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CONODONT FAUNA AND BIOSTRATIGRAPHY OF THE EARLY-MIDDLE DEVONIAN UNITS IN BEYKOZ, ŞILE AND KURTDOĞMUŞ AREAS, İSTANBUL, TURKEY

Dilek Gülnur SAYDAM-DEMİRAY* and Şenol ÇAPKINOĞLU**

ABSTRACT.- Conodont faunas defining the *delta-pesavis* zones (upper Lochkovian, Lower Devonian) from Beykoz and Karamandere sections of the İstinye Formation (the Yumrukaya Group) and the *laticostatus*, *serotinus*, *patulus* and *partitus* zones (upper Emsian-lower Eifelian, Lower-Middle Devonian) from Büyükdere and Kokarpınar sections of the Kozyatağı member of the Kartal Formation were obtained. A total of 22 species/subspecies were described belonging to the genera *Neopanderodus* (2), *Icriodus* (8), *Pelekysgnathus* (1), *Lanea* (1), *Polygnathus* (4), *Ozarkodina* (2), *Pseudooneotodus* (2) and *Belodella* (2).

Key words: Lower-Middle Devonian, conodont fauna, biostratigraphy, İstinye Formation, Kozyatağı member, İstanbul, Turkey

INTRODUCTION

The first conodont investigations in the İstanbul zone of the Pontides, Turkey were made by Abdüsselamoğlu (1963); followed by Haas (1968), Gedik (1975), Göncüoğlu et al. (2004), and Çapkınoğlu (1997, 2000, 2005*a*, 2005*b*) who described conodont faunas from Paleozoic and Triassic units in the vicinity of İstanbul and Kocaeli, Turkey. A total of 96 limestone samples for conodont were collected, for this study, from four measured stratigraphic sections in Beykoz, Şile and Kurtdoğmuş areas (İstanbul, Turkey) (Figure 1) of the Kozyatağı Member (the Kartal Formation) and the İstinye Formation (the Yumrukaya Group). The Lower-Middle Devonian conodonts were found in 34 samples, which were used to carry out the biostratigraphic zonation of the investigated stratigraphic sections.

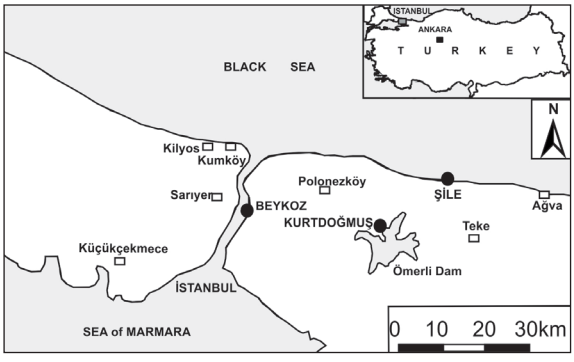

Figure 1- Location map of the study area.

MATERIALS AND METHODS

Samples collected for conodonts were broken down pieces in 2-3 cm diameter and processed in plastic buckets using standard acidizing techniques with formic- and/or acetic-acid. In the formic acid method, each kilogram of rock is placed in a solution of 1500 ml formic-acid and 6000 ml water fro 24 hours. In the acetic acid method, a solution of 100 ml acetic acid and 900 ml water, is used per 1 kg of rock.

Residue filtered from the nested sieves of 100 micron and 2 mm was washed by running water until fully clear water flows. The residue on 100-micron sieve was transferred into a porcelain bowl or glass holder and dehydrated in

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an oven at 60°C. Dry residues were screened through nested sieves of 100 micron and 1 mm, and conodonts were picked from the 100 micron to 1 mm fraction under the binocular microscope.

STRATIGRAPHY

The lithostratigraphic units in the İstanbul Paleozoic sequence were given different names (Lower Ordovician–Visean) by different investigators in previous studies (Kaya, 1973; Önalan 1981, 1982; Gedik et al., 2004). In this study, the stratigraphic nomenclature of Gedik et al. (2004) was taken as the basis (Figure 2).

The Dolayoba Formation, the basal unit of the Yumrukaya Group, was first named as "the Dolayoba Limestone" by Kaya (1973), and then, was changed to "the Dolayoba Formation" by Önalan (1981, 1982). It consists mainly of light-gray, sometimes pink to light-brown reefal limestones. Yellow to beige, thin-bedded shales are observed near the bottom. It includes abundant corals, brachiopods, orthoceratids and crinoid stems. The Dolayoba Formation (100 m thick) is conformably bounded by the Gözdağ Formation from the lower and the İstinye Formation from the upper. The İstinye formation, the upper unit of the Yumrukaya Group, was first defined by Kaya (1973). It was subdivided, in ascending order, into three members: the Sedefadası (thinly laminated limestone-shale), Gebze (thin- to medium-bedded limestones), and Kaynarca (coarse nodular limestone–shale) members. The İstinye Formation, about 300 m thick, is conformable and transitional with the underlying Dolayoba Formation and the overlying Kartal Formation.

The Kartal Formation consists of shale, sandstone and limestone alternation. The Kozyatağı Member, the middle part of the Kartal Formation, was first defined by Kaya (1973) as a stratigraphic formation, but was reduced in rank by Gedik et al. (2004) to a member. It is made up of greenish-gray, gray and whitish-beige, thin- to medium-bedded limestone, bioclastic limestone, sandy limestone, laminated limestone and gray carbonated shales, and is both laterally and vertically transitional with other rock types forming the Kartal Formation. It comprises rather dense, reworked brachiopod and crinoid. Nodular limestones and/or nodular limestone-shale alternation are observed at some levels.

BIOSTRATIGRAPHY

The Lower Devonian conodont faunas were obtained from the Beykoz and Karamandere stratigraphic sections of the İstinye Formation (the Yumrukaya Group) (Figures 3, 4) and the Lower–Middle Devonian from the Büyükdere and Kokarpınar stratigraphic sections of the Kozyatağı member of the Kartal Formation (Figure 5).

A direct correlation with common conodont zones of the pelagic biofacies was not possible, because of the lack of conodonts in many samples, the absence of (Klapper and Ziegler, 1979; Johnson et al., 1980; Johnson et al., 1985) zone-defining taxa due to shallow-water biofacies, the restricted diversity of species, and the irregular vertical distributions of the present taxa.

The Beykoz Measured Stratigraphic Section (the İstinye Formation, the Yumrukaya Group)

A total of 35 samples were collected from the Beykoz Section (155 m thick), but only 4 samples produced conodont faunas (Figure 6).

Sample BG28 collected from gray to dark-gray, massive limestone bed, and sample BG34 from the lower part of gray, thick- or thinly-bedded limestones yielded *Lanea eleanorae* (Lane and Ormiston) (Figure 6, Table 1). Sample BG30 from nodular limestone bed produced *Icriodus* cf. *vinearum* Carls, Klapper and Murphy and *Pseudooneotodus* sp., and sample BG32 *Icriodus rectangularis lotzei* (Carls) and *Icriodus* cf. *vinearum* Carls.

