

MIDDLE CALLOVIAN TO VALANGINIAN MICROFOSSIL BIOSTRATIGRAPHY IN THE WEST BALKAN MOUNTAIN, BULGARIA (SE EUROPE)

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Abstract. This study is a part of special micropalaeontological investigation, aiming at detailed biostratigraphy of sections across the uppermost part of Middle Jurassic (Middle Callovian) to Lower Cretaceous (Valanginian) interval in the carbonate successions in the West Balkan Mountain, Bulgaria. The paper presents the biostratigraphic data on the foraminiferal and calcareous dinoflagellate cyst occurrence in the Slivnitsa Formation and the base of Salash Formation at the area of Dragoman. Biostratigraphic data are herein presented on two microfossil groups: benthic foraminifers and calcareous dinoflagellate cysts. The analysis of the benthic foraminifer and calcareous dinocyst occurrence within the Middle Callovian - Valanginian interval resulted in recognition of six successive foraminiferal interval biozones: *Globuligerina oxfordiana*, *Protopenneroplis striata*, *Pseudocyclammina lituus*, *Haplophragmoides joukowskyi*, *Montsalevia salevensis* and *Meandrospira favrei*. The recognized foraminiferal biozones define regional interval biozones. It is necessary to undertake additional investigation on other section, representing facially different sediments, for a more precise definition and further confirmation of the proposed foraminiferal biozonation.

Keywords: benthic foraminifers, biozones, Middle Jurassic, Lower Cretaceous, West Balkan Mountain, Bulgaria, SE Europe

INTRODUCTION

The present study is a part of special micropalaeontological investigation, aiming at detailed biostratigraphy of sections across the uppermost part of Middle Jurassic (Middle Callovian) to Lower Cretaceous (Valanginian) interval in the carbonate successions in the West Balkan Mountain, Bulgaria. The paper presents the biostratigraphic data on the foraminiferal and calcareous dinoflagellate cyst occurrence in the Slivnitsa Formation and the base of Salash Formation at the area of Dragoman.

The Slivnitsa Formation is built up by thick-bedded to massive light grey to whitish organogenic and less common micritic limestones. According to the previous authors in the studied area, it ranges in age from Middle Callovian to Early Hauterivian.

The Salash Formation represents an alternation of thin-bedded micritic limestones, clayey limestones and marls. It covers a time span from Berriasian (locally latest Tithonian) to Barremian.

There have been sampled and studied three sections, situated north-west of Sofia. These are the sections at Chavchi Kamak (Tri Ushi Hill), Dragoman and Berende Izvor (Kalotina) (Fig. 1). The most important for this study is Berende Izvor (Kalotina) section. The section is situated at 1-2 km north-east of Berende Izvor hamlet of Kalotina village near the Bulgarian-Yugoslavian state border. A 499.00 m thick succession is studied, some 480.00 m of them being from Slivnitsa Formation (samples NN Be-74 to Be-146) and 19.00 m from the lower portion of Salash Formation (samples NN Be-147 to Be-156).

RESULTS

Biostratigraphic data are herein presented on two microfossil groups: benthic foraminifers and calcareous dinoflagellate cysts. The taxonomic identification of the fossils has been done following Charollais et al., 1966; Canerot & Moullade, 1974 and Zaninetti et al., 1987.

The stratigraphic distribution of the taxa has been presented after Salvini-Bonnard et al., 1984; Arnaud-Vanneau et al., 1988; Bucur, 1988; Bucur, 1993; Bucur et al., 1995; Altiner, 1991 and Chiocchini et al., 1994. The analysis of the benthic foraminifer and calcareous dinocyst occurrence within the Middle Callovian - Valanginian interval resulted in recognition of six successive foraminiferal biozones. The calibration of the biozones has been accomplished with associated calcipionellids and calcareous nannofossils (in the upper part of the section). The biozones are named as follows:

Globuligerina oxfordiana Interval Biozone

Nomenclature. Altiner (1991) introduced the biozone as an interval zone. It is described in Bulgaria for the first time.

