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Early Cretaceous foraminifera fauna from Bersek Hill, Gerecse Mts, Hungary

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(4 figures, 1 plate)

This is the first investigation on isolated Early Cretaceous foraminifera fauna from Hungary. The fauna was set free by concentrated acetic-acid from calcareous layers and by hydrogene peroxide from silty layers of Bersek Marl and Lábatlan Sandstone Formations in Gerecse Mts, Hungary. The foraminifera indicate a Valanginian – Barremian age of this succession which is well correlated with data based on ammonite and nannoflora stratigraphy. Family Vaginulinidae is the most abundant and the most diversified, *Lenticulina nodosa* (REUSS), *L. muensteri* (ROEMER) and *Glomospira gordialis* (JONES et PARKER) are the dominant species. The composition of foraminifera assemblages suggests that Bersek Marl and Lábatlan Sandstone Formation were formed in outer shelf – upper slope environment, where the intensity of paleocurrents influenced not only the kind of sediments but the distribution and preservation of microfauna.

Geological setting

Lower Cretaceous siliciclastic formations are known from the Gerecse Mountains within the ALCAPA unit. The investigation of these sequences goes back to the 19th century. The studied section of Bersek Hill is located near Lábatlan village in the NE part of Transdanubian Range in Hungary, in the Eastern part of the Gerecse Mts (Fig. 1.).

The Upper Jurassic – Lower Cretaceous calpionellid limestone is overlain by a thick marl and sandstone succession (HAAS 2001). These Lower to Middle Cretaceous flysch-like sediments are known only from Gerecse Mts within the Transdanubian Range in Hungary. The lower part of the sequence is represented by light greenish-gray, reddish, gray marl with thin, turbiditic sandstone and pelagic limestone layers (HAAS 2001). The age of the 160-200 m thick Bersek Marl Formation is Valanginian to Early Hauterivian.

The marl formation is overlain by varicoloured, fine- to coarse-grained sandstones interbedded with marl and sandy siltstone layers. Graded bedding, trace fossils, and erosional structures of the Lábatlan Sandstone Formation suggest that these layers were deposited by turbidity currents. The best outcrop of these formations is in the Bersek Hill quarry. This outcrop shows in 30 metres thickness the Valanginian – Barremian succession of the upper part of Bersek Marl and the lower part of Lábatlan Sandstone Formations. Many papers have worked on the lithology, sedimentology, petrology of this section, but nobody has been dealt with microfauna in detail at earlier time.

HANTKEN (1868) in his pioneering work called attention to similarity of these Lower Cretaceous sediments to the Rossfeld Beds in the Eastern Alps and he established a mid-Neocomian age for the Lábatlan Sandstone. HOFMANN (1884) gave a synopsis of the Upper Jurassic to Lower Cretaceous sequence of Gerecse Mts. He realized the Berriasian age of the lowest part of the succession. After this SOMOGYI (1914) gave a list of macrofossils (mainly ammonites) and established the Valanginian-Hauterivian age of the marl-sandstone sequence. In the middle of the last century FÜLÖP (1958) performed a comprehensive synthesis of the sequence. The first mention of the microfauna from Bersek Hill was in the monograph of FÜLÖP (1958) but he identified only two foraminifera genus, *Lenticulina* and *Globigerina*. SIDÓ (1973) summarised the results of the Cretaceous foraminifera studies of Hungary, she mentioned some *Lenticulina* sp. from the Gerecse Mountains.

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During the early 1960s the Geological Institute of Hungary led the first bed by bed collection from this succession, which yielded more than 11,000 ammonites. Subsequently several papers were published about the ammonite fauna (NAGY in: FÜLÖP 1958; NAGY 1964, 1967) which proved the Valanginian – Barremian age of the Bersek Marl and Lábatlan Sandstone Formations.

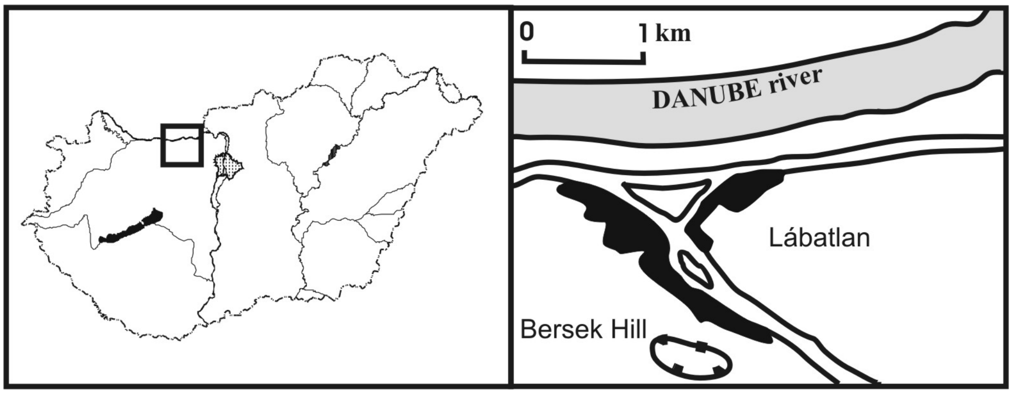

Fig. 1. Sketch map of the locality of the studied section in Gerecse Mts, near Lábatlan (modified after GÖRÖG, 1995).

Sedimentological studies of the siliciclastic sequence of Gerecse started only in the end of the 1980s. The results of these studies (CSÁSZÁR & HAAS 1984, KÁZMÉR 1988, SZTANÓ 1990) were summarised by FOGARASI (1995a, b). On the base of sedimentological features these authors considered that Bersek Marl is formed between ACD and CCD. In the middle of the last decade the investigation of Early Cretaceous siliciclastic succession got a new impulse. FŐZY (1995), FŐZY & FOGARASI (2002) re-examined the ammonites of the so-called "FÜLÖP Collection" of the Hungarian Natural History Museum. FŐZY recognized numerous standard Mediterranean Early Cretaceous ammonite zones which encompasing Late Valanginian to Upper Barremian age. FÉLEGYHÁZY & NAGYMAROSY (1991, 1992) studied the nannoplankton flora of this section and stating that the Bersek Marl is not older than Early Aptian. Results of subsequent ammonite and nannoplankton investigations (FŐZY & FOGARASI 2002) are inconsistent with these studies.