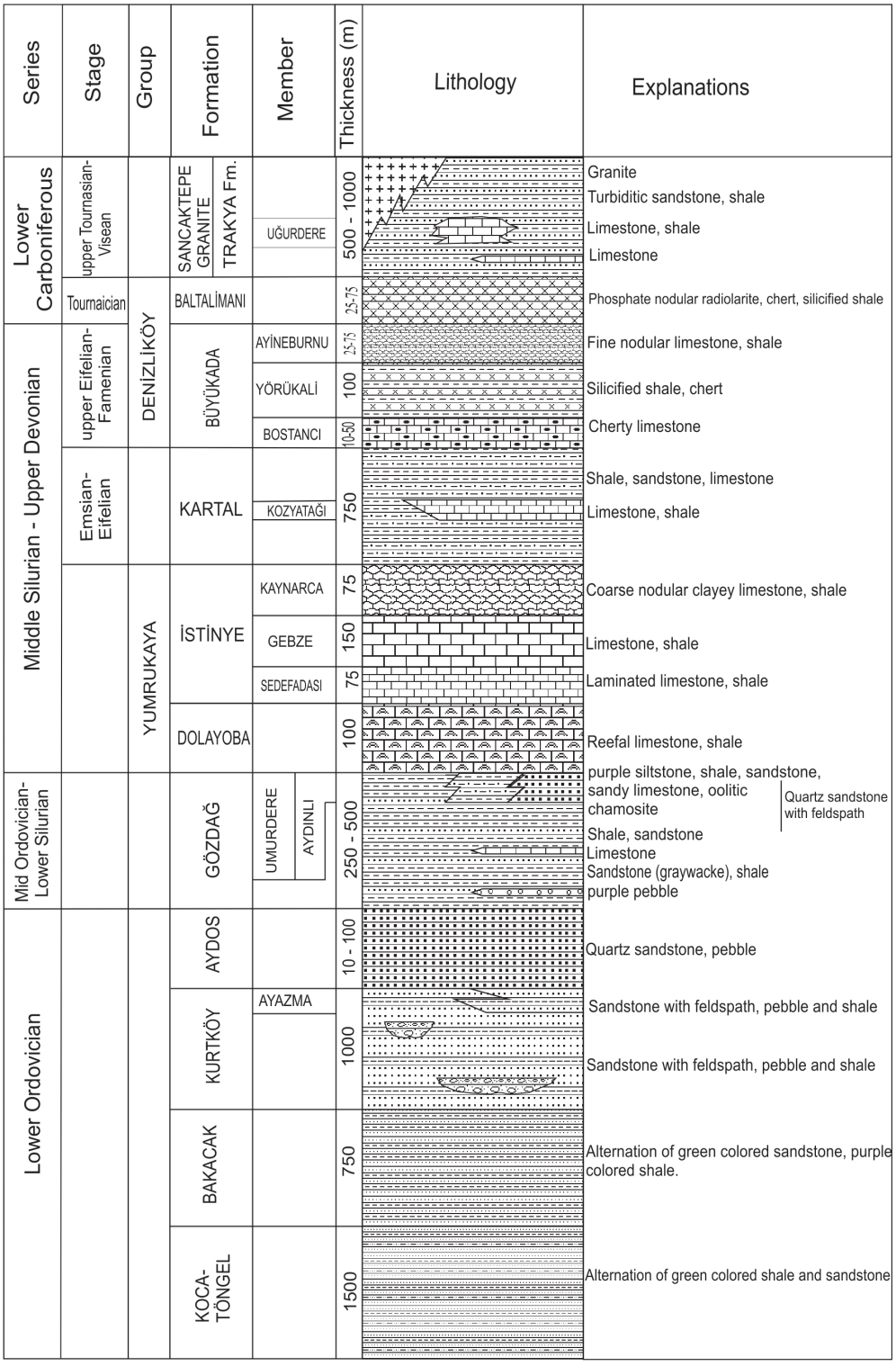

Figure 2- Generalized columnar section of the İstanbul Paleozoic Sequence

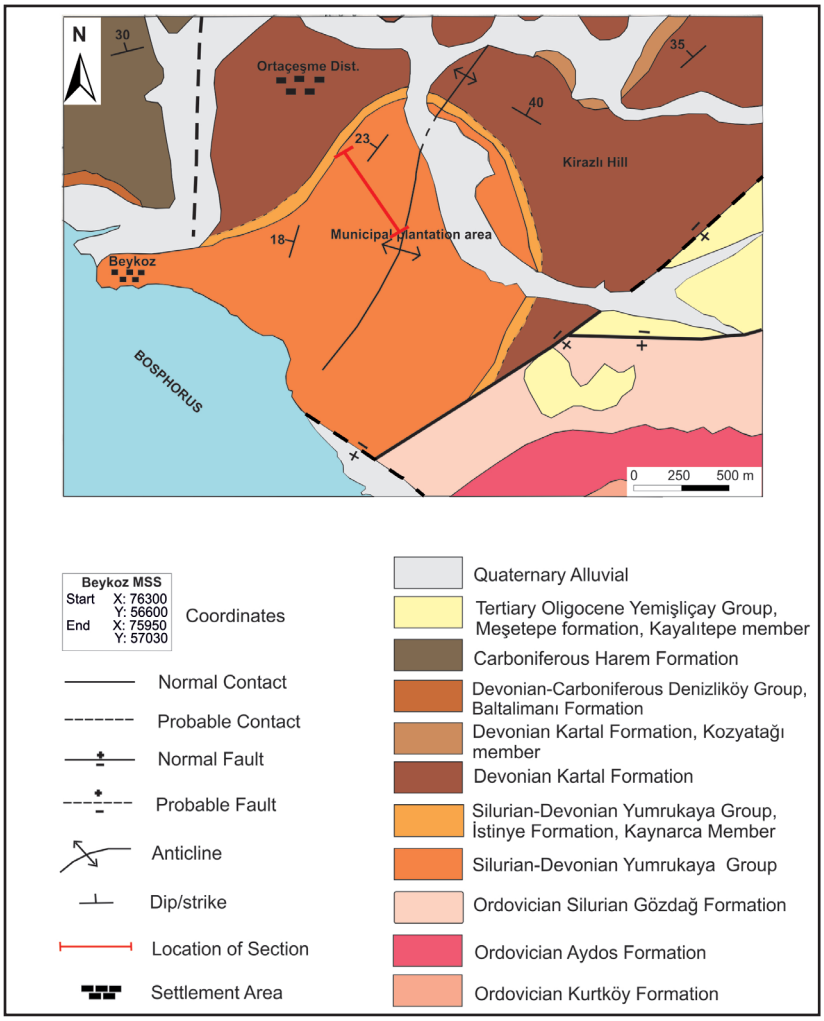

Figure 3- Geological map showing the location of the Beykoz section.

Table 1- Conodont distribution at the Beykoz section.

STAGE	upper Lochkovian			
ZONE	*delta*			
SAMPLE (BG)	28	30	32	34
Lanea eleanorae	1			2
Icriodus rectangularis lotzei			2	
Icriodus cf. *vinearum*		1	2	
Pseudooneotodus sp.		1		

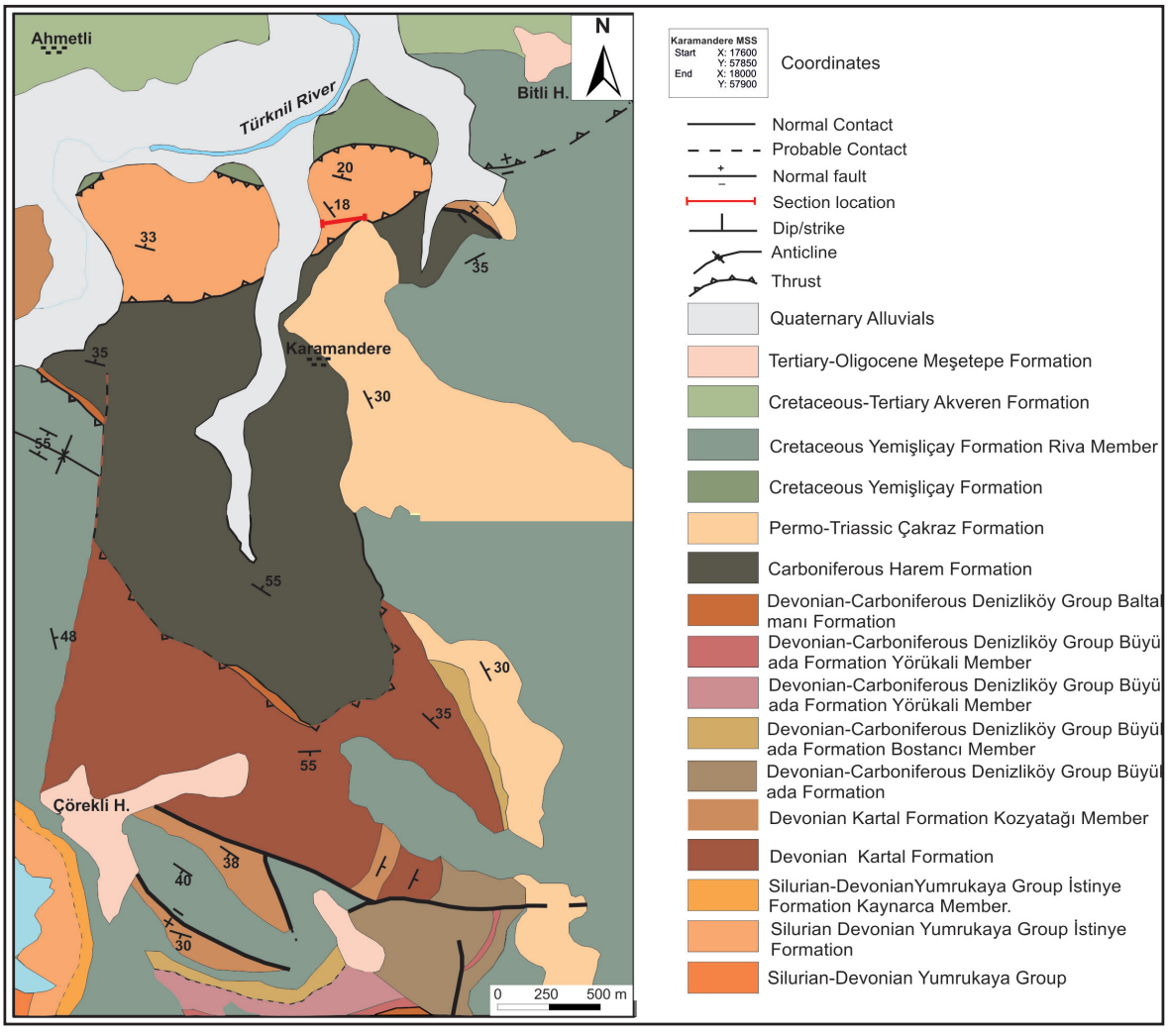

Figure 4- Geological map showing the location of the Karamandere section.

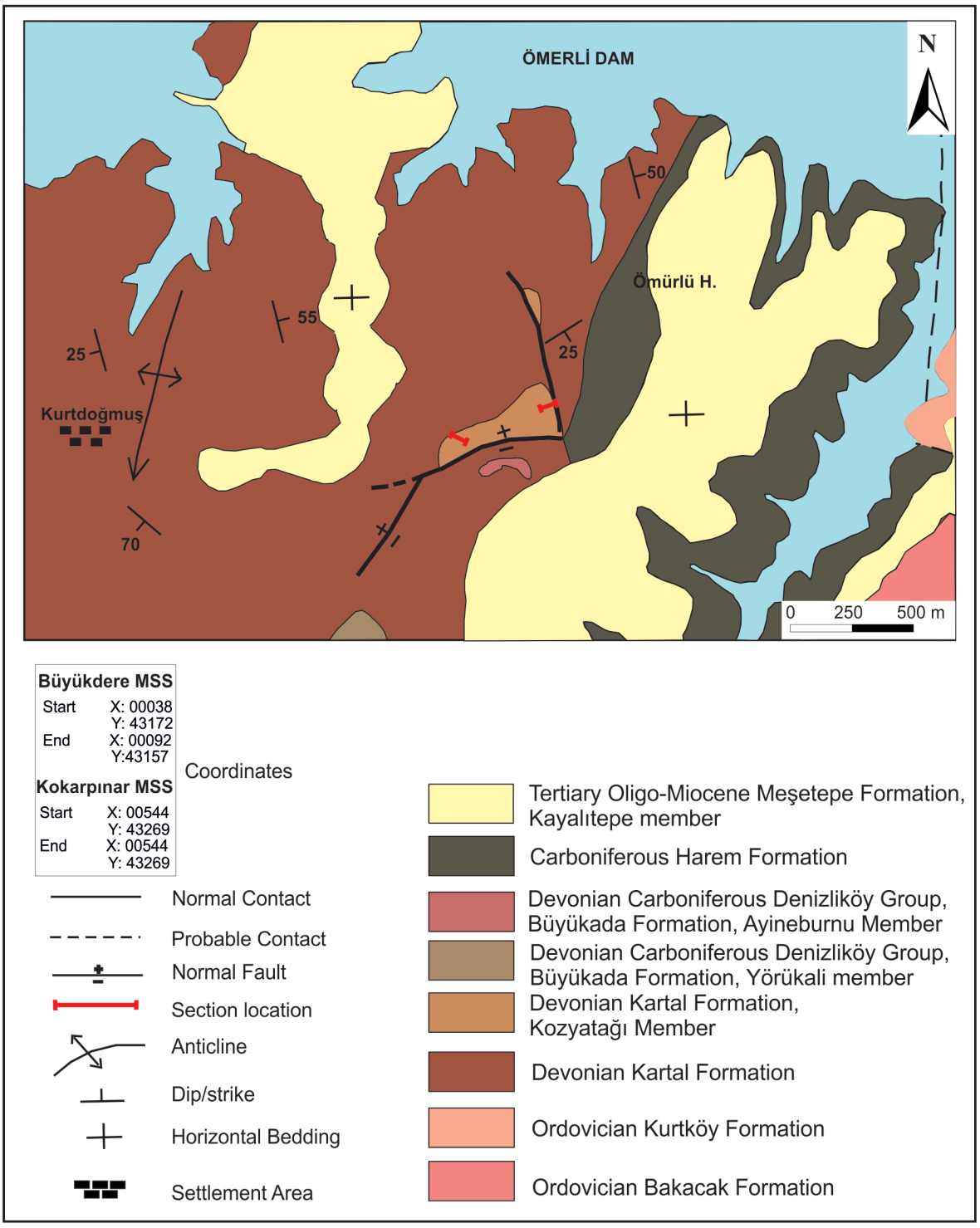

Figure 5- Geological map showing the locations of the Büyükdere and Kokarpınar sections.

