, “Early Oligocene Flora of Seifhennersdorf (Saxony),” Acta Musei Nationalis Praeae, Series B – Historia Naturalis, vol. 63(2-4), pp. 85–174, 2007.

[23] M. S. Kayseri Özer, R. H. Sancay, Ş. Şen, K. Sözeri, G. Métays, T. Aydiyldz, B. Varol, “Paleoenvironment of the Late Oligocene from the Kağızman-Tuzluca Basin (northeastern Anatolia) based on the micro- and macrofloras,” Turkish Journal of Earth Sciences, vol. 26, pp. 227-248, 2017.

[24] A. Türkcean ve A. Yurtsever, “İstanbul Paftası, 1: 500 000 ölçekli Türkiye Jeoloji Haritası Serisi,” Maden Tetkik ve Arama Genel Müdürlüğü, 2002.

[25] M. Siyako, “Trakya Bölgesi Litostratigrafı Birimleri (Tersiyer Bölümü), Stratigrafi Komitesi, Litostratigrafı Birimleri Serisi-2,” Maden Tetkik ve Arama Genel Müdürlüğü yayını, 30 s., 2006.

[26] N. P. Boer, “Report on geological reconnaissance in Turkish Thrace,” G.A. Report no. 25373, petrol Dairesi, The Hague, February, 1954.

[27] K.O. Kopp, N. Pavoni ve C. Schindler, “Geologie Thraiens IV: Das Ergene-Becken,” Beih zum Geol. Jahrb., Heft 76, 136 s., 1969.

[28] Ozansoy, F., “Doğu Trakya Alt Oligosen Antrakoterienleri,” Maden Tetkik Arama Enstitüsü Dergisi, c. 58, s. 85-96, 1962.

[29] Ü. Şafak ve M. Güldürek, “Edirne –Kırklareli /Trakya Yöresi Sondajlarında Mikropaleontolojik ve Paleoortamsal Yorumlar;” KSU Mühendislik Bilimleri Dergisi, 20/4, s. 90-115, 2017.

[30] Z. Kvaček ve H. Walther, “Revision der mitteleuropäischen tertiären Fagaceen nach blattepidermalen Charakteristiken III. Teil: Dryophyllum Depex ex Saporta und
Eotrigonobalanus Walther and Kvaček gen. nov.,” *Feddes Repertorium* 100, pp. 575- 601, 1989.

[31] E. Palamarev, V. Bozukov, K. Uzunova, A. Petkova and G. Kitano, “Catalogue of the Cenozoic plants of Bulgaria (Eocene to Pliocene),” *Phytol Balcan*, vol. 11, pp. 215-364, 2005.

[32] E. Velitzelos, J. M. Bouchal and T. Denk, “Review of the Cenozoic floras and vegetation of Greece,” *Review of Palaeobotany and Palynology*, vol. 204, May, pp. 56-117, 2014.

[33] D.H. Mai, “Tertiäre Vegetationsgeschichte Europas,” *Methoden und Ergebnisse*, G. Fischer, Jena, 691s., 1995.

[34] H. Winterscheid and Z. Kvaček, “Late Oligocene macrofloras from fluvialite siliciclastic facies of the Köln Formation at the south-eastern border of the Lower Rhine Embayment (North Rhine-Westphalia, Germany),” *Acta Palaeobotanica*, vol. 56(1), pp. 41–64, 2016.

[35] E.A. Rossmaßler, “Die Versteinerungen des Braunkohlensandsteines aus der Gegend von Altsattel in Böhmen,” *Arnoldische Buchhandlung, Dresden and Leipzig*, pp. 1–42, 1840.

[36] C.O. WEBER, “Die Tertiärflora der Niederrheinischen Braunkohlenformation,” *Palaeontographica*, vol. 2(4–5), pp. 115–236, 1851–1852.

[37] H. Weyland, “Beiträge zur Kenntnis der rheinischen Tertiärflora. I. Floren aus den Kieseloolithund Braunkohlenschichten der niederrheinischen Bucht,” *Abh. Preuss. Geol. Landesanst., N. F.*, vol. 161, pp. 1–122, 1934.

[38] H. Weyland, “Beiträge zur Kenntnis der rhei-nischen Tertiärflora. IV. Die Flora der “liegenden tonigen und quarzigen Schichten” des Siebengebir- ges,” *Palaeontographica B*, vol. 84, pp. 103–116, 1940.

[39] R. Kräusel and H. Weyland, “Kritische Untersuchungen zur Kutikularanalyse tertiärer Blätter I.,” *Palaeontographica B*, vol. 91, pp. 7–92, 1950.

[40] E. Knobloch, M. Konzalová and Z. Kvaček, “Die obereozäne Flora der Staré Sedlo-Schichtenfolge in Böhmen (Mitteleuropa),” *Roz. Česk. Geol. Úst.*, 49, pp. 1–260, 1996.