Petrological and micromineralogical studies ÁRGYELÁN (1989, 1995; CSÁSZÁR & ÁRGYELÁN 1994) proved close similarity between the siliciclastic sediments of Gerecse Mts and the Rossfeld Beds. CSÁSZÁR (1995) gave a comprehensive synthesis of the Lower Cretaceous sequence in the Gerecse Mts.

Material and methods

The studied Early Cretaceous foraminifera fauna was collected from the east quarry-yard of Bersek Hill, Gerecse Mountains, Hungary. Seventeen samples were collected from indurated calcareous marl and clayey marl layer pairs from Bersek Marl and from indurated beds of Lábatlan Sandstone (Fig. 2.).

All samples weighted about half kilogram. The microfossils were set free from the clayey marl by hydrogene peroxide but it was impossible to isolate the microfossils by standard washing from indurated layers. These rocks were dissolved in concentrated acetic-acid as described by LETHIERS & CRASQUIN-SOLEAU (1988) and LIRER (2000) but without heating the samples. The samples treated by H_2O_2 were not appreciable for microfossils. The microfauna were represented mainly by foraminifers, few radiolarians and some ostracods were found. In samples all the foraminiferal individuals were picked up, the specimens were identified and their abundance was counted.

Foraminiferal data

In the studied section benthic foraminifers are more common and diverse than planktonic forms but the number of specimens is strongly varied from sample to sample. Nevertheless, there is no significant difference between composition of foraminiferal assemblages along the studied section (Fig. 3.). Most of the extracted foraminifers are strongly recrystallized and partly crushed; only three layers yielded well-preserved microfauna (samples No. 5, 8 and 11).

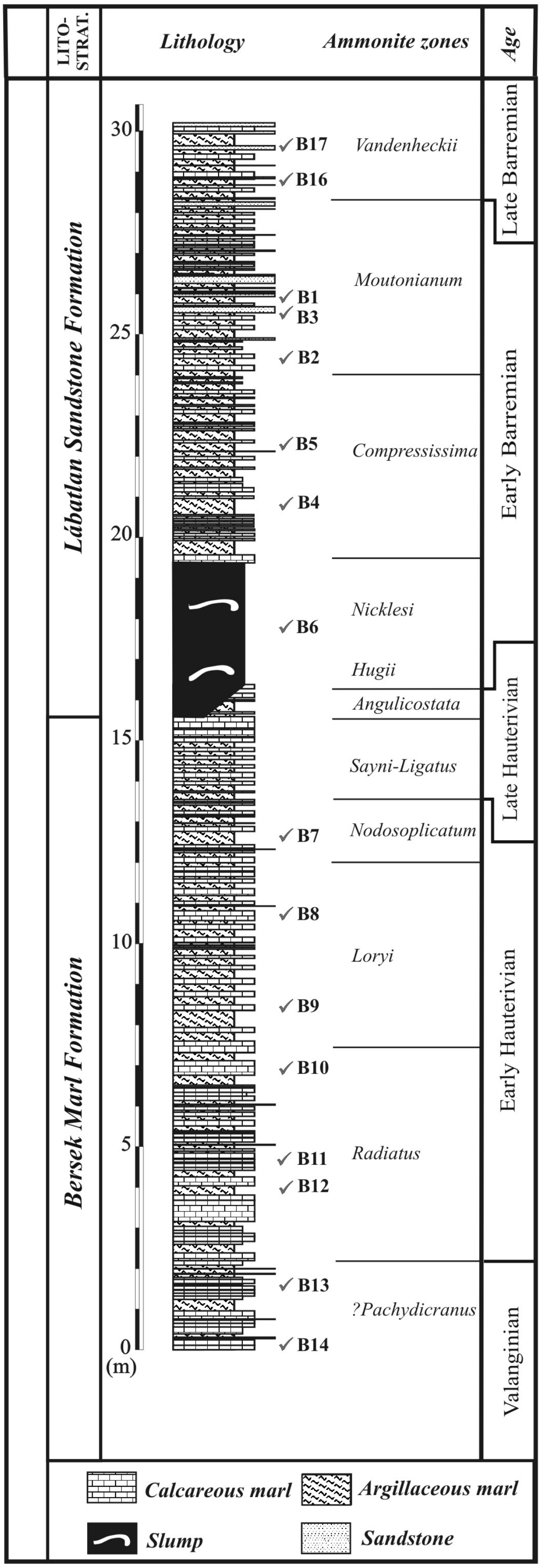

Fig. 2. Stratigraphic log of the studied section indicating with Early Cretaceous ammonite zones and the exact place of samples (simplified after FŐZY & FOGARASI 2002).

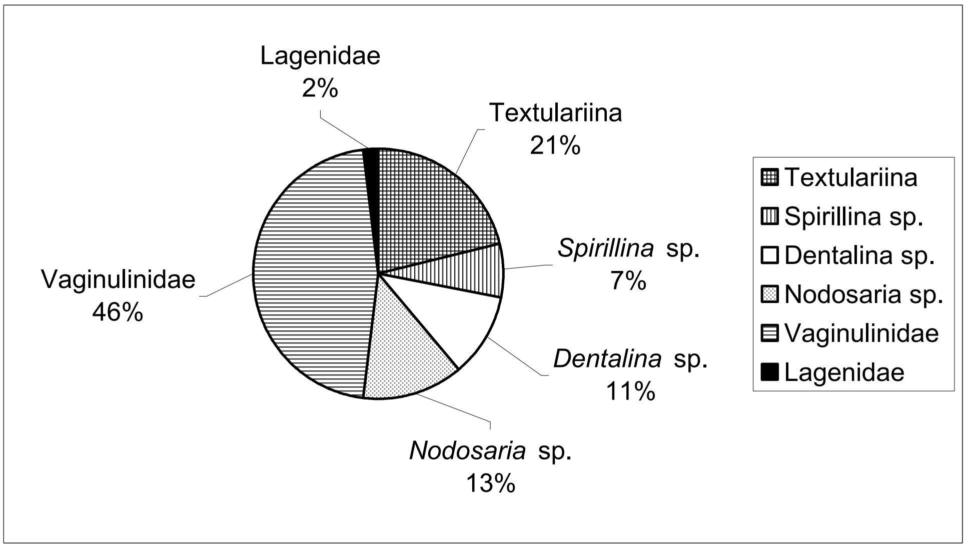

Fig. 3. Relative abundance of foraminifera taxa in sample B5.