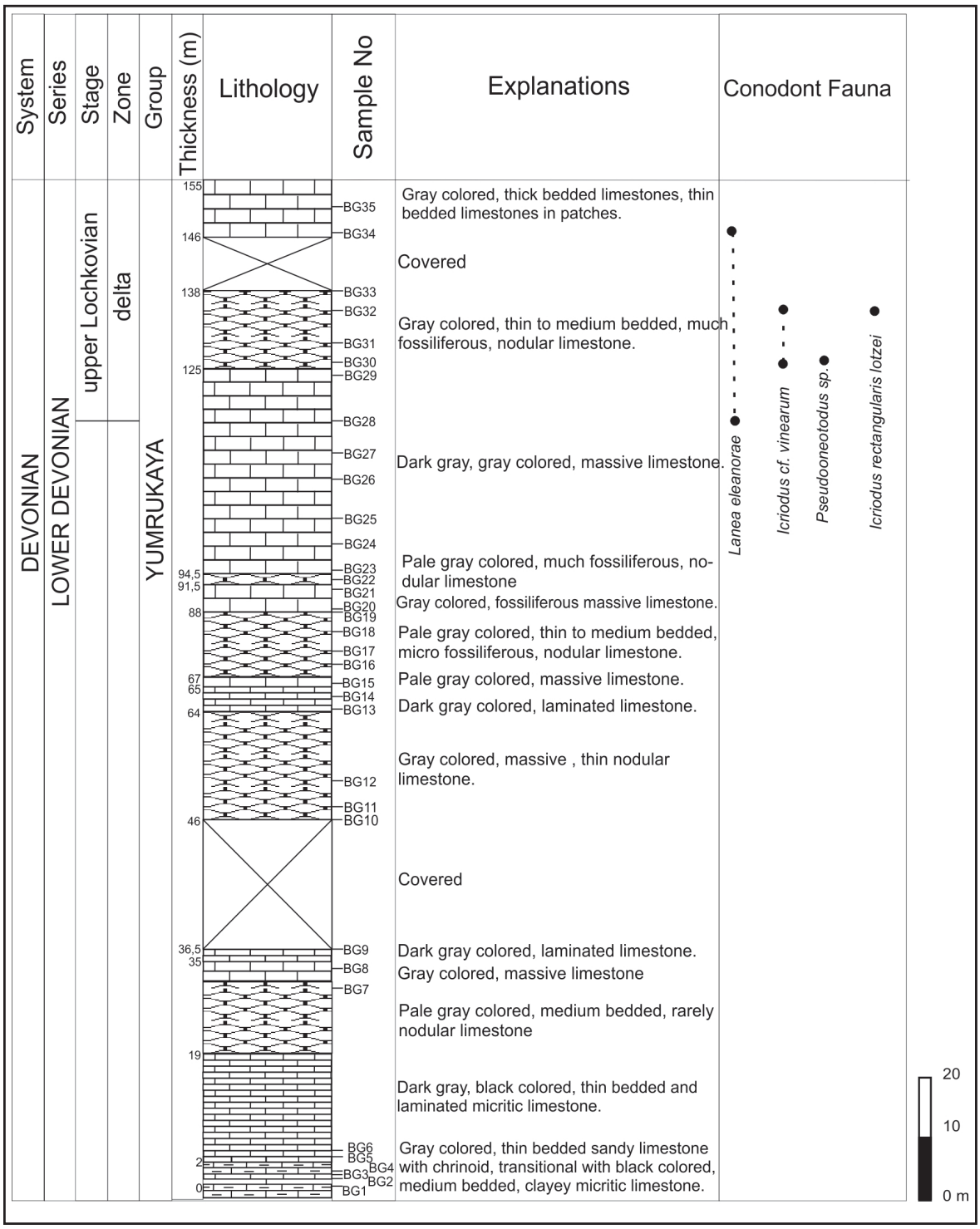

Figure 6- The Beykoz measured stratigraphic section.

Based on the presence of *Lanea eleanorae* (Lane and Ormiston) with a range restricted to the *delta* Zone (upper Lochkovian) (Murphy and Matti, 1983, Figure 4; Murphy and Berry, 1983, Figure 2), samples BG28–BG34 in the Beykoz section are referred to this zone (Table 1).

The Karamandere Measured Stratigraphic Section (the İstinye Formation, the Yumrukaya Group)

Only 7 of 15 samples collected from limestone strata in the Karamandere Section of the İstinye Formation (99.8 m thick) produced conodont faunas (Figure 7). Sample ŞG3 from blackish-gray, thin- to medium-bedded, detrital limestone bed with calcite veins produced *Ozarkodina* sp. Sample ŞG4 from a dark-gray, brachiopod bearing massive limestone bed yielded *Icriodus angustoides alcoleae* Carls and *Icriodus* cf. *vinearum* Carls. *Icriodus angustoides alcoleae* Carls was recovered sample ŞG5 taken from a light-gray, thin- to brachiopod and crinoid bearing medium-bedded limestone bed . Sample ŞG8 produced *Pseudooneotodus beckmanni* (Bischoff and Sannemann) and *Icriodus angustoides alcoleae* Carls. Samples ŞG9-10 and ŞG15 yielded *Icriodus angustoides alcoleae* (Carls and Gandl).

The presence of *Icriodus angustoides alcoleae* Carls and Gandl, identified by Valenzuela-Rios (1994) from the *delta* and *pesavis* zones (upper Lochkovian), indicate that samples ŞG4-ŞG15 in the Karamandere Section are Upper Lochkovian in age (Table 2).

Table 2- Conodont distribution at the Karamandere section.

STAGE	upper Lochkovian						
ZONE	*delta-pesavis*						
SAMPLE (ŞG)	3	4	5	8	9	10	15
Icriodus angustoides alcolea		6	2	3	3	2	2?
Icriodus cf. *vinearum*		1?					
Ozarkodina sp.	2						
Pseudooneotodus beckmanni				1			

The Kokarpınar Measured Stratigraphic Section (the Kozyatağı member, the Kartal Formation)

Only 11 of 19 limestone samples that were collected from the Kokarpınar stratigraphic section (4.65 m thick) produced conodont faunas (Figure 8). The section begins with 25 cm thick, gray, nodular limestone bed. A conodont fauna consisting of *Neopanderodus perlineatus* Ziegler and Lindström, *Belodella resima* (Philip) and *Pseudooneotodus beckmanni* (Bischoff and Sannemann) was recovered from sample KP1 taken from this bed.

The following conodont faunas were obtained from samples collected from limestone strata within greenish-gray to gray, thin- to medium-bedded limestone and shale sequence constituting the majority of the section.

Sample KP10 produced *Neopanderodus perlineatus* (Ziegler and Lindström); sample KP11 *Belodella resima* (Philip); sample KP12, *Neopanderodus transitans* (Ziegler and Lindström); sample KP13 *Neopanderodus perlineatus* Ziegler and Lindström, and *Pseudooneotodus beckmanni* (Bischoff and Sannemann); sample KP13A *Polygnathus linguiformis bultyncki* Weddige beta morphotype, *Neopanderodus perlineatus* (Ziegler and Lindström), *Pseudooneotodus beckmanni* (Bischoff and Sannemann), and *Ozarkodina carinthiaca* (Schulze); sample KP13B *Neopanderodus transitans* Ziegler and Lindström, *Pseudooneotodus beckmanni* (Bischoff and Sannemann); sample KP14 *Neopanderodus transitans* Ziegler and Lindström, and *Belodella resima* (Philip); sample KP15 *Ozarkodina carinthiaca* (Schulze) and *Neopanderodus perlineatus* (Ziegler and Lindström); sample KP16 *Neopanderodus perlineatus* Ziegler and Lindström, and *Belodella resima* (Philip). A fauna containing *Polygnathus linguiformis bultyncki* Weddige alpha morphotype, *Icriodus corniger* subsp., and *Neopanderodus perlineatus* (Ziegler and Lindström) was recovered from sample KP17 collected from a 15 cm thick, gray nodular limestone bed forming the uppermost part of the Kokarpınar section.

Polygnathus linguiformis bultyncki Weddige has a range extending from the base of the *serotinus* Zone to the end of the *costatus* Zone (Klapper et al., 1978, Figure 3). According to

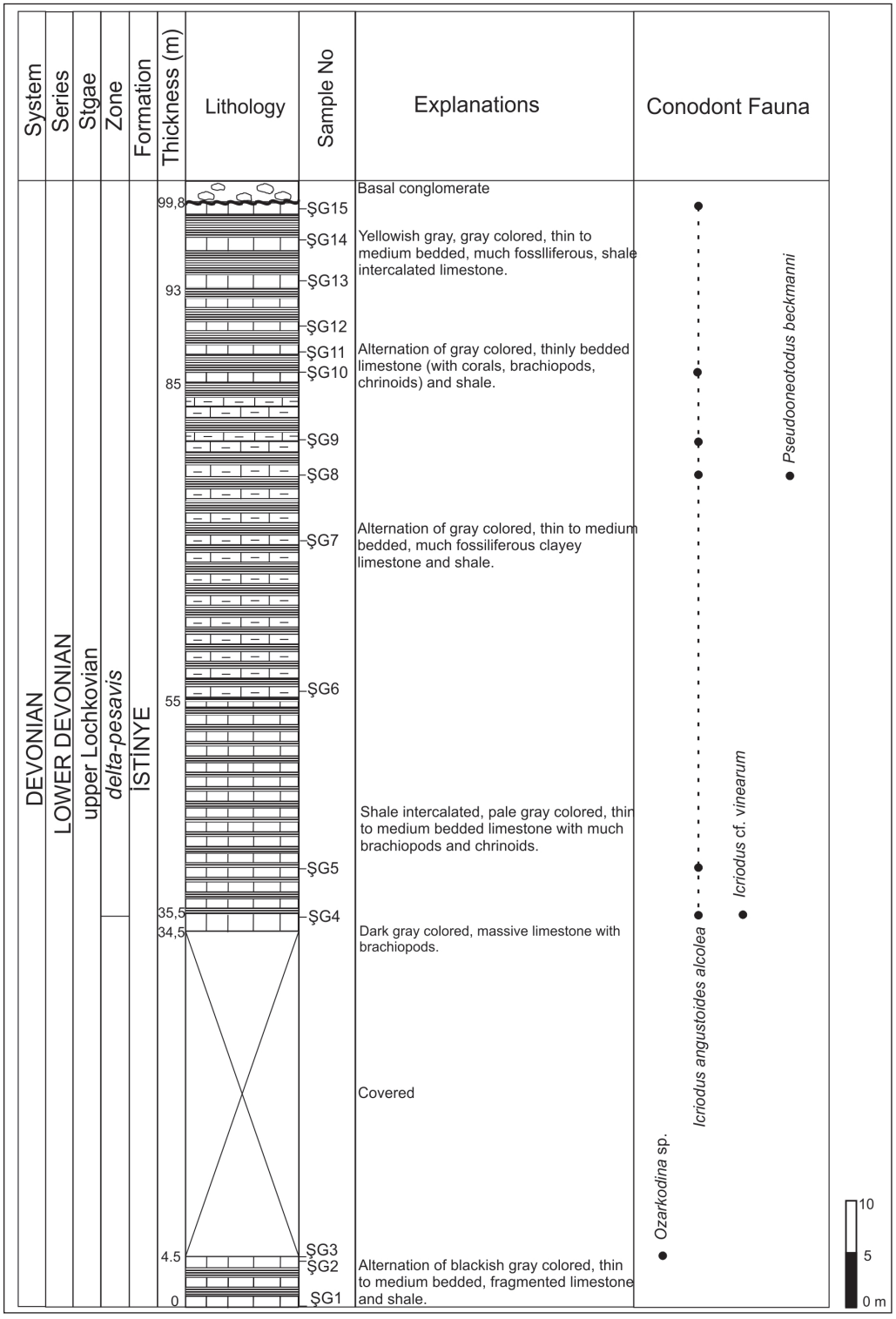

Figure 7- The Karamandere measured stratigraphic section.