Definition and boundaries. The lower boundary is marked by the appearance of the index species *Globuligerina oxfordiana* (Grigelis, 1958) and the upper - by the appearance of *Protopenneroplis striata* Weynschenk, 1950.

Zonal association. Other foraminiferal species occurring in the interval: *Ophthalmidium strumosum* (Guembel, 1862); *Ophthalmidium* sp.; *Nubecularia* sp., the first representatives of calcareous dinocyst and *Globochaete alpina* Lombard, 1945.

Chronostratigraphic position. Middle Callovian - Oxfordian (without the uppermost part).

Distribution. The biozone is established in Berende Izvor (Kalotina) section, where it comprises the lowermost part (9.00 m) of the limestones of the Slivnitsa Formation.

Correlation. The biozone correlates to the Zone I (*Globuligerina* gr. *oxfordiana* Zone) introduced as an interval zone in the North - Western Anatolia, Turkey (Altiner, 1991).

Protopenneroplis striata Interval Biozone

Nomenclature. The biozone is introduced herewith for the first time.

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Definition and boundaries. The lower boundary is marked by the appearance of the index species *Protopenneroplis striata* Weynschenk, 1950 and the upper - by the appearance of *Pseudocyclammina lituus* (Yokoyama, 1890).

Zonal association. The association is characterised by the almost simultaneous first occurrence of *Protopenneroplis striata* Weynschenk, 1950 and *Tubiphytes morronensis* Crescenti, 1970. The association contains a diversified microfauna including several foraminifers: *Labyrinthina mirabilis* Weynschenk, 1951; *Pseudocyclammina lituus* (Yokoyama, 1890); *Mesoendothyra izjumiana* Dain, 1958; *Ophthalmidium* sp.; *Verneuilina* sp., single calcareous dinocyst species and the pelagic crinoid genus *Saccocoma* Agassiz.

Chronostratigraphic position. Oxfordian (uppermost part) - Kimmeridgian (without the upper part).

Distribution. The biozone is indicated in Berende Izvor (Kalotina) section, where it comprises the interval from 9.00 m to 160.00 m of the Slivnitsa Formation.

Correlation. The biozone correlates to the lower part of the Zone II (*Tubiphytes morronensis* Zone) introduced as an interval zone in the North - Western Anatolia, Turkey (Altiner, 1991).

Pseudocyclammina lituus Interval Biozone

Nomenclature. The biozone is introduced herewith for the first time.

Definition and boundaries. The lower boundary is marked by the appearance of the index species *Pseudocyclammina lituus* (Yokoyama, 1890) and the upper - by the appearance of *Haplofragmoides joukowskyi* Charollais, Broennimann & Zaninetti, 1966.

Zonal association. The biozone is characterised by the almost simultaneous first occurrence of *Pseudocyclammina lituus* (Yokoyama, 1890) and the representatives of genus *Trocholina* Paalzow, 1922: *Trocholina alpina* (Leupold, 1935), *T. elongata* (Leupold, 1935); *T. odukpaniensis* (Dessauvagine, 1968), *T. delphinensis* Arnaud-Vanneau, Boisseau & Darsac, 1988. Other species appear within in the interval: *Neotrocholina* sp., *Protopenneroplis ultragranulata* (Gorbachik, 1971); *Hechtina praeantiqua* Bartenstein & Brand, 1949; *Ammobaculites* sp.; *Belorussiella* sp.; *Arenobulimina* sp. and single calcareous dinocyst.

Chronostratigraphic position. Kimmeridgian (upper part) - Berriasian (lower part).

Distribution. The biozone is indicated in Berende Izvor (Kalotina) section, where it comprises the interval from 160.00 m to 287.00 m of the Slivnitsa Formation.