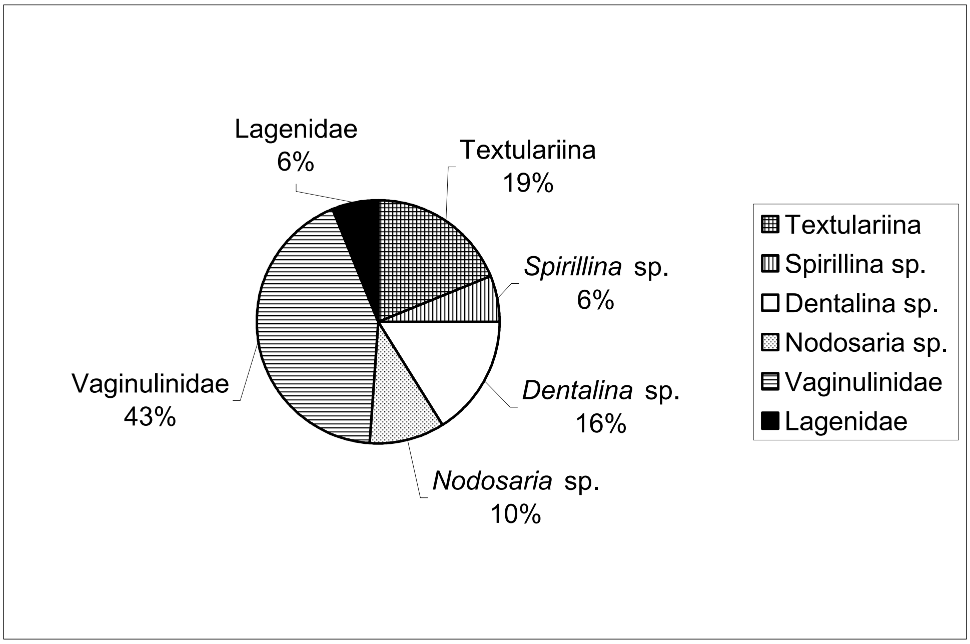

Fig. 3. Relative abundance of foraminifera taxa in sample B8.

Twenty five taxa of benthic foraminifera were identified. They belong to suborder Textulariina, Involutinina, Spirillinina and Lagenina and they are distributed in 12 families following the classification of LOEBLICH and TAPPAN (1988). The only one planktonic genus *Favusella* belongs to suborder Globigerinina. Suborder Lagenina is well represented (70-75 %) with the constant presence and abundance of Nodosariidae and Vaginulinidae. Suborder Textulariina is slightly less significant (18-24 %).

Suborder Textulariina is represented by 8 genera and 10 species and about 20 % of the specimens belong to these forms. *Ammodiscus tenuissimus* REUSS, *Glomospira gordialis* (JONES and PARKER) and *G. charoides* (JONES and PARKER) are the most dominant specimens of this group. In suborder Spirillinina only one genus with one species were identified but *Spirillina minima* SCHACKO gives about 6-7 % of the total fauna.

Suborder Lagenina is the most diversified group of the assemblages, composed of 7 genera and 13 species. The specimens of family Nodosariidae are mostly fragmentary; only few of them were completely preserved. Genus *Dentalina* and *Nodosaria* are represented in a closely equal proportion they compose about 10-15% of Suborder Lagenina.

In each samples the genus *Lenticulina* is the most abundant but in the upper part of the succession there are two major groups of them. In the samples of Lábatlan Sandstone the small and large sized lenticulinids appeared all together. Especially abundant species is *Lenticulina muensteri* (ROEMER) which represents more than 70 % of *Lenticulina* in Bersek Marl and nearly 60 % in Lábatlan Sandstone.

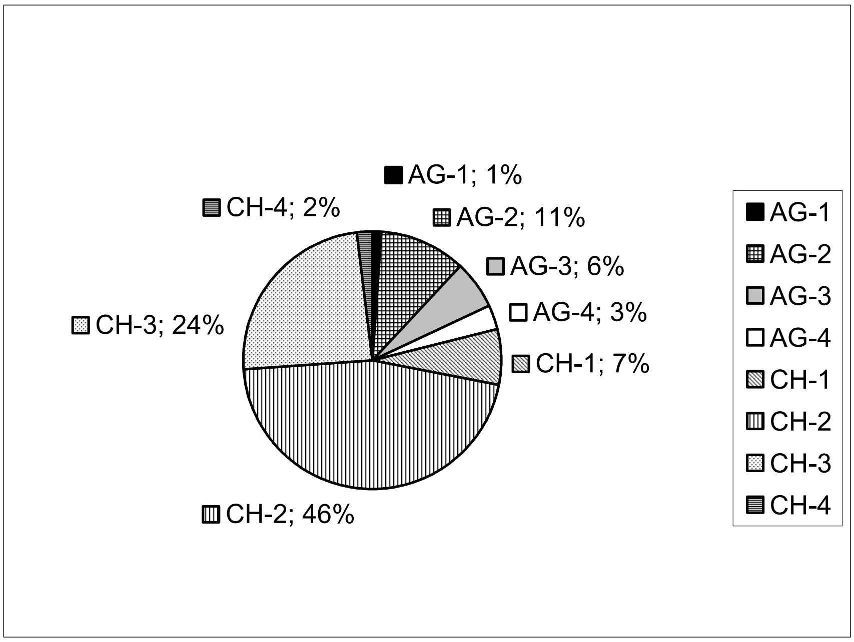

Fig. 4. Relative abundance of morphogroups in sample B5. (For legend seeTab. 1).