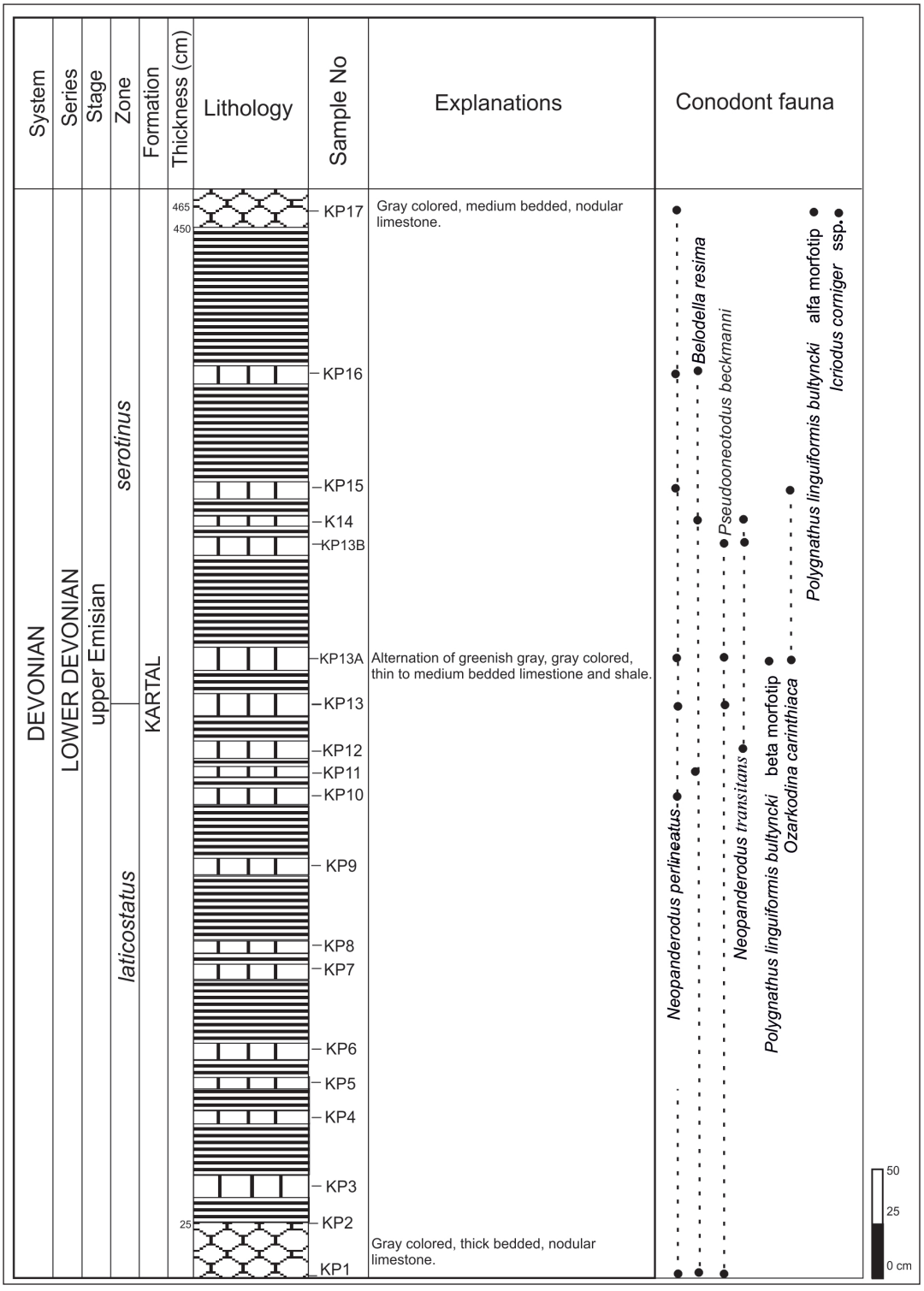

Figure 8- The Kokarpınar measured stratigraphic section.

Wang and Ziegler (1983), alpha and beta morphotypes of this subspecies belong to the *serotinus* Zone. Also, *Ozarkodina carinthiaca* (Schulze) has a range extending from the beginning of the *serotinus* Zone to the end of the *patulus* Zone (Klapper et al., 1978, figure 3). Thereby, samples KP13A-KP17 including collective ranges of these taxa indicated above are within the *serotinus* Zone (upper Emsian) (Table 3). The lower samples (KP1–KP13) most probably belong to the *laticostatus* and older zones.

The Büyükdere Measured Stratigraphic Section (the Kozyatağı Member, the Kartal Formation)

A total of 27 limestone samples were collected from the Büyükdere section (12,25 m thick) of the Kozyatağı member of the Kartal Formation, but only 12 of these samples yielded conodont faunas (Figure 9). *Belodella devonica* (Stauffer), *Belodella resima* (Philip) and *Pseudooneotodus beckmanni* (Bischoff and Sannemann) were recovered from sample BD1 collected from the bottom of the Büyükdere section starting with gray, greenish-gray, thin- to medium-bedded, limestone-shale alternation. The overlying part of the section consists of greenish-gray to gray, thin- to medium-bedded limestone with sometimes laminated limestone and shale alternations. From samples collected from this part, sample BD4 produced *Polygnathus cooperi cooperi* Klapper and *Belodella resima* (Philip); sample BD11 *Ozarkodina carinthiaca* (Schulze) and *Neopanderodus perlineatus* Ziegler and Lindström; sample BD13 *Polygnathus inflexus* Baranov, *Polygnathus linguiformis bultyncki* Weddige alpha morphotype, *Polygnathus linguiformis bultyncki* Weddige beta morphotype, *Ozarkodina carinthiaca* (Schulze), *Pelekysgnathus serratus*, *Icriodus corniger* subsp., *Neopanderodus perlineatus* (Ziegler and Lindström), *Neopanderodus transitans* (Ziegler and Lindström), *Belodella resima* (Philip), and *Pseudooneotodus beckmanni* (Bischoff and Sannemann); sample BD17 *Polygnathus cooperi cooperi* Klapper, *Polygnathus inflexus* Baranov, *Polygnathus linguiformis bultyncki* Weddige beta morphotype, *Polygnathus serotinus* Telford delta morphotype, *Ozarkodina carinthiaca* (Schulze), *Neopanderodus perlineatus* (Ziegler and Lindström), *Neopanderodus transitans* Ziegler and Lindström.

From samples collected from thin-bedded limestones, sample BD18 yielded *Polygnathus cooperi cooperi* (Klapper); sample BD19 *Belodella resima* (Philip); sample BD20 *Polygnathus cooperi cooperi* (Klapper), *Polygnathus inflexus (*Baranov), *Polygnathus linguiformis bultyncki*

Table 3- Conodont distribution at the Kokarpınar section.

STAGE	upper Emsian										
ZONE	*laticostatus* / *serotinus*										
SAMPLE (KP)	1	10	11	12	13	13A	13B	14	15	16	17
Polygnathus linguiformis bultyncki alfa morfotip											1
Polygnathus linguiformis bultyncki beta morfotip						1					
Ozarkodina carinthiaca						1?			2		
Icriodus corniger ssp.											1
Neopanderodus perlineatus	2	2			1	1			3	1	1
Neopanderodus transitans				2			1	1			
Belodella resima	1		1					1		2	
Pseudooneotodus beckmanni	2				2	2	1				

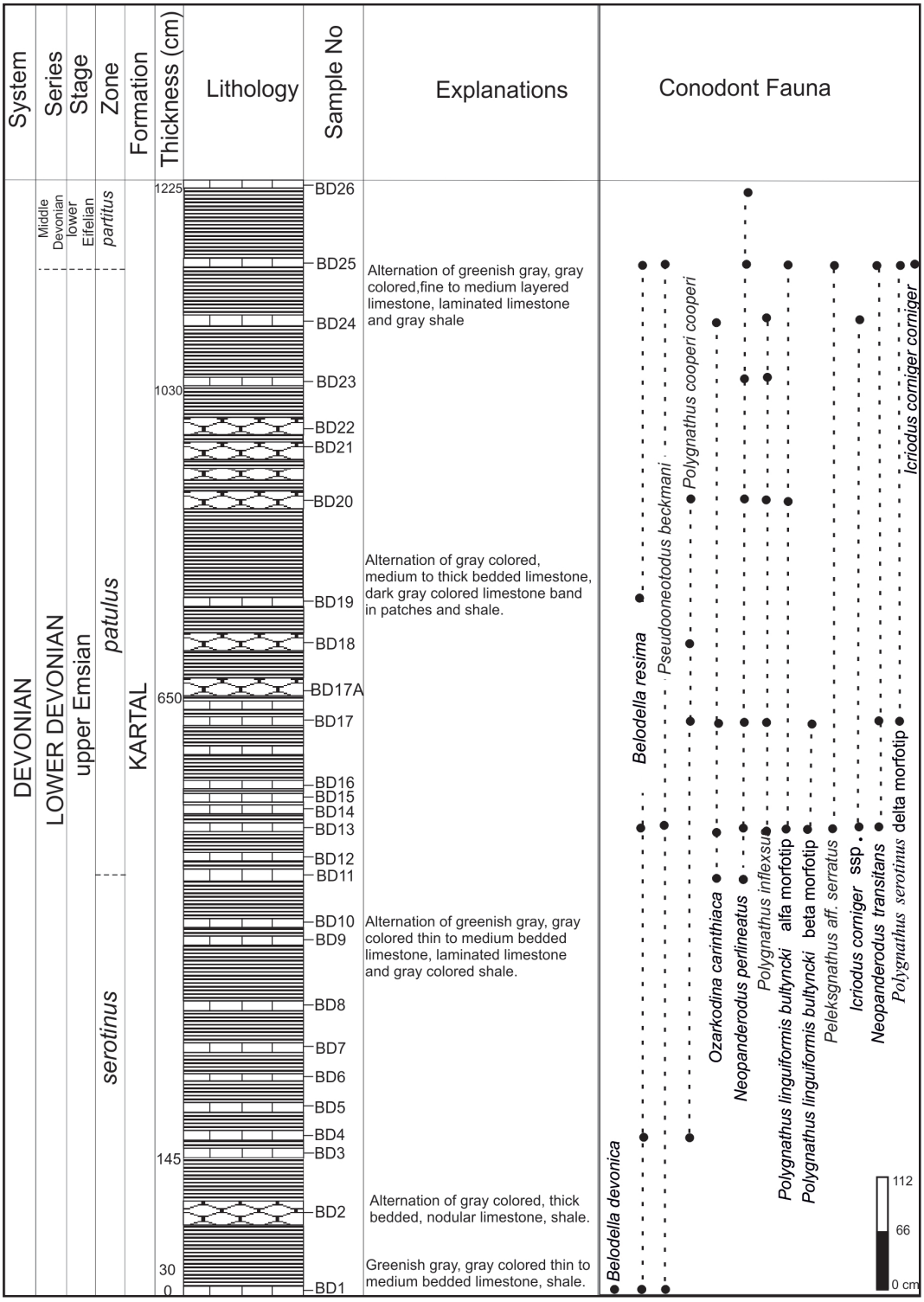

Figure 9- The Büyükdere measured stratigraphic section.

(Weddige) alpha morphotype, and *Neopanderodus perlineatus* (Ziegler and Lindström).