Correlation. This biozone corresponds to the upper part of the Zone II (*Tubiphytes morronensis* Zone) and the lower part of Zone III (*Protopenneroplis ultragranulata* Zone) introduced as an interval zones in the North - Western Anatolia, Turkey (Altiner, 1991).

Haplofragmoides joukowskyi Interval Biozone

Nomenclature. Altiner (1991) introduced the biozone as an interval subzone. It is described as an interval biozone for the first time.

Definition and boundaries. The lower boundary is marked by the appearance of the index species *Haplofragmoides joukowskyi* Charollais, Broennimann & Zaninetti, 1966 and the upper - by the appearance of *Montsalevia salevensis* (Charollais, Broennimann & Zaninetti, 1966).

Zonal association. Several foraminiferal species

have been recorded from this interval: *Charentia cuvillieri* Neumann, 1965; *Nautiloculina bronnimanni* Arnaud-Vanneau & Peybernes, 1978, *Rumanoloculina robusta* (Neagu, 1968), *Trocholina campanella* Arnaud-Vanneau, Boisseau & Darsac, 1988, *T. cherchiaea* Arnaud-Vanneau, Boisseau & Darsac, 1988, *A. sagittaria* Arnaud-Vanneau, Boisseau & Darsac, 1988, *Glomospira* sp. and single calcareous dinocyst.

Chronostratigraphic position. Berriasian (without lower part).

Distribution. The biozone is found in Berende Izvor (Kalotina) section, where it comprises the interval from the 287.00 m to the 347.00 m of the Slivnitsa Formation.

Correlation. The zone is equal to the Subzone III A (*Haplofragmoides joukowskyi* Subzone) introduced as an interval subzone in the North - Western Anatolia, Turkey (Altiner, 1991).

Montsalevia salevensis Interval Biozone

Nomenclature. Altiner (1991) introduced the biozone as an interval zone. It is described in Bulgaria for the first time.

Definition and boundaries. The lower boundary is defined by the first occurrence of the index species *Montsalevia salevensis* (Charollais, Broennimann & Zaninetti, 1966) and the upper - by the appearance of *Meandrospira favrei* (Charollais, Broennimann & Zaninetti, 1966).

Zonal association. Other foraminiferal species occurring in this association are: *Valdanchella milliani* Schroeder, 1968, *Paracoskinolina pfenderae* Canerot & Moullade, 1971, *Everticyclammina cylindrica* Redmond, 1964, *Pseudocyclammina sphaeroidalis* Hottinger, 1967, *Novalesia* sp., *Vercorsella* sp., *Bolivinopsis* sp. The other organisms include calcareous dinocyst species *Cadosina fusca fusca* Wanner, 1940 and *Cadosina fusca cieszynica* Nowak, 1966.

Chronostratigraphic position. Valanginian (without the upper part).

Distribution. The biozone is indicated in Chavchi Kamak, Dragoman and Berende Izvor (Kalotina) sections. In Berende Izvor (Kalotina) section it comprises the interval from 347.00 m to 467.00 m of the Slivnitsa Formation.

Correlation. The biozone corresponds exactly to the Zone IV (*Montsalevia salevensis* Zone) introduced as an interval zone in the North - Western Anatolia, Turkey (Altiner, 1991).

Meandrospira favrei Interval Biozone

Nomenclature. Altiner (1991) introduced the biozone as an interval zone. It is described in Bulgaria for the first time.

Definition and boundaries. The lower boundary is delimited from the first occurrence of the index species *Meandrospira favrei* (Charollais, Broennimann & Zaninetti, 1966) and the upper - is not studied.

Zonal association. The biozone contains a diversified microfauna including several foraminifers and calcareous dinocysts: *Patellina turriculata* Dieni & Massari, 1966, *Gaudryina* sp., *Meandrospiranella* sp., *Stomiosphaera echinata* Nowak, 1968, *Colomisphaera heliosphaera* (Vogler, 1941), *Cadosina fusca cieszynica* Nowak, 1966, *Cadosina semiradiata semiradiata* Wanner, 1940, *Cadosina semiradiata olzae* Nowak, 1966, *Cadosinopsis nowaki* Borza, 1986.