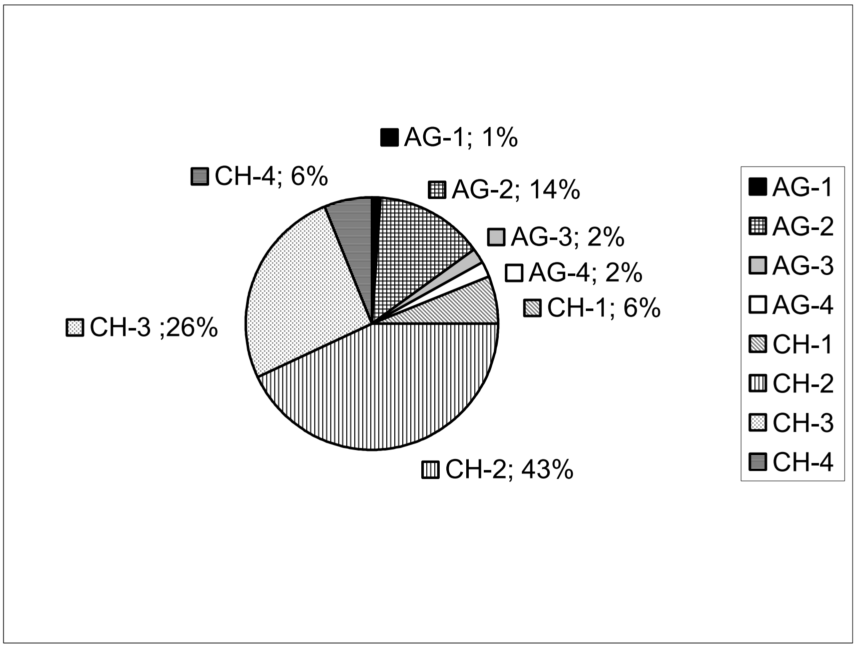

Fig. 4. Relative abundance of morphogroups in sample B8. (For legend seeTab. 1).

The foraminiferal assemblages of Lábatlan Sandstone and Bersek Marl are very similar. There is no significant difference between the distribution pattern of benthic foraminifera in these formations. The most characteristic difference is in preservation. All foraminifers from Lábatlan Sandstone were poorly preserved and partly crushed. The number of specimens were much more fewer than Bersek Marl but the composition of the assemblages were similar to that.

Results

The evaluation of the foraminifera fauna in conjunction with the results of the ammonite data suggest that the Early Cretaceous Bersek Marl and Lábatlan Sandstone Formations were deposited in outer shelf – upper slope environment.

Majority of the species have wide palaeogeographical and stratigraphical distribution. For this reason the stratigraphical subdivision is based on ammonites indicating Valanginian – Barremian age. Foraminifera data confirm this.

Benthic foraminifera represent an important tool for interpreting fossil marine environments. SLITER and BAKER (1972) proposed a palaeobathymetric model for benthic foraminifera and they described the composition of the foraminifera fauna in shelf and slope environments. In 1985 JONES and CHARNOCK created four morphogroups with 8 submorphogoups of agglutinated foraminifera to be used for palaeoenvironmental reconstructions. Later KOUTSOUKOS and HART (1990) described the composition of foraminifera associations in Cretaceous sediments of Brazil. Recently, GROSHENY and MALATRE (2002) published their work for the reconstruction of outer shelf environment in the Turonian – Coniacian of Southeast France.

Due to poor preservation an ecological interpretation of the fauna is difficult. In this work I created the morphogroups in a similar way as described by the authors mentioned above (Table 1).

Tab.1. Foraminiferal morphogroups of the identified taxa from Bersek Hill (modified after JONES & CHARNOCK 1985; KOUTSOUKOS & HART 1990).

Morphogroup	Test form	Shape	Life position	Taxa
Agglutinated-1 (AG-1)	unilocular	tubular/branched	epifaunal/erect	*Hyperammina*
Agglutinated-2 (AG-2)	unilocular	discoidal/flattened	epifaunal	*Ammodiscus, Glomospira*
Agglutinated-3 (AG-3)	multilocular	elongated	shallow infaunal	*Dorothia, Gaudryna*
Agglutinated-4 (AG-4)	multilocular	planispiral/streptospiral	shallow infaunal	*Ammobaculites*
Calcareous-Hyaline-1 (CH-1)	bilocular	discoidal/flattened	epifaunal	*Spirillina*
Calcareous-Hyaline-2 (CH-2)	multilocular	compressed planispiral/ lenticuline shaped	epifaunal/ infaunal	Lenticulinids
Calcareous-Hyaline-3 (CH-3)	multilocular	elongate	epifaunal/shallow infaunal	*Nodosaria, Dentalina*
Calcareous-Hyaline-4 (CH-4)	bilocular/ multilocular	globular/ovate	epifaunal/ infaunal	*Lagena, Globulina*

Agglutinated foraminifera are dominated by epifaunal, shallow infaunal specimens, they give 19-21 % of the total fauna. The most abundant unilocular, discoidal agglutinated forms (*Ammodiscus*, *Glomospira*) represent morphogroup AG-2. (Fig. 4.)

Calcareous, hyaline foraminifers are very abundant. Morphogroups CH represent 77-82 % of total fauna.