From samples collected from limestone strata in the uppermost part made up of greenish gray to gray limestones and laminated limestones with shale intercalations of the Büyükdere section, sample BD23 produced *Polygnathus inflexus* Baranov, and *Neopanderodus perlineatus* (Ziegler and Lindström); sample BD24 *Ozarkodina carinthiaca* (Schulze), *Polygnathus inflexus* Baranov and *Icriodus corniger* subsp.; sample BD25 *Polygnathus linguiformis bultyncki* Weddige alpha morphotype, *Polygnathus serotinus* Telford delta morphotype, *Pelekysgnathus serrratus* Jentzsch, *Icriodus corniger corniger* Weddige, *Neopanderodus perlineatus* Ziegler and Lindström, *Neopanderodus transitans* (Ziegler and Lindström), *Belodella devonica* (Stauffer), *Belodella resima* (Philip), and *Pseudooneotodus beckmanni* (Bischoff and Sannemann); and sample BD26 *Neopanderodus perlineatus* Ziegler and Lindström.

Polygnathus inflexus was identified by Baranov (1992) from the *patulus* Zone. *Ozarkodina carinthiaca* (Schulze) has a range extending from the beginning of the *serotinus* Zone to the end of the *patulus* Zone (Klapper et al., 1978, Figure 3). Thereby, samples BD13–BD24 including the joint occurrence of these two taxa are within *patulus* Zone (upper Emsian), and the overlying samples BD25–BD26 are within the *partitus* Zone (lower Eifelian). *Icriodus corniger corniger* Wittekindt recovered from sample BD25 has a range, which is restricted to the *partitus* and *costatus* zones (Weddige et al., 1979, Figure 4). Sample BD12 and underlying samples are probably within the *serotinus* Zone or older zones (Table 4).

Table 4- Conodont distribution at the Büyükdere section.

STAGE	upper Emsian										lower Eifelian	
ZONE	*serotinus*			*patulus*							*partitus*	
SAMPLE (BD)	1	4	11	13	17	18	19	20	23	24	25	26
Polygnathus cooperi cooperi		1?			2	1		1				
Polygnathus inflexus				3	3			1	1	1?		
Polygnathus linguiformis bultyncki alfa morfotipi				1				1			2	
Polygnathus linguiformis bultyncki beta morfotipi				1	3							
Polygnathus serotinus delta morfotipi					1						1	
Ozarkodina carinthiaca			1	11	12					1		
Pelekysgnathus aff. *serrratus*				1							1	
Icriodus corniger corniger											3	
Icriodus corniger ssp.				1						1?		
Neopanderodus perlineatus			2	21	4			3	1		7	1
Neopanderodus transitans				6	6						5	
Belodella devonica	1											
Belodella resima	2	2		2			1				1	
Pseudooneotodus beckmanni	2			3							2	

SYSTEMATIC PALEONTOLOGY

Family: Icriodontidae MÜLLER and MÜLLER, 1957
Genus: *Icriodus* BRANSON and MEHL, 1938
Type Species: *Icriodus expansus* BRANSON and MEHL, 1938

Icriodus angustoides alcoleae CARLS, 1969

(Plate 1, Figures 8-12, 23)

1969 *Icriodus angustoides alcoleae* CARLS, p. 326-329, Pl.1, Figs. 12, Pl. 2, Figs. 1, 2.
1976 *Caudicriodus angustoides alcoleae* CARLS.- BULTYNCK, p. 34, 35, Pl. 4, Figs. 14, 18-28.
1985 *Icriodus angustoides alcoleae* CARLS.- MASTANDREA, p. 248-250, Pl. 4, Figs. 7-20.
2001 *Icriodus angustoides alcoleae* CARLS.- CORRADINI, LEONE, LOI and SERPAGLI, Pl.1, Fig. 2.
2007 *Icriodus angustoides alcoleae* CARLS.- BONCHEVA, SACHANSKI, LAKOVA and YANEVA, Figs. 5-S

Remarks.- A narrow spindle and a cusp higher than the other denticles are the most distinguishing characteristics of the Pa elements of *Icriodus angustoides alcoleae* Carls. The Pa elements of *Icriodus angustoides angustoides* (Carls and Gandl, 1969) have a stronger and higher cusp.
Age and Range.- Late Lochkovian, *delta–pesavis* Zones (Valenzuela-Rios, 1994).
Material.- 18 Pa elements.

Icriodus corniger ancestralis WEDDIGE, 1977

(Plate 1, Figures 15-20)

1977 *Icriodus corniger ancestralis* WEDDIGE, p. 407, Pl. 1, Figs. 3-6.
1979 *Icriodus corniger ancestralis* WEDDIGE.- ARBIZU et al., Pl. 3, Figs. 13, 14.
1985 *Icriodus corniger ancestralis* WEDDIGE.- WEDDIGE, Pl. 4, Figs. 39-46.

Remarks.- The most distinctive characteristic of Pa elements of *Icriodus corniger* subspecies is that they have a posterior margin of the basal cavity, oblique to the long axis of the element. *Icriodus corniger ancestralis* Weddige differs from the other subspecies of the species by having a lens-shaped platform outline in upper view.
Age and Range.- Late Emsian, the *laticostatus-serotinus* zones (Weddige, 1985).
Material.- 24 Pa elements.

Icriodus corniger corniger WITTEKINDT, 1966

(Plate 1, Figures 13, 14)

1966 *Icriodus corniger* WITTEKINDT, p. 629, Pl. 1, Figs. 9-12.
1977 *Icriodus corniger corniger* WITTEKINDT.- WEDDIGE, p. 407, Pl. 1, Figs. 16-20.
1979 *Icriodus corniger corniger* WITTEKINDT.- ARBIZU et al., p. 123, Pl. 3, Figs. 22, 23.
1981 *Icriodus corniger corniger* WITTEKINDT.- WANG and ZIEGLER, Pl. 1, Fig. 11.

Remarks.- The Pa elements of this subspecies differ from those of *Icriodus corniger ancestralis* Weddige by the shape of the spindle.
Age and Range.- Early Eifelian, the *partitus-costatus* zones (Weddige, 1985).
Material.- 3 Pa elements.

Icriodus corniger subsp.

(Plate 1, Figures 21, 22)

Remarks.- The Pa elements are similar to those of *Icriodus corniger rectirostratus* BULTYNCK. However, the Pa elements of *Icriodus corniger rectirostratus* BULTYNCK have a longer platfrom with more lateral rows of denticles.
Age and Range.- Late Emsian, *serotinus-patulus* zones.
Material.- 3 Pa element.

***Icriodus rectangularis lotzei* CARLS, 1969**
(Plate 1, Figures 1, 2)

1969 *Icriodus lotzei* CARLS, p. 328-330, Pl. 1, Figs. 4-10.
1975 *Icriodus rectangularis lotzei* CARLS.- CARLS, p. 415-416, Pl. 1, Figs. 13, Pl. 3, Figs. 45-47.
1976 *Praelatericriodus rectangularis lotzei* (CARLS).- BULTYNCK, p. 44-45, Pl. 1, Figs. 1-3, 5-11; Pl. 2, Figs. 1-14.

Remarks.- The Pa elements of *Icriodus rectangularis rectangularis* Carls and Gandl have a posterior lateral process perpendicular to the main axis and straight. In the Pa elements of *Icriodus rectangularis lotzei* Carls, the posterior lateral process is slightly curved.
Age and Range.- Late Lochkovian, the *delta* and *pesavis* zones (Valenzuela-Rios, 1994).
Material.- 2 Pa elements.

***Icriodus* cf. *vinearum* CARLS, 1975**
(Plate 1, Figures 4-7)

Remarks.- The Pa elements have a spindle similar to those of *Icriodus vinearum* Carls, but differ in the development of lateral ridges and spur. The basic difference between the Pa elements of *Icriodus postwoscmidti* Mashkova and *Icriodus vinearum* Carls is their shape of the basal cavities. *Icriodus postwoscmidti* has a wider basal cavity and a more distinct spur.
Material.- 4 Pa elements.

Family: Polygnathacea BASSLER, 1925
Type Genus: *Polygnathus* HINDE, 1879
Genus: *Polygnathus* HINDE, 1879
Type Species: *Polygnathus dubius* HINDE, 1879

***Polygnathus cooperi cooperi* KLAPPER, 1971**
(Plate 2, Figures 16-19, 22, 23)

1971 *Polygnathus linguiformis cooperi* KLAPPER, p. 64, Pl. 1, Figs. 17-22, Pl. 2, Fig. 21.
1977 *Polygnathus linguiformis cooperi* KLAPPER.- WEDDIGE, Pl. 5, Figs. 93, 94.
1977 *Polygnathus linguiformis cooperi* KLAPPER.- KLAPPER in ZIEGLER, p. 471-472, *Poygnathus*-Pl. 9, Figs. 2, 3.
1978 *Polygnathus cooperi* KLAPPER.- KLAPPER, ZIEGLER and MASHKOVA, p. 108, Pl. 2, Figs. 21, 22, 29, 30.
1979 *Polygnathus cooperi* KLAPPER.- LANE and ORMISTON, Pl. 3, Fig. 27.
1983 *Polygnathus cooperi cooperi* KLAPPER.- SPARLING, Figs. 10 D, E.
1992 *Polygnathus cooperi cooperi* KLAPPER.- BONCHEVA, p. 34-35, Pl. 1, Figs. 1-4.
2009 *Polygnathus cooperi cooperi* KLAPPER.- BERKYOVA, Figs. 7 A-D.

Remarks.- The Pa elements of *Polygnathus cooperi cooperi* have a weaker posterior transverse ridge development, a few of them completely cross the tongue of platform, as opposed to *Polygnathus linguiformis linguiformis* Hinde gamma morphotype. Generally the posterior third of the outer margin is more sharply deflected inward in *Polygnathus linguiformis linguiformis* (Klapper in Ziegler, 1977; p. 471).
Age and Range.- Late Emsian- early Eifelian, from the upper part of the *serotinus* Zone to the end of the *partitus* Zone (Klapper et al., 1978).
Material.- 7 Pa elements.

***Polygnathus inflexus* BARANOV, 1992**
(Plate 2, Figures 11-15)

1983 *Polygnathus* aff. *trigonicus* BARANOV.- SPARLING, Figs.10 L-P.
1992 *Polygnathus inflexus* BARANOV, p. 175, Pl. 1, Figs. g-m.

Definition.- The Pa element has a narrow and elongated platform with margins ornamented by distinctive nodes. The outer platform

is wider than the inner one. The platform margins do not extend to the posterior end of the element. The carina, strongly curved inwardly after the posterior one-third, extends beyond the posterior end of the platform. The free blade is about half of the platform. The basal cavity is oval shaped and close to the anterior part of the platform.

Remarks.- The Pa elements of *Polygnathus zieglerianus* Weddige have a wider platform from those of *Polygnathus inflexus*.

Age and Range.- Early Devonian (Late Emsian), the *patulus* Zone (Baranov, 1992).

Material.- 9 Pa elements.

Polygnathus linguiformis bultyncki **WEDDIGE, 1977 alpha morphotype**
(Plate 2, Figures 24-26)

1977 *Polygnathus linguiformis bultyncki* WEDDIGE, p. 313-314, Pl. 5, Figs. 91,92.
1979 *Polygnathus linguiformis bultyncki* WEDDIGE.- LANE and ORMISTON, Pl. 7, Figs. 38, 39.
1983 *Polygnathus linguiformis bultyncki* WEDDIGE alpha morphotype.- WANG and ZIEGLER, p. 89, Pl. 5, Fig. 19.
1992 *Polygnathus linguiformis bultyncki* WEDDIGE.- BONCHEVA, p. 39-40, Pl. 5, Fig. 6.
2003 *Polygnathus linguiformis bultyncki* WEDDIGE.- DANIEL, Pl. 4, Fig. 12.