Chronostratigraphic position. Valanginian (upper part) - Lower Hauterivian.

Distribution. The biozone is indicated in Chavchi Kamak, Dragoman and Berende Izvor (Kalotina) sections. In Berende Izvor (Kalotina) section it comprises the highest part (13.00 m) of Slivnitsa Formation and the lower portion (19.00 m) of Salash Formation.

Correlation. The biozone corresponds exactly to the Zone V (*Meandrospira favrei* Zone) introduced as an interval zone in the North - Western Anatolia, Turkey (Altiner, 1991).

The first occurrence of calcareous dinocyst *C. nowaki* (recorded by Borza, 1984) in the Hauterivian (but without mentioning its total range) in sample N Be-147 at the very base of Salash Formation in Kalotina section, suggests that the deposition of Salash Formation started within the earliest Hauterivian, or, possibly at the end of Valanginian. The first occurrence of the calcareous nannofossil taxa *Eprolithus septentrionalis*

and *E. floralis* at sample N Be-155 evidences an Early Hauterivian age (Stoykova in Ivanova et al., 2000).

The recognized foraminiferal biozones define regional interval biozones. It is necessary to undertake additional investigation on other section, representing facially different sediments, for a more precise definition and further confirmation of the proposed foraminiferal biozonation.

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PLATES

Plate I

- Fig. 1. *Ophthalmidium strumosum* (Guembel, 1862); Berende Izvor (Kalotina) section, Slivnitsa Formation, sample N 75; *Globuligerina oxfordiana* Interval biozone
- Fig. 2. *Globuligerina oxfordiana* (Grigelis, 1958); Berende Izvor (Kalotina) section, Slivnitsa Formation, sample N 74; *Globuligerina oxfordiana* Interval biozone
- Fig. 3. *Protopeneroplis striata* Weynschenk, 1950; Berende Izvor (Kalotina) section, Slivnitsa Formation, sample N 90; *Protopeneroplis striata* Interval biozone
- Fig. 4. *Mesoendothyra izjumiana* Dain, 1958; Berende Izvor (Kalotina) section, Slivnitsa Formation, sample N 81; *Protopeneroplis striata* Interval biozone
- Fig. 5. *Labyrinthina mirabilis* Weynschenk, 1951; Berende Izvor (Kalotina) section, Slivnitsa Formation, sample N 82; *Protopeneroplis striata* Interval biozone
- Fig. 6. *Pseudocyclammia lituus* (Yokoyama, 1890); Berende Izvor (Kalotina) section, Slivnitsa Formation, sample N 93; *Pseudocyclammia lituus* Interval biozone
- Fig. 7, 8. *Haplophragmoides joukowskyi* Charollais, Broennimann & Zaninetti, 1966; Berende Izvor (Kalotina) section, Slivnitsa Formation, samples NN 120, 140; *Haplophragmoides joukowskyi* and *Montsalevia salevensis* Interval biozones
- Fig. 9, 10. *Meandrospira favrei* (Charollais, Broennimann & Zaninetti, 1966); Berende Izvor (Kalotina) section, Salash Formation, samples N 147, 148; *Meandrospira favrei* Interval biozone
- Fig. 11, 12. *Montsalevia salevensis* (Charollais, Broennimann & Zaninetti, 1966); Berende Izvor (Kalotina) section, Slivnitsa Formation, sample N 136, 140; *Montsalevia salevensis* Interval biozone
- Fig. 13. *Patellina turriculata* Dieni & Massari, 1966; Berende Izvor (Kalotina) section; Salash Formation, sample N 147; *Meandrospira favrei* Interval biozone
- Fig. 14. *Hechtina praeantiqua* Bartenstein & Brand, 1949; Berende Izvor (Kalotina) section, Slivnitsa Formation, sample N 123; *Montsalevia salevensis* Interval biozone
- Figs. 1 – 3, 7 – 14 x 100; Figs. 4 – 6 x 50