All samples are dominated by calcareous foraminifera. The samples of Bersek Marl contain diverse nodosariid and lenticulinid specimens: *Nodosaria screptum screptum* REUSS, *Dentalina* spp., *Dentalina cylindroides* REUSS, *Lenticulina nodosa* (REUSS) and *L. muensteri* (ROEMER). While in the foraminifera fauna of Lábatlan Sandstone predominate lenticulinids and occur other *Lagenina* specimens. Moreover lenticulinids are represented by small-size and large-size forms together in the upper part of this section. Probably this distribution of nodosariid and lenticulinid forms reflects the sedimentological changes within the succession. KOUTSOUKOS and HART (1990) mentioned diverse coiled vaginulinids (*Astacolus*, *Lenticulina*, *Planularia*) and nodosariids (*Dentalina*, *Nodosaria*, *Pseudonodosaria*) from neritic and upper-middle bathyal biotopes which are similar to the fauna of the studied section.

Considering the results of previous studies distribution pattern of benthic foraminiferal assemblages in Bersek-hill suggest that Bersek Marl and Lábatlan Sandstone were deposited in outer shelf – upper slope environment. The results of this foraminifera investigation is inconsistent with earlier point of view because in my opinion the depositional depth of Bersek Marl was not deeper than Aragonite Compensation Depth (ACD). Estimates of sea depth between ACD and CCD came from the misunderstanding that lack of aragonite ammonite shells is a depositional feature. However, their dissolution is due to diagenetic processes, as indicated by numerous ammonite casts. The presence of aragonitic *Miliospirella* and *Favusella* foraminifers corroborates it.

Systematic descriptions

Taxa are arranged according to the systematics of the LOEBLICH & TAPPAN (1988).

Phylum Protista
Subphylum Sarcodina SCHMARDA, 1871
Classis Rhizopodea VON SIEBOLD, 1845
Subclassis Lobosia CARPENTER, 1861
Ordo Foraminiferida EICHWALD, 1830
Subordo Textulariina DELAGE & HÉROUARD, 1894
Superfamilia Lituolacea DE BLAINVILLE, 1827
Familia Schizamminidae NORVANG, 1894
Genus *Saccammina* CARPENTER, 1869
Saccammina placenta (GRZYBOWSKI, 1898)

1898 *Reophax placenta* n. sp. GRZYBOWSKI in: KAMINSKI et al. 1993 p. 249, tab. 2, fig. 5-7.

Description: Test monothalamous, rounded shape, often compressed. Wall is finely agglutinated. Aperture single, on a short neck.

Distribution: Cosmopolitan in Alpine-Carpathian region in Cretaceous – Paleocene.

Familia Hyperammininae EIMER & FICKERT, 1899
Genus *Hyperammina* BRADY, 1878
Hyperammina gaultina DAM, 1950

1974 *Hyperammina gaultina* DAM – BARTENSTEIN p. 685, tab. 1, fig. 5-30.
1995 *Hyperammina gaultina* DAM – HOLBURN & KAMINSKI p. 436, tab. 1, fig. 17-18.

Description: Test free, elongate, proloculus large and followed by undivided tubular chamber. Wall finely agglutinated.

Distribution: Hauterivian – Albian.

Familia Ammodiscidae REUSS, 1862
Genus *Ammodiscus* REUSS, 1862
Ammodiscus tenuissimus (GUEMBEL, 1862)
Pl. 1, fig.1.

1972 *Ammodiscus tenuissimus* (GUEMBEL) – NEAGU p. 191, tab. 1, fig. 20.
1974 *Ammodiscus tenuissimus* (GUEMBEL) – BARTENSTEIN p. 687, tab. 3, fig. 7-13.

Description: Test flattened, globular proloculus followed by planispirally enrolled, undivided tubular second chamber.

Distribution: Europe: Upper Jurassic – Albian.

Genus *Glomospira* RZEHAK, 1885
Glomospira gordialis (JONES & PARKER, 1860)
Pl. 1, fig.2.

1860 *Trochammina squamata* var. *gordialis* JONES and PARKER; p. 304.
1972 *Glomospira gordialis* (JONES & PARKER) – NEAGU p. 191, tab. 1, fig. 33.
1974 *Glomospira gordialis* (JONES & PARKER) – BARTENSTEIN p. 12, tab. 2, fig. 51-54.
1979 *Glomospira gordialis* (JONES & PARKER) – KAPTARENKO-CHERNOUSOVA, PLOTNIKOVA & LIPNIK p. 11, tab. 1, fig. 7.

Description: Test small variable shape; consist of irregularly coiled tubular chamber, winding about the proloculus in various planes. Wall finely agglutinated; aperture at the end of the tube; surface smooth and bright.
Distribution: Mentioned from Cretaceous to Tertiary.

Glomospira charoides (JONES & PARKER, 1860)

1860 *Trochammina squamata* var. *charoides* JONES and PARKER; p. 304.
1972 *Glomospira charoides* (JONES & PARKER) – NEAGU p. 191, tab. 2, fig. 14-15.
1974 *Glomospira charoides* (JONES & PARKER) – BARTENSTEIN p. 686, tab. 2, fig. 45-50.

Description: Test small variable shape; irregularly coiled about an axis. Wall finely agglutinated; aperture at the end of the tube; surface smooth and bright.
Distribution: Cosmopolitan in Early Cretaceous.

Familia Hormosinidae HAECKEL, 1894
Subfamilia Reophacinae CUSHMAN, 1910
Genus *Reophax* DE MONTFORT, 1808
Reophax cf. *troyeri* TAPPAN, 1960

1990 *Reophax troyeri* TAPPAN – WEIDICH p. 86, tab. 34, fig. 18.

Description: Test free, elongate, with three or four rounded chambers in arcuate series. Aperture terminal, rounded produced on a slight neck.
Distribution: Lower Cretaceous of the Alps.

Familia Lituolidae DE BLAINVILLE, 1827
Genus *Ammobaculites* CUSHMAN, 1910
Ammobaculites cf. *reophacoides* BARTENSTEIN, 1952

1967 *Ammobaculites reophacoides* BARTENSTEIN – FUCHS & STRADNER p. 266, tab. 2. fig. 5.
1972 *Ammobaculites reophacoides* BARTENSTEIN – NEAGU tab. 2, fig. 2-3.
1988 *Ammobaculites reophacoides* BARTENSTEIN – DECKER & RÖGL p. 54, tab. 1, fig. 16.