Remarks.- A sharply angular outer margin at the contact with the tongue and the main part of the platform, a relatively long tongue with transverse ridges, and an anterior outer margin distinctly higher than the carina and the inner margin are the most distinguishing characteristics of the delta morphotype Pa element. It differs from the beta morphotype by its angular outer margin and higher anterior outer margin (Wang and Ziegler, 1983; p. 89).

Age and Range.- Late Emsian, the *serotinus* Zone (Wang and Ziegler, 1983).

Material.- 5 Pa elements.

Polygnathus linguiformis bultyncki **WEDDIGE, 1977 beta morphotype**
(Plate 2, Figures 9, 10, 20, 21)

1977 *Polygnathus linguiformis bultyncki* WEDDIGE, p. 313-314, Pl. 5, Fig. 90.
1977 *Polygnathus linguiformis linguiformis* WEDDIGE.- KLAPPER in ZIEGLER, p. 493, *Poygnathus*-Pl. 9, Figs. 6-8.
1979 *Polygnathus linguiformis bultyncki* WEDDIGE.- LANE and ORMISTON, Pl. 7, Figs. 1, 2, 34; Pl. 8, Figs. 11, 12.
1978 *Polygnathus linguiformis bultyncki* WEDDIGE.- KLAPPER, ZIEGLER and MASHKOVA, Pl. 1, Figs. 21, 22, 26-29.
1983 *Polygnathus linguiformis bultyncki* WEDDIGE beta morphotype.- WANG and ZIEGLER, p. 89, Pl. 5, Fig. 18.
1992 *Polygnathus linguiformis bultyncki* WEDDIGE.- BONCHEVA, p. 33, 45, Pl. 5, Figs. 5-7.
2003 *Polygnathus linguiformis bultyncki* WEDDIGE.- DANIEL, Pl. 4, Figs. 10, 11.
2009 *Polygnathus linguiformis bultyncki* WEDDIGE.- BERKYOVA, Figs. 8 H-I.

Remarks.- Pa elements are distinguished from those of alpha morphotype by having an anterior outer margin at the same height as the carina and the inner margin, and an outer margin rounded at the contact with the tongue and the anterior outer margin.

Age and Range.- Late Emsian, the *serotinus* Zone (Wang and Ziegler, 1983).

Material.- 14 Pa elements.

Polygnathus serotinus **TELFORD, 1975 delta morphotype**
(Plate 2, Figures 1-8)

1975 *Polygnathus foveolatus serotinus* TELFORD, Pl. 7, Figs. 5-8.
1977 *Polygnathus serotinus* TELFORD.- KLAPPER in ZIEGLER, p. 495-496, *Poygnathus*-Pl. 9, Figs. 4, 5.

1979 *Polygnathus serotinus* TELFORD delta morphotype.- LANE and ORMISTON, p. 63, Pl. 8, Figs. 8-10, 34, 35.
1983 *Polygnathus serotinus* TELFORD delta morphotype.- WANG and ZIEGLER, Pl. 6, Figs. 18.
1987 *Polygnathus serotinus* TELFORD delta morphotype.- MAWSON, p. 280, 282, Pl. 33, Figs. 9-12; Pl. 36, Fig.10.
1992 *Polygnathus serotinus* TELFORD.- BONCHEVA, p. 41-42, Pl. 6, Figs. 5-7.
2003 *Polygnathus serotinus* TELFORD.- DANIEL, Pl. 3, Figs. 1-6.
2009 *Polygnathus serotinus* TELFORD.- BERKYOVA, Fig. 8J.

Remarks.- An outer platform margin with a sharp inward deflection in the beginning of the posterior one-third, and a flange-like anterior outer margin distinctly higher than carina and inner margin are the most distinguishing characteristics of the Pa elements of this morphotype.
Age and Range.- Late Emsian, the *serotinus* Zone– the Lower *costatus* Zone (Klapper et al., 1978).
Material.- 19 Pa elements.

Family: Spathognathodontidae HASS, 1959
Genus: *Lanea* MURPHY and VALENZUELA-RÍOS, 1999
Type Species: *Ozarkodina eleanorae* LANE and ORMISTON, 1979

***Lanea eleanorae* (LANE and ORMISTON, 1979)**
(Plate 3, Figures 22-24)

1979 *Ozarkodina eleanorae* LANE and ORMISTON, p. 55, Pl. 1, Figs. 40, 47; Pl. 2, Figs. 6, 7; Pl. 3, Figs. 7, 8, 11, 12.
1991 *Ancyrodelloides eleanorae* (LANE and ORMISTON, 1979).- KLAPPER in ZIEGLER, p. 17-18, Pl. 2, Figs. 3, 5 (see for further synonymy).
1999 *Lanea eleanorae* (LANE and ORMISTON, 1979).- MURPHY and VALENZUELA-RİOS, p. 328, 330, Pl. 2, Figs. 15-20.
2012 *Lanea eleanorae* (LANE and ORMISTON, 1979).- CORRADINI and CORRIGA, Fig. 6O.

Remarks.- A few badly preserved Pa elements with subequal platform lobes were assigned to this species.
Age and Range.- Late Lochkovian, the *delta* Zone (Klapper and Murphy, 1980).
Material.- 3 Pa elements.

Genus *Ozarkodina* BRANSON and MEHL, 1934
Type Species *Ozarkodina typica* BRANSON and MEHL, 1934

***Ozarkodina carinthiaca* (SCHULZE, 1968)**
(Plate 1, Figures 3-6)

1968 *Spathognathodus carinthiacus* SCHULZE, Pl. 17, Figs. 14, 15, 17.
1973 *Ozarkodina carinthiaca* (SCHULZE).- KLAPPER in ZIEGLER, p. 219, *Ozarkodina*- Pl. 1, Fig. 3.
1978 *Ozarkodina carinthiaca* (SCHULZE).- KLAPPER, ZIEGLER and MASHKOVA, p. 108, Pl. 1, Figs. 1, 8.
1980 *Ozarkodina carinthiaca* (SCHULZE).- KLAPPER and ZIKMUNDOVÁ, p. 231, Pl. 8, Figs. 6, 17, 18.
2009 *Ozarkodina carinthiaca* (SCHULZE).- BERKYOVA, Fig. 9 A

Remarks.- The Pa element is similar to *Ozarkodina eurekaensis* Klapper and Murphy, and *Ozarkodina bidentata* (Bischoff and Ziegler). However, more numerous and thinner denticles and a somewhat narrower basal cavity distinguish the Pa element of *Ozarkodina carinthiaca* from that of *Ozarkodina eurekaensis* Klapper and Murphy. The Pa elements of *Ozarkodina eurekaensis* have relatively broad and closely spaced blade

denticles, and a large, elliptical basal cavity occupying slightly more than the posterior half of the unit. The Pa element of *Ozarkodina bidentata* (Bischoff and Ziegler) is distinguished from that of *Ozarkodina carinthiaca* by having a more planar upper surface and absence of the alternating denticles posteriorly.

Age and Range.- Early Devonian (Emsian), from bottom of the *serotinus* Zone to the end of the *patulus* Zone (Klapper et al., 1978, p. 107, Fig. 3).

Material.- 28 Pa elements.

RESULTS

22 species, subspecies and morphotypes of 8 conodont genera were identified from limestone samples collected from the Lower–Middle Devonian outcrops in the vicinity of Beykoz, Şile and Kurtdoğmuş (İstanbul, Turkey).

The conodont fauna of samples BG28-BG34 of the Beykoz section indicates that this interval is in the *delta* Zone (upper Lochkovian). Also, samples ŞG4–ŞG15 from the Karamandere section of the İstinye Formation are in the *delta–pesavis* zones (upper Lochkovian). The conodont faunas from samples KP13A–KP17 from the Kokarpınar section of the Kozyatağı Member, the Kartal Formation define the *serotinus* Zone (upper Emsian). However, the lower samples (KP1-13) most probably belong to the *laticostatus* and older zones.

Samples BD1-BD12 from the Büyükdere section are in probably the *serotinus* Zone (upper Emsian) or older biozones; samples BD13–BD24, in the *patulus* Zone (upper Emsian); and samples BD 25–BD26, in the *partitus* Zone (lower Eifelian).

Based on the occurrence of *Icriodus corniger corniger* Weddige with a range restricted to the *partitus* and *costatus* zones (Weddige et al. 1979, Fig. 4), It can be said that the Kozyatağı member ranges up to lower Eifelian.

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REFERENCES

Abdüsselamoğlu, Ş. 1963. İstanbul Boğazı doğusunda mostra veren Paleozoik arazide stratigrafik ve paleontolojik yeni müşahedeler. MTA Dergisi, 60: 1-6, Ankara.

Arbizu, M., Garcia-Alcalde, J.L., Garcia-Lopez, S., Mendez-Bedia, I., Sanchez De Posada, L.C., Soto, F.M., Truyols, M., Truyols, J., Alverez, A., Mendez, C. and Menendez, J.R. 1979. Biostratigraphical study of the Moniello Formation (Cantabrian Mountains, Astrurias, NW Spain). *Geologica et Palaeontologica* 13: 103-124, 5 Abb., 3 Taf, Marburg.

Baranov, V.V. 1992. New Late Silurian and Early Devonian conodonts from northeastern USSR. *Paleontological Journal*, 26(1): 173-179.

Bassler, R.S. 1925. Classification and stratigraphic use of the conodonts. *Geol. Soc. Amer. Bull.* 36: 218-220, Washington/D.C.

Berkyova, S. 2009. Lower-Middle Devonian (upper Emsian-Eifelian, *serotinus-kockelianus* zones) conodont faunas from the Prague Basin, the Czech Republic. *Bulletin of Geosciences*, 84(4): 667-686.

Boncheva, I. 1992. Emsian representatives of the conodont Genus *Polygnathus* Hinde, 1879 from Southwest Bulgaria. *Geologica Balcania*, 22(2): 33-45, Sofia.

_____, Sachanski, V, Lakova, I. and Yaneva, M. 2007. Facies Transition and biostratigraphic correlation of the Silurian and Lower Devonian in West Bulgaria. *Geological Quarterly*. 51(4) 407-418.

Branson, E.B. and Mehl, M.G. 1934. Conodont from the Bushberg and equivalent formations of Missouri. Univ. Missouri Studies, 8(4): 265-299, pp. 22-24.

_____ and _____ 1938. The conodont genus *Icriodus* and its stratigraphic distribution. *Journal of Paleontology* 12(2): 156-166.

Bultynck, P. 1976. Le Silurian superieur et le Devonien inferieur de la Sierra de Guadarrama (Espagne Centrale). *Bulletin de l'Institut Royal des Sciences Naturelles de Belgique*, 49(5): 1-74.

Carls, P. 1969. Die Conodonten des tieferen Unter-Devonsder Guadarrama (Mittel -Spanien) und die Stellung des Grenzbereiches Lochkovium/Pragium nach der rheinischen gliederung.-*Senckenbergiana lethaea*, 50:303-355, 4 text-figs., 4 tables, 4 pls., Frankfurt a.M.

_____ 1975. Zusätzliche Conodonten-Funde aus dem tieferen Unter-Devon Keltiberiens (Spanien). *Senckenbergiana lethaea*, 56(4/5): 399-428.