Plate II

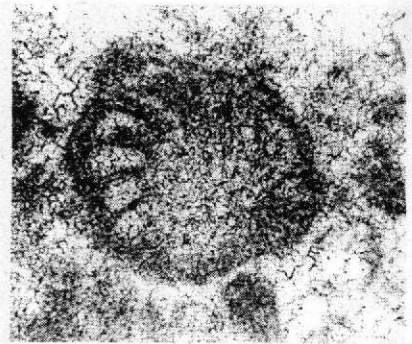
- Fig. 1, 2. *Trocholina campanella* Arnaud-Vanneau, Boisseau & Darsac, 1988; Berende Izvor (Kalotina) section, Slivnitsa Formation, samples NN 113, 118; *Haplophragmoides joukowskyi* Interval biozone
- Fig. 3, 4. *Trocholina alpina* (Leupold, 1935); Berende Izvor (Kalotina) section, Slivnitsa Formation, samples NN 103, 119; *Pseudocyclammia lituus* and *Haplophragmoides joukowskyi* Interval biozones
- Fig. 5. *Trocholina sagittaria* Arnaud-Vanneau, Boisseau & Darsac, 1988; Berende Izvor (Kalotina) section, Slivnitsa Formation, sample N 130; *Montsalevia salevensis* Interval biozone
- Fig. 6. *Trocholina cherchiaei* Arnaud-Vanneau, Boisseau & Darsac, 1988; Berende Izvor (Kalotina) section, Slivnitsa Formation, sample N 139; *Montsalevia salevensis* Interval biozone
- Fig. 7. *Trocholina delphinensis* Arnaud-Vanneau, Boisseau & Darsac, 1988; Berende Izvor (Kalotina) section, Slivnitsa Formation, sample N 112; *Haplophragmoides joukowskyi* Interval biozone
- Fig. 8. *Trocholina odukpaniensis* Dessauvagie, 1968; Berende Izvor (Kalotina) section, Slivnitsa Formation, sample N 121; *Haplophragmoides joukowskyi* Interval biozone
- Fig. 9, 10. *Rumanoloculina robusta* (Neagu, 1968); Berende Izvor (Kalotina) section, Slivnitsa Formation, sample N 122, 128; *Haplophragmoides joukowskyi* and *Montsalevia salevensis* Interval biozones
- Fig. 11. *Charentia cuvillieri* Neumann, 1965; Berende Izvor (Kalotina) section, Slivnitsa Formation, sample N 137; *Montsalevia salevensis* Interval biozone
- Figs. 1, 3, 5 – 7, 11 x 50; Figs. 2, 4, 8 – 10 x 100