Description: Test free, elongate, early portion close coiled, later uncoiling and rectilinear. Wall coarsely agglitunated, interior simple, aperture terminal.
Distribution: Barremian from Romania, Hauterivian to Aptian in the Alps.

Ammobaculites suprajurassicus (SCHWAGER, 1865)

1966 *Ammobaculites suprajurassicus* (SCHWAGER) – DIENI & MASSARI p. 88, tab. 1,fig. 10-11.
1990 *Ammobaculites subcretaceus* CUSHMAN & ALEXANDER, 1930 – WEIDICH p. 92, tab. 2, fig. 13-16.

Description: Test free, elongate, early portion close coiled, later uncoiling and rectilinear. Wall coarsely agglitunated. Fragmentary.
Distribution: Upper Hauterivian from Romania. Liassic series from Sicily, Liassic to Cretaceous from Germany and Valanginian from Poland.

Familia Prolixoplectidae LOEBLICH & TAPPAN, 1985
Genus *Gaudryina* D'ORBIGNY, 1839
Gaudryina sp.

Description: Test free, elongate and triserial in early stage. Later becoming biserial and triangular in section.

Familia Eggerellidae CUSHMAN, 1937
Genus *Dorothia* PLUMMER, 1931
Dorothia praehauteriviana DIENI & MASSARI, 1966

1966 *Dorothia praehauteriviana* DIENI & MASSARI p. 108, tab. 2, fig. 23-24.
1972 *Dorothia praehauteriviana* DIENI & MASSARI – NEAGU p. 200. tab. 3, fig. 1-14.

Description: Test elongate, conoidal, early stage trochospirally enrolled. Four or five chambers in the first few whorls, but then reduced to biserial. Wall finely agglutinated. Aperture an interiomarginal slit in a slight reentrant of the final chamber.
Distribution: Valanginian from Italy and Valanginian to Upper Hauterivian in Europe.

Subordo Involutinina HOHENEGGER & PILLER, 1977
Familia Involutinidae BÜTSCHI, 1880
Genus *Miliospirella* GRIGYALIS, 1958
Miliospirella cretacea DIENI & MASSARI, 1966

1966 *Miliospirella cretacea* DIENI & MASSARI p. 169. tab. 8. fig. 1-3.

Description: Ovate test, proloculus followed by tubular undivided enrolled second chamber coiling of the tubular chamber in three planes. Wall aragonitic, hyaline, coarsely perforate.
Distribution: Valanginian sediments in Italy.

Subordo Spirillinina HOHENEGGER & PILLER, 1975
Familia Spirillinidae REUSS & FRITSCH, 1861
Genus *Spirillina* EHRENBERG, 1843
Spirillina minima SCHACKO, 1892
Pl. 1, fig.3.

1974 *Spirillina minima* SCHACKO – KOUZNETSOVA p. 680. tab. 2. fig. 18-19.
1990 *Spirillina minima* SCHACKO – WEIDICH p. 142, tab. 44, fig. 28.

Description: Planispirally coiled, discoidal perforated test with tubular second chamber; flat; proloculus small and globular. Aperture single and terminal.
Distribution: Widely recorded from Early Cretaceous sediments.

Subordo Rotaliina DELAGE & HÉROUARD, 1879
Superfamilia Nodosariacea EHRENBERG, 1838
Familia Nodosariidae EHRENBERG, 1838
Subfamilia Nodosariinae EHRENBERG, 1838
Genus *Dentalina* D'ORBIGNY, 1839
Dentalina sp.

Description: Test elongate, uniserial, arcuate. Chambers oval, slightly asymmetrical, spherical in cross section. Fragmentary.

Dentalina cylindroides REUSS, 1860
Pl. 1, fig.4.

1957 *Dentalina cylindroides* REUSS – BARTENSTEIN, BETTENSTÄDT & BOLLI p. 153, tab. 3, fig. 200-202.
1972 *Dentalina cylindroides* REUSS – NEAGU tab. 6. fig. 5-9.

Description: Test elongate, uniserial, chambers ovate and sutures horizontal. Wall is calcareous hyaline. Aperture terminal, radiate.

Distribution: Hauterivian to early Aptian.

Genus *Nodosari*a LAMARCK 1812
Nodosaria screptum REUSS, 1863
Pl. 1, fig.5.

1974 *Nodosaria screptum screptum* REUSS – KOUZNETSOVA p. 680, tab. 2. fig. 10.

1979 *Nodosaria screptum* REUSS – KAPTARENKO-CHERNOUSOVA, PLOTNIKOVA & LIPNIK p. 257, tab. 5. fig. 17.

Description: Test elongate, consist of 4-5 chambers, multilocular, ovate proloculus followed by uniserial globular chambers. Surface ornamented with 10 ribs. Aperture terminal.

Distribution: Upper Jurassic to Lower Cretaceous.

Genus *Pseudonodosaria* BOOMGART, 1949
Pseudonodosaria humilis (ROEMER, 1841)
Pl. 1, fig. 6.

1994 *Pseudonodosaria humilis* (ROEMER) – MEYN & VESPERMANN p. 223, tab. 11, fig. 1-15.

1995 *Pseudonodosaria humilis* (ROEMER) – GÖRÖG p. 75, tab. 6, fig. 5.

Description: Elongate, uniserial, ovate test with overlapping chambers increasing rapidly in size in the juvenile stage. Last chamber inflated much larger than previous ones. Aperture radiate and terminal.

Distribution: Cosmopolitan in Early Cretaceous.

Familia Vaginulinidae REUSS, 1860
Subfamilia Lenticulininae CUSHMAN, PARR & COLLINS, 1934
Genus *Lenticulina* LAMARCK, 1804
Lenticulina nodosa (REUSS, 1863)
Pl. 1, fig. 7.

1966 *Lenticulina nodosa* (REUSS) – DIENI & MASSARI p. 118, tab. 3, fig. 14-15.