_____ and Gandl, J. 1969. Stratigraphie und Conodonten des Unter-Devons der Östlichen Iberischen Ketten (NE-Spanien). *Neues Jahrbuch für Geologie und Paläontologie, Abhandlungen*, 132(2): 155-218.

Corradini, C., Leone, F., Loi, A. and Serpagli, E. 2001. Conodont Stratigraphy of a highly tectonised Siluro-Devonian Section in the San Basilio area (SE Sardinia). *Bollettino della Società Paleontologica Italiana 40*, 315–323.

_____ and Corriga, M. G., E. 2012. A Přídolí–Lochkovian conodont zonation in Sardinia and the Carnic Alps: implications for a global zonation scheme. *Bulletin of Geosciences*, 87(2): 1-16.

Çapkınoğlu, Ş. 1997. Conodont fauna and biostratigraphy of the Famennian of Büyükada, İstanbul, Northwestern Turkey. *Bollettino della Società Paleontologica İtaliana*, 35 (2):165-185, Modena.

Çapkınoğlu, Ş. 2000. Late Devonian (Famennian) Conodonts from Denizliköyü, Gebze, Kocaeli, Northwestern Turkey. *Turkish J. Earth Sci*., 9: 91-112, Ankara.

_____ 2005*a*. Famenian Conodonts from the Ayineburnu Formation of the İstanbul Zone, NW Turkey. *Geologica Carpathica*, 56(2): 113-122.

_____ 2005*b*. Upper Devonian (Upper Frasnian-Lower Famenian) Conodont Biostratigraphy of the Ayineburnu Formation, İstanbul, NW Turkey. *Geologica Carpathica*, 56(3): 223-236.

_____ and Bektaş, O. 1998. Karakaya Kompleksi'ne Ait Karasenir Formasyonu (Amasya) İçindeki Kireçtaşı Olistolitlerinden Erken Devoniyen Conodontları, Maden Tetkik ve Arama Dergisi No. 120. pp. 159-170.

Daniel, J.J. 2003. Sedimentology, conodont biostratigrapy and paleogeograpy of a mid-Devonian carbonate/siliciclastic platform margin, Broken River region, north-eastern Australia. *Cour. Forsch.-Inst. Senkenberg*. Frankfurt a. M., 245: 327-355.

Gedik, İ. 1975. Die Conodonten der Trias auf der Kocaeli-Halbinsel (Türkei). *Palaeontographica* A, 150: 99-160, Stuttgart.

_____, Pehlivan, Ş., Timur, E., Duru, M., Altun, İ., Akbaş, B., Özcan, İ., and Alan, İ. 2005. Kocaeli Yarımadasının Jeolojisi. MTA Report. 10774 Ankara.

Göncüoğlu, M.C., Boncheva. I. and Göncüoğlu, Y. 2004. First discovery of Middle Tournaisian conodonts in hhe Griotte-type nodular pelagic limestones, Istanbul area, NW Turkey. Rivista Italiana di Paleontologia e Stratigrafia, 110(2): 431-439.

Hass, W. 1959. Conodonts from the Chappel Limestone of Texas. U. S. Geol. Surv. Prof. Pap. 294-J: 365-399, pls.46-50, Washington/D.C.

_____ 1968. Das Alt-Paläozoikum von Bithynien (Nordwest-Türkei). *N. Jb. Geol. Paläont. Abh*., 131(2):178-242, Stuttgart.

Hinde, G.J. 1879. On conodonts from the Chazy and Cincinnati group of the Cambro-Silurian and from the Hamilton and Genesee Shale divisions of the Devonian, in Canada and the United States. *Quarterly Journal of the Geological Society of London*, 35: 351–369, London.

Jentzsch, I. 1962. Conodonten aus dem Tentaculitenknollenkalk (Unterdevon) in Thüringen. *Geologie*, 11(8): 961-985, Berlin.

Johnson, J.G., Klapper, G. and Trojan, W.R. 1980. Brachiopod and Conodont successionsin the Devonian of the northern Antelope Range, central Nevada. *Geologica et Palaeontologica*, 14: 77-116, Marburg.

_____, _____ and Sandberg, C.A. 1985. Devonian eustatic fluctuations in Euroamerika. *Geological Society of America Bulletin*, 96: 567-587.

Kaya, O. 1973. The Devonian and Lower Corboniferous stratigraphy of the İstinye, Bostancı and Büyükada subareas (Paleozoic of Istanbul: Ed. O. Kaya). Ege Üniversitesi Fen Fakültesi Kitaplar Serisi, 40:1-36, İzmir.

Klapper, G. 1971. Sequence within the conodont genus *Polygnathus* in the New York lower Middle Devonian. *Geologica et Palaeontologica*, 5: 59–79. Marburg.

_____ 1977. Lower and Middle Devonian conodont sequence in Central Nevada; with contributions by D.B. Johnson.- In: Murphy, M.A., Berry, W.B.N. & Sandberg, C.A. (eds.), Western North America: Devonian.- Univ. California, Riverside Campus Mus. Contrib. 4: 33-54.

_____, Ziegler, W. and Mashkova, T.V. 1978. Conodonts and correlation of Lower-Middle Devonian boundary beds in the Barrandian area of Czechoslovakia. *Geologica et Palaeontologica* 12: 103-116, Marburg.

_____ and Ziegler, W. 1979. Devonian conodont biostratigraphy. The Devonian System. Special Papers in Palaeontology 23: 199-224.

Klapper, G. and Murphy, M.A. 1980. Conodont zonal species from the *delta* and *pesavis* Zones (Lover Devonian) in central Nevada. *N. Jb. Geol. Palaont. Mh*., 8: 490-504.

_____ and Zikmundová, J. 1980. Silurian and Devonian conodont localites of the Barrandian. Second Europen Conodont Symposium-Ecos II, P.147-180, (Fig. 16, Pl. 25).

Lane, H.R. and Ormiston, A.R. 1979. Siluro-Devonian biostratigraphy of the Salmontrout River area, east-central Alaska. *Geologica et Palaeontologica* 13: 39-96, Marburg.

Mastandrea, A. 1985*a* (1984). Early Devonian (Lochkovian) conodonts from southwestern Sardinia. *Bollettino della Società Paleontologica Italiana*, 23(2): 240-258.

Mawson, R. 1987. Early Devonian conodont faunas from Buchan and Bindi, Victoria, Australia. *Palaeontology*, 30(2): 251-297, Pls. 31-41.

Murphy, M.A. and Berry, W.B.N., 1983. Early Devonian Conodont-Graptolite Collation and Correlations with Brachiopod and Coral Zones, Central Nevada. *AAPG Bulletin*, 67(3): 371-379.

_____ and Matti, J.C., 1983, Lower Devonian Conodont (*hesperius-kindlei* zones), Central Nevada. Univ. California Publ., Geological sciences, 123: 1-83.

_____ and Valenzuela-Ríos, J.I. 1999. *Lanea* new genus, lineage of Early Devonian conodonts. *Bollettino della Società Paleontologica Italiana*, 37: 321–334, Modena.

Müller, K.J. and Müller, E.M. 1957. Early Upper Devonian (Independence) conodonts from Iowa, Part 1. *Journal of Paleontology*, 31(6): 1069-1108, Tulsa/Okla.

Önalan, M. 1981. İstanbul Ordovisiyen ve Silüriyen istifinin çökelme ortamları. İst. Üniv. Yerbilimleri Fakültesi Yerbilimleri Dergisi 2(3-4): 161-177, İstanbul.

_____1982. Pendik bölgesi ile adaların jeolojisi ve sedimenter özellikleri. İst. Üniv. Yerbilimleri

Fakültesi Jeoloji Bölümü, Doçentlik tezi (unpublished), 156 p., İstanbul.(thesis)

Schulze, R. 1968. Die Conodonten aus dem Paläozoikum der mittleren Karawanken (Seeberggebiet). *N. Jb. Geol. Paläont., Abh.,* 130: 133-245, pls. 16-20, Stuttgart.

Sparling, D.L. 1983. Conodont biostratigraphy and biofacies of lower Middle Devonian limestones, north-central Ohio. *Journal of Paleontology*, 57: 825-864.

Telford, P.G. 1975. Lower and Middle Devonian conodonts from the Broken River Embayment, North Queensland, Australia. Special Paper in Palaeontology, Paleontological Association of London, 15: 1-96, 9 text-fig., 6 tables, 16 pls., London.

Thomas, L.A. 1949. Devonian-Mississippian formations of southeast Iowa. *Geol. Soc. Amer. Bull.* 60: 403-437, 1 table, 4 pls., New York/ N.Y.

Valenzuela-Ríos, J.I. 1994. Conodontos del Lochkoviense y Praguiense (Devónico inferior) del Pirineo Central Español. Memorias del Museo Paleontológico de la Universidad de Zaragoza, 5: 1-178.

Wang, C., and Ziegler, W. 1981. Middle Devonian conodonts from Xiguitu Qi, Inner Mongolia Autonomous Region, China. *Senckenbergiana lethaea*, 62 (2/6): 125-139. 3 Text-Fig, 5 Tab, 2 Pls.

Wang, C., and Ziegler, W. 1983. Devonian conodont biostratigraphy of Guangxi, south China, and the correlation with Europe. *Geologica et Palaeontologica* 17: 75-107, Marburg.

Weddige, K. 1977. Die Conodonten der Eifel-Stufe im Typusgebiet und in benachbarten Faziesgebieten. *Senckenbergiana lethaea*, 58(4/5): 271–419.

Weddige, K. 1985. Systematik von Ober-Emsium-Icriodontiden und Formenentwicklung. *Senckenbergiana lethaea*, 66(3/5): 347-381.

_____, Werner, R. and Ziegler, W. 1979. The Emsian-Eifelian Boundary. *Newsl. Stratigr.* 8(2): 159-169.

Wittekindt, H. 1966. Zur Conodontenchronologie des Mitteldevons, in: Das Mitteldevon des Rheinischen Schiefergebirges. Ein Symposium.- *Fortschr. Geol. Rheinl.-Westf.* 9: 621-646, 1 text-fig., 1 table, 3 pls., Krefeld (date of imprint 1965).

Ziegler, W. 1973. Catalogue of Conodonts. E. Schweizerbart'sche, 1, XVIII+504 S., 23 Text-Fig., 27 Pls., Stuttgart.

_____ 1977. Catalogue of Conodonts. E. Schweizerbart'sche, 3., 574 S., 17 Text-Fig., 39 Pls., Stuttgart.

_____ 1991. Catalogue of Conodonts. E. Schweizerbart'sche, 5., III+212 S., 8 Text-Fig., 13 Pls., Stuttgart.

PLATES

PLATE - I

Figures 1, 2. *Icriodus rectangularis lotzei* (CARLS, 1969)
1, 2. Upper and lower views. Sample BG32.

Figure 3. *Icriodus* aff. *rectangularis lotzei* (CARLS, 1969)
3. Upper view. Sample BG32.

Figures 4-7. *Icriodus* cf. *vinearum* (CARLS, 1975)
4. Upper view. Sample BG32.
5. Upper view. Sample BG32.
6. Upper view. Sample BG30.
7. Upper view. Sample ŞG4.

Figures 8-12. *Icriodus angustoides alcoleae* CARLS, 1969
8. Upper view. Sample ŞG5.
9, 10. Upper and lateral views. Sample ŞG4.
11, 12. Upper and lateral views. Sample ŞG9.