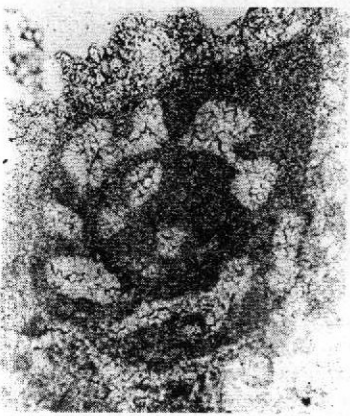
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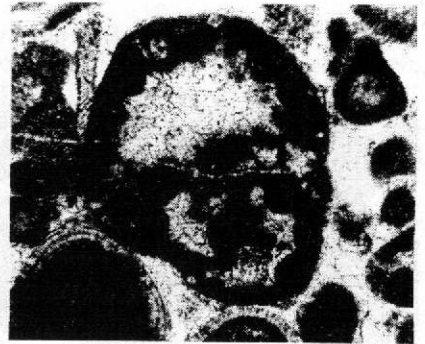
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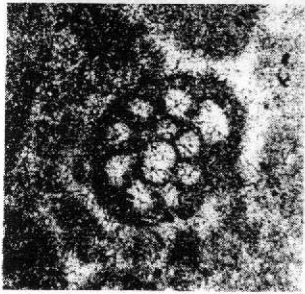
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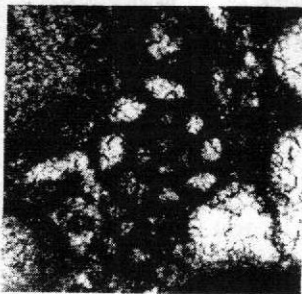
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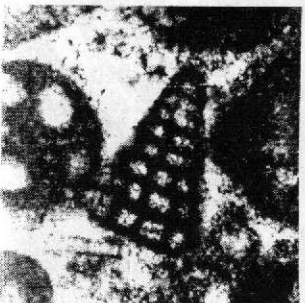
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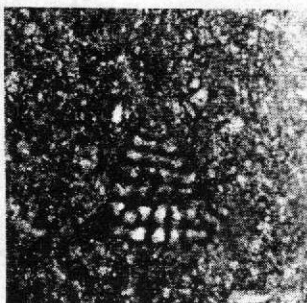
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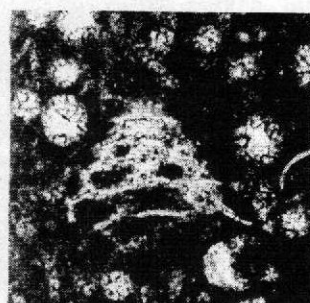
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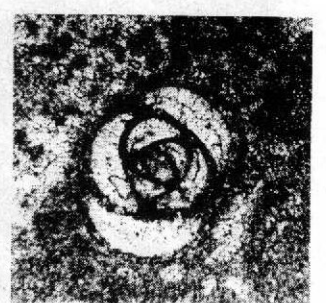
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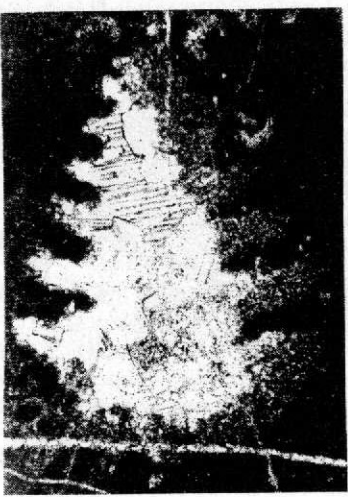
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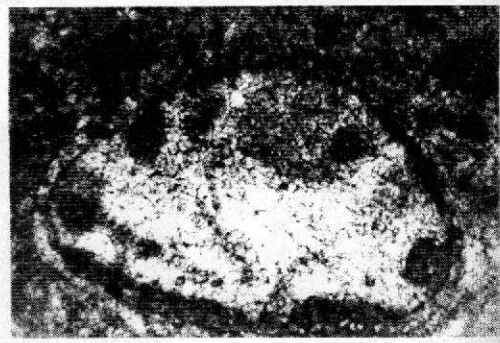
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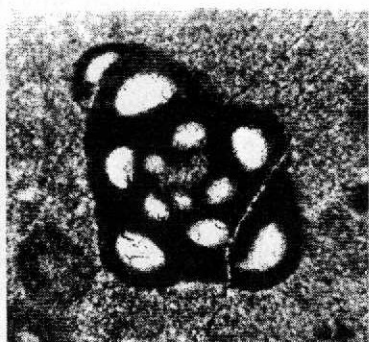
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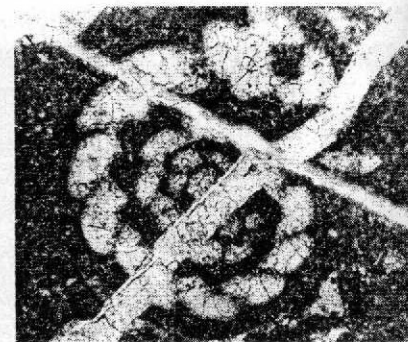
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