1971 *Lenticulina nodosa* (REUSS) – FUCHS p. 49, tab. 5, fig. 9.

1974 Lenticulina nodosa (REUSS) – BARTENSTEIN, p. 540, pl. 1, fig. 3-17.

Description: Small, involute test with 6-10 chambers in last whorl separated by thick sutures. Typically with polygonal perifery. Aperture radiate and peripheral angle.

Distribution: Late Jurassic to Aptian in Tethys region.

Lenticulina muensteri (ROEMER, 1839)
Pl. 1, fig. 8.

1994 *Lenticulina muensteri* (ROEMER) – MEYN & VESPERMANN p. 223, tab. 24, fig.1-17.

Description: Smooth involute, lenticuline shaped test with numerous (8-11) chambers in the last whorl. Flush, markedly curved sutured coalesce into a large, dark, slightly projecting umbonal disc. Sharp periphery, radiate aperture at peripheral angle.

Distribution: Cosmopolitan species in the Jurassic-Cretaceous sediments.

Lenticulina dunkeri (REUSS, 1863)

1994 *Lenticulina dunkeri* (REUSS) – MEYN & VESPERMANN p. 137, tab. 26, fig. 1-6.

Description: Planispirally coiled, involute lenticuline shaped test with radiate, terminal aperture. Sutures are broad and linear.

Distribution: Valanginian to Hauterivian.

Lenticulina heiermanni BETTENSTÄDT, 1952
Pl. 1, fig. 9.

1952 *Lenticulina heiermanni* BETTENSTÄDT p. 270, tab. 1, fig. 9-11.
1990 *Lenticulina heiermanni* BETTENSTÄDT – WEIDICH p. 123, tab.20, fig. 15-16.

Description: Thick involute test with 10 or more chambers in the last whorl. Sutures are curved, strongly raised and form a thick irregular umbilical callus. Radiate aperture of the peripheral angle.

Distribution: Mentioned from the Hauterivian-Barremian sediments of the Tethyan region.

Subfamilia Marginulininae WEDEKIND, 1937
Genus *Astacolus* DE MONTFORT, 1808
Astacolus calliopsis (REUSS, 1863)

1951 *Lenticulina (Astacolus) calliopsis* (REUSS) – BARTENSTEIN & BRAND p. 286, tab. 5. fig. 122.
1994 *Lenticulina (Astacolus) calliopsis* (REUSS) – MEYN & VESPERMANN p. 223, tab. 40. fig. 15-16.

Description: Elongate, gently curved test with ventrally inflated chambers, separated by slightly depressed, inclined sutures. Aperture radiate and terminal.

Distribution: Cosmopolitan in the Early Cretaceous.

Subfamilia Vaginulininae REUSS, 1860
Genus *Planularia* DEFRANCE, 1826
Planularia crepidularis tricarinella (REUSS, 1863)
Pl. 1, fig. 10.

1972 *Planularia crepidularis tricarinella* (REUSS) – NEAGU p. 212, tab. 4, fig. 49.
1994 *Planularia tricarinella* (REUSS) – MEYN & VESPERMANN p. 223, tab. 55, fig. 1-5.

Description: Flattened, „fan-shaped" test with low chambers separated by curved, limbate sutures. Aperture radiate and terminal.

Distribution: Cosmopolitan in the Early Cretaceous.

Planularia complanata (REUSS, 1845)

1990 *Planularia complanata* (REUSS) – WEIDICH p. 130, tab. 40, fig. 13-14.

Description: Flattened, fan-shaped test with low chambers separated by slightly depressed, inclined sutures. Radiate, terminal aperture.

Distribution: Cosmopolitan in Early Cretaceous sediments.

Familia Lagenidae REUSS, 1862
Genus *Lagena* WALKER & JAKOB, 1798

1951 *Lagena hauteriviana hauteriviana* BARTENSTEIN & BRAND, Pl. 1, fig. 11.
1990 *Lagena hauteriviana hauteriviana* BARTENSTEIN & BRAND – WEIDICH p. 119, tab. 40. fig. 30. tab. 45. fig. 10.

Description: Test globular, unilocular. Wall calcareous hyaline. Aperture rounded, at the end of a short neck.
Distribution: Berriasian to lower Barremian.

Lagena hauteriviana cylindracea BARTENSTEIN & BRAND, 1951

1990 *Lagena hauteriviana cylindracea* BARTENSTEIN & BRAND – WEIDICH p. 122, tab. 45, fig. 11-12.

Description: Test ovate, unilocular. Wall calcareous, hyaline. Aperture rounded, at the end of a long neck.
Distribution: Hauterivian to Upper Cretaceous.

Familia Polymorphinidae D'ORBIGNY, 1839
Subfamilia Polymorphininae D'ORBIGNY, 1839
Genus *Globulina* D'ORBIGNY, 1839
Globulina lacrima (REUSS, 1845)

1990 *Globulina lacrima* (REUSS) – WEIDICH p. 137, tab. 45, fig. 21-22.

Description: Ovate test with rounded base and slightly tapering apertural end. The aperture is large and radial.
Distribution: Germany: Lower Cretaceous; Alps: Hauterivian - Albian

Subordo Globigerinina DELAGE & HÉROUARD 1986
Superfamilia Favusellacea LONGORIA 1974
Familia Favusellidae LONGORIA 1974
Genus *Favusella* MICHAEL 1973
Favusella stiftia Rösler, LUTZE & PFLAUMANN 1979

1979 *Favusella stiftia* RÖSLER, LUTZE & PFLAUMANN p. 276, tab. 1, fig. 2-4.
1997 *Favusella stiftia* RÖSLER, LUTZE & PFLAUMANN – BOUDAGHER-FADEL, BANNER & WHITTAKER p. 269, tab. 3, fig. 1-3.