Figures 13, 14. *Icriodus corniger corniger* WEDDIGE, 1977
13, 14. Upper and lateral views. Sample BD 25.

Figures 15-20. *Icriodus corniger ancestralis* WEDDIGE, 1977
15, 16. Upper and lower views. Sample BD17.
17, 18. Upper and lower views. Sample BD17.
19, 20. Upper and lower views. Sample BD17.

Figures 21, 22. *Icriodus corniger* subsp.
21. Upper view. Sample KP17.
22. Upper view. Sample BD13.

Figure 23. *Icriodus angustoides alcoleae* CARLS, 1969
23. Upper view. Sample ŞG5.

PLATE - I

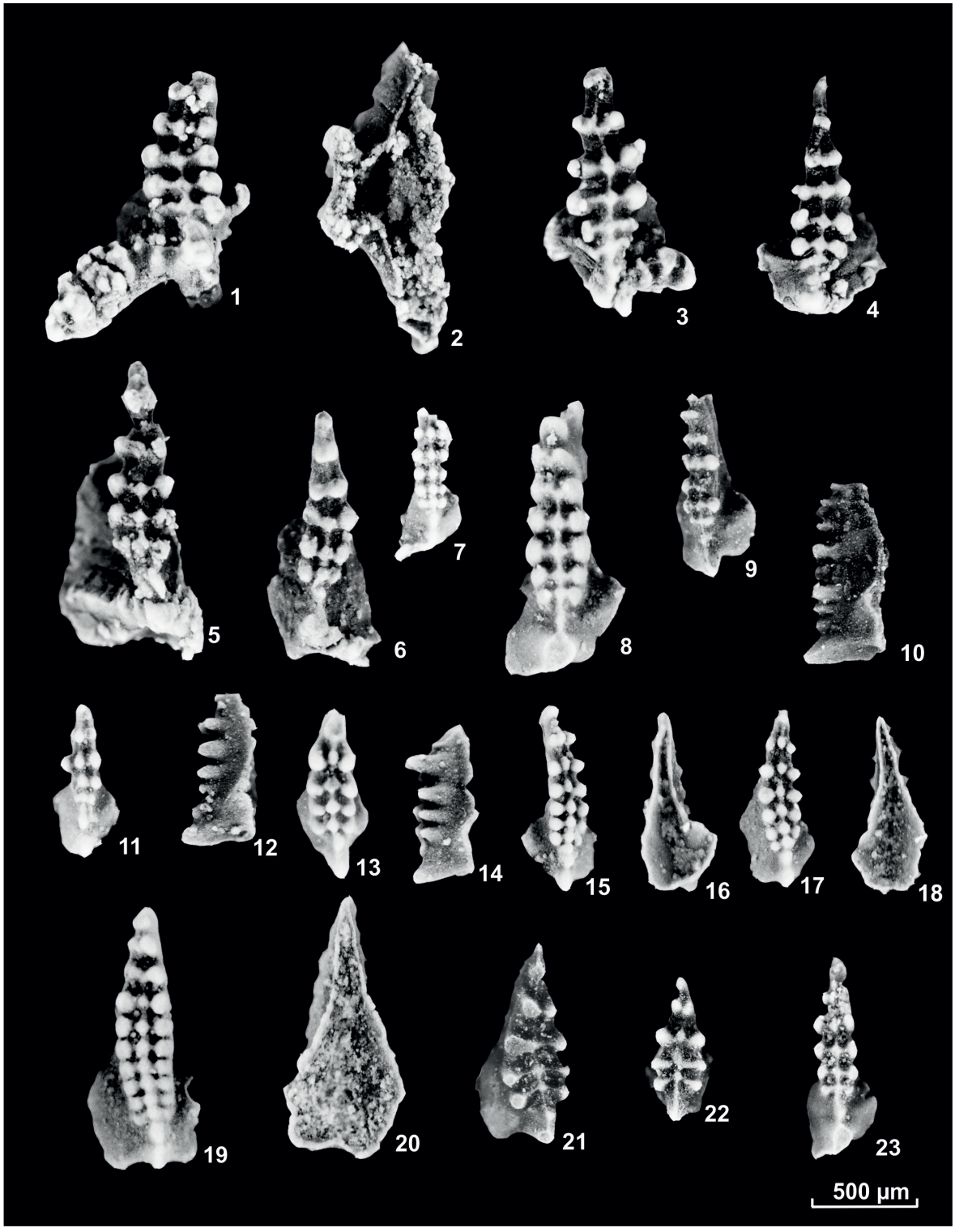

PLATE - II

Figures 1-8. *Polygnathus serotinus* TELFORD, 1975 delta morphotype
1, 2. Upper and lower views. Sample BD17.
3, 4. Upper and lower views. Sample BD17.
5, 6. Upper and lower views. Sample BD17.
7, 8. Upper and lower views. Sample BD25.

Figures 9, 10. *Polygnathus linguiformis bultyncki* WEDDIGE, 1977 beta
9. Upper view. Sample KP13A.
10. Upper view. Sample BD17.

Figures 11-15. *Polygnathus inflexus* BARANOV, 1992
11. Upper view. Sample BD20.
12, 13. Upper and lower views. Sample BD23.
14. Upper view. Sample BD13.
15. Upper view. Sample BD17.

Figures 16-19, 22,23. *Polygnathus cooperi cooperi* KLAPPER, 1971
16. Upper view. Sample KP 13A.
17. Upper view. Sample BD 13.
18. Upper view. Sample BD 20.
19. Upper view. Sample BD 13.
22. Upper view. Sample BD 18.
23. Upper view. Sample BD 17.

Figures 20, 21. *Polygnathus linguiformis bultyncki* WEDDIGE, 1977 beta morphotype
20. Upper view. Sample BD 17.
21. Upper view. Sample BD 13.

Figures 24-26. *Polygnathus linguiformis bultyncki* WEDDIGE, 1977 alpha morphotype
24. Upper view. Sample BD 25.
25. Upper view. Sample BD 25.
26. Upper view. Sample KP 17.

PLATE - II

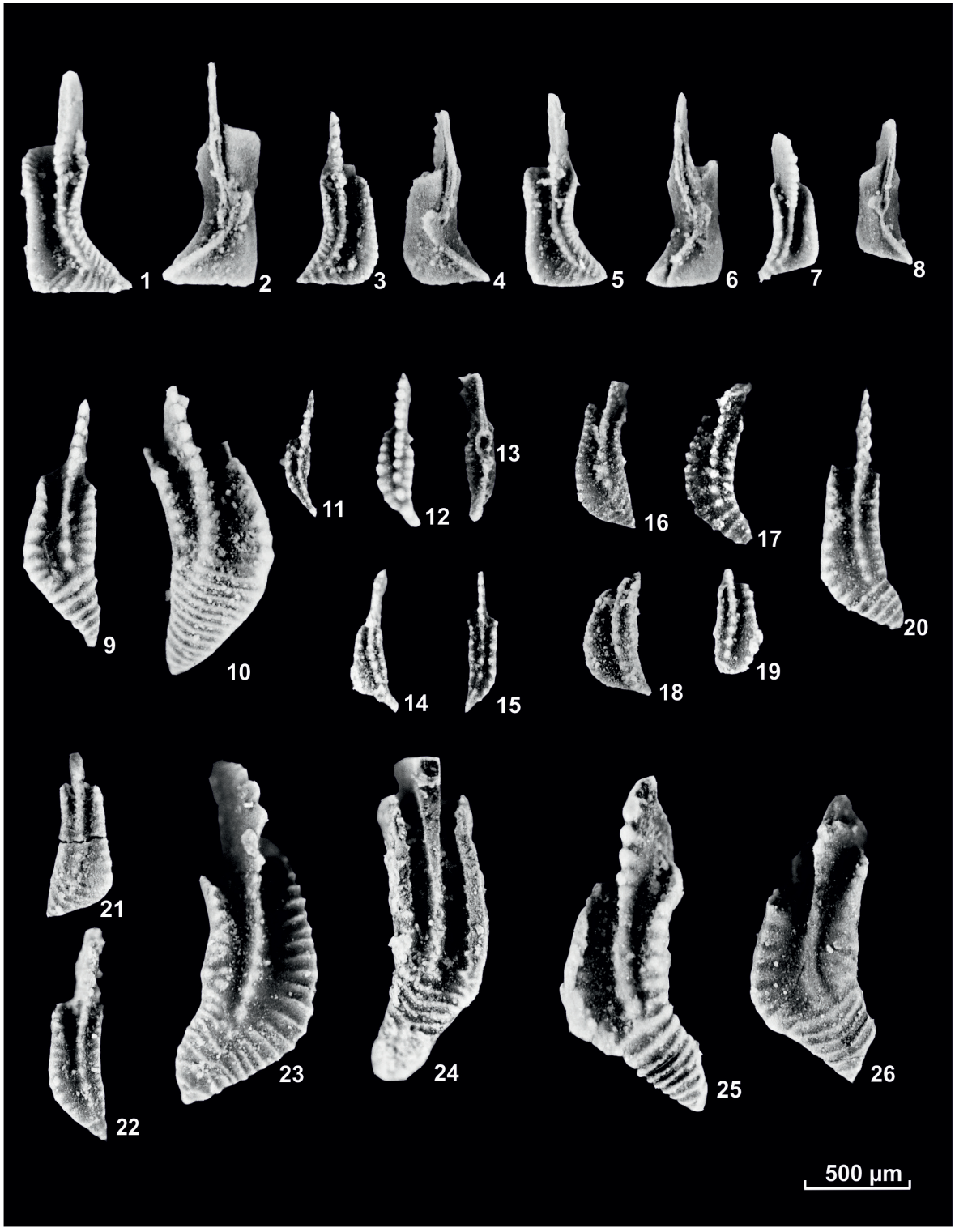

PLATE - III

Figures 1-2. *Ozarkodina* sp.
1, 2. Upper and lower views. Sample ŞG3.

Figures 3-6. *zarkodina carinthiaca* (SCHULZE, 1968)
3, 4. Lateral and upper views. Sample BD17.
5, 6. Lateral and upper views. Sample BD17.

Figure 7. *Pelekysgnathus serrratus* JENTZSCH, 1962
7. Upper view. Sample BD25.

Figures 8-12. *Pseudooneotodus beckmanni* (BISCHOFF and SANNEMANN, 1958)
8, 9. Upper and lateral views. Sample BD25.
10, 11. Lateral and lateral views. Sample BD25.
12. Upper view. Sample BD1.

Figure 13. *Pseudooneotodus* sp. (BISCHOFF and SANNEMANN, 1958)
13. Upper view. Sample BD30.

Figures 14-17. *Neopanderodus transitans* ZIEGLER and LINDSTRÖM, 1971
14, 15. Lateral view. Sample BD17.
16, 17. Lateral view. Sample BD25.

Figure 18. *Neopanderodus perlineatus* ZIEGLER and LINDSTRÖM, 1971
18. Lateral view. Sample BD17.

Figures 19, 20. *Belodella resima* (PHILIP, 1965)
19, 20. Lateral view. Sample BD4.

Figure 21. *Belodella* cf. *devonica* (STAUFFER, 1940)
21. Lateral view. Sample BD1.

Figures 22-24. *Lanea eleanorae* (LANE and ORMISTON, 1979)
22, 24. Upper and lower views. Sample BG28.
23. Upper view. Sample BG34.

PLATE - III