Description: There are four chambers in the last whorl, the last one being reduced in size. The reticulation ridges are much more regular than in *F. hoterivica*. The aperture is intraumbilical covered by a bulla.
Distribution: Hauterivian - Barremian

Favusella hoterivica (SUBBOTINA 1953)

1979 *Hedbergella hoterivica* (SUBBOTINA) – BUTT p. 269, tab. 3, fig. 1-5.
1995 *Favusella hoterivica* (SUBBOTINA) – WERNLI, ASCOLI & WILLIAMS p. 379-398, tab. 2, fig. 1-16, tab. 3, fig. 1-15.

Description: Test is small with four chambers in the final whorl. The surface is finely reticulate. The aperture is intraumbilical.
Distribution: Berriasian - Hauterivian

Conclusions

This study is based on seventeen fossiliferous samples collected from the Valanginian – Barremian succession of Bersek Hill, Gerecse Mts, Hungary. After the quantitative and qualitative evaluation of foraminiferal data it is possible to put forward the following conclusions:

(1) Benthic foraminiferal assemblages from Bersek Hill indicate an outer shelf – upper slope depositional environment, it seems that Bersek Marl is formed above ACD.
(2) Similarity of foraminiferal assemblages suggests no significant difference between the depositional place of marl and sandstone. Perhaps only the intensity of the paleocurrents changed in time as FOGARASI (1995) suggested in his sedimentological work.
(3) The results of the foraminiferal studies confirm the results of previous ammonite and nannoflora (FŐZY & FOGARASI 2002) stratigraphical works that the age of this succession is Valanginian to Barremian.

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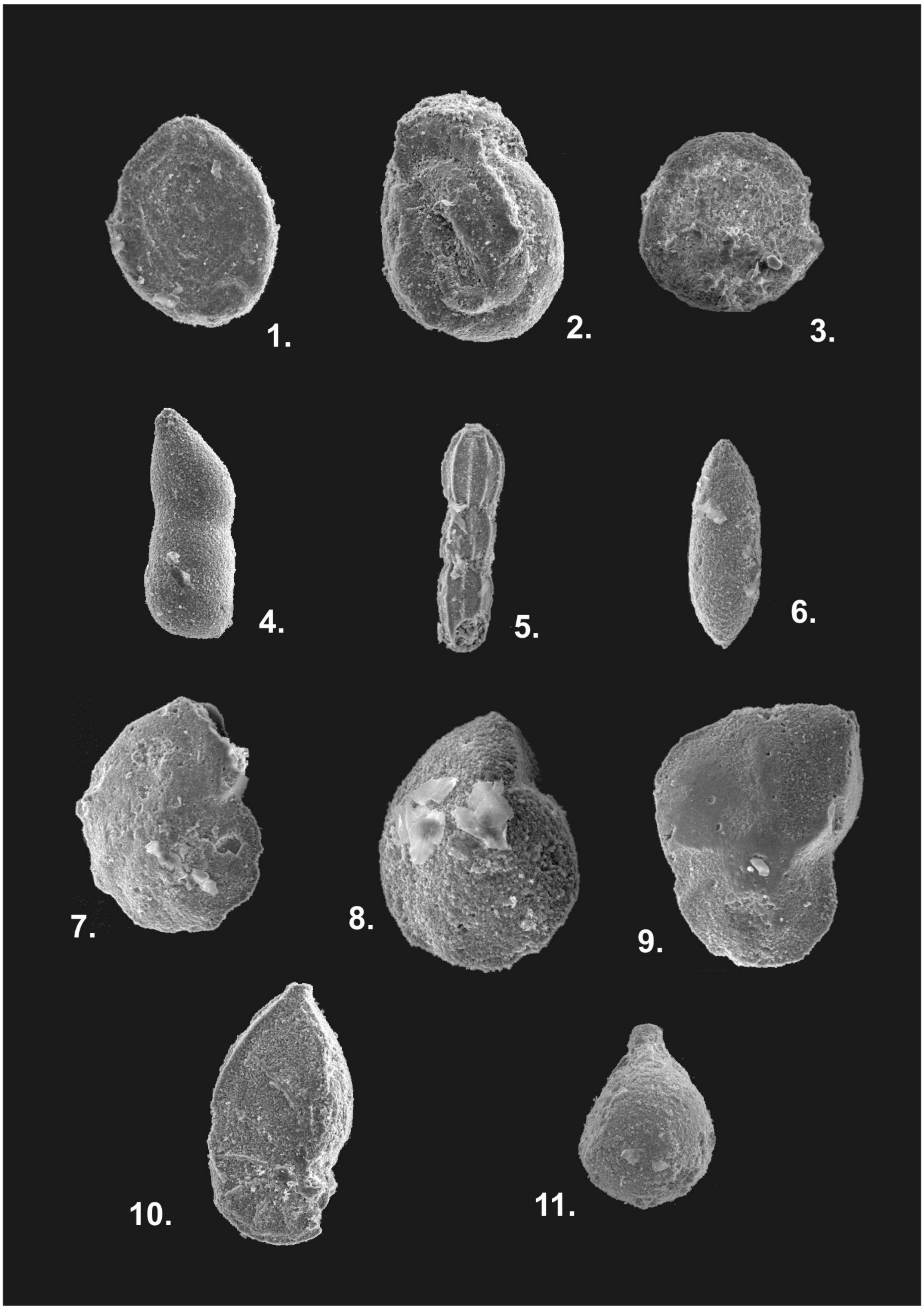

Plate 1. **1.** *Ammodiscus tenuissimus* (GUEMBEL) x 90, **2.** *Glomospira gordialis* (JONES & PARKER) x 110, **3.** *Spirillina minima* SCHACKO x 120, **4.** *Dentalina cylindroides* REUSS x 135, **5.** *Nodosaria screptum* REUSS x 115, **6.** *Pseudonodosaria humilis* (ROEMER) x 110, **7.** *Lenticulina nodosa* (REUSS) x 100, **8.** *Lenticulina muensteri* (ROEMER) x 130**, 9.** *Lenticulina heiermanni* BETTENSTÄDT x 100, 1**0**. *Planularia crepidularis* (ROEMER) x 130, **11.** *Lagena hauteriviana hauteriviana* BARTENSTEIN & BRAND x 100