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 dinoflagellates 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, Protoperoperlops striata, Pseudcocystina vitreoides, Haplophragmoides jokowskyi, Montasalevia salevensis and Meandrospira favrei. The recognized foraminiferal biozones define regional interval biozones. It is necessary to undertake additional investigation on other section, representing facies 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 Usli 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., 1968; Canerot & Moullade, 1974 and Zaninetti et al., 1987.

The stratigraphic distribution of the taxa has been presented after Salvinii-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 calpionellids and calcareous nanofossils (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 (Grigeli, 1958) and the upper - by the appearance of Protoperoperlops striata Weynschenk, 1950.

Zonal association. Other foraminiferal species occurring in the interval: Ophthalmidium stromosum (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).

Protoperoperlops striata 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 *Protopeneroplis striata* Weynschenk, 1950 and the upper - by the appearance of *Pseudocyclamina litus* (Yokoyama, 1890).

Zonal association. The association is characterised by the almost simultaneous first occurrence of *Protopeneroplis striata* Weynschenk, 1950 and *Tubiphytes morronensis* Crescenti, 1970. The association contains a diversified microfauna including several foraminifers: *Labyrinthis mirabilis* Weynschenk, 1951; *Pseudocyclamina litus* (Yokoyama, 1890); *Mesoendothyra izumiana* Dain, 1958; *Ophthalimidium sp.*; *Vermeullina 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 Silvinita 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).

**Pseudocyclamina litus 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 *Pseudocyclamina litus* (Yokoyama, 1890) and the upper - by the appearance of *Haplofragmoides joukowskyi* Charollais, Broennmann & Zaninetti, 1966.

Zonal association. The biozone is characterised by the almost simultaneous first occurrence of *Pseudocyclamina litus* (Yokoyama, 1890) and the representatives of genus *Tracholina* Paalzow, 1922; *Tracholina alpina* (Leupold, 1935), *T. elongata* (Leupold, 1935); *T. odukpanienis* (Dessauvage, 1968); *T. delphinensis* Arnaud-Vanneau, Boisseau & Darsac, 1988. Other species appear within in the interval: *Neotricholina* sp.; *Protopeneroplis ultranigrulata* (Gorbachik, 1971); *Hechtina praenana* Baartenstein & Brand, 1949; *Ammobaculites* sp.; *Belorussiella* sp.; *Arenobuliminia* 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 Silvinita Formation.

Correlation. This biozone corresponds to the upper part of the Zone II (*Tubiphytes morronensis* Zone) and the lower part of Zone III (*Protopeneroplis ultranigrulata* Zone) introduced as an interval zone 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, Broennmann & Zaninetti, 1966 and the upper - by the appearance of *Montsalevia salevensis* (Charollais, Broennmann & Zaninetti, 1968).


Chronostratigraphic position. Berrissian (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 Silvinita 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, Broennmann & Zaninetti, 1966) and the upper - by the appearance of *Meandrospira favrei* (Charollais, Broennmann & Zaninetti, 1966).


Chronostratigraphic position. Vальнагин (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 Silvinita 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, Broennmann & Zaninetti, 1966) and the upper - is not studied.


Chronostratigraphic position. Vальнагин (upper part) - Lower Hauterivian.
Distribution. The biozone is indicated in Chavchik Kamak, Dragoman and Berende Ivzor (Kalotina) sections. In Berende Ivzor (Kalotina) section it comprises the highest part (13.00 m) of Sivlitassa Formation and the lower portion (19.00 m) of Salash Formation.

Correlation. The biozone corresponds exactly to the Zone V (Meadiospira 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 nanofossil taxa Epiolithus septentrionalis and E. florisus 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. Ophthalomidium strumosum (Guembel, 1862); Berende Izvor (Kalotina) section, Slivnitsa Formation, sample N 75; Globuligerina oxfordiana Interval biozone.

Fig. 2. Globuligerina oxfordiana (Grigels, 1958); Berende Izvor (Kalotina) section, Slivnitsa Formation, sample N 74; Globuligerina oxfordiana Interval biozone.

Fig. 3. Protopenerolipis striata Weynschenk, 1950; Berende Izvor (Kalotina) section, Slivnitsa Formation, sample N 90; Protopenerolipis striata Interval biozone.

Fig. 4. Mesoendothyra izumiiana Dain, 1958; Berende Izvor (Kalotina) section, Slivnitsa Formation, sample N 81; Protopenerolipis striata Interval biozone.

Fig. 5. Labyrinthina mirabilis Weynschenk, 1951; Berende Izvor (Kalotina) section, Slivnitsa Formation, sample N 82; Protopenerolipis striata Interval biozone.

Fig. 6. Pseudocyclammina litus (Yokoyama, 1890); Berende Izvor (Kalotina) section, Slivnitsa Formation, sample N 93; Pseudocyclammina litus 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 praebantiqua Bartenstein & Brand, 1949; Berende Izvor (Kalotina) section, Slivnitsa Formation, sample N 123; Montsalevia salevensis Interval biozone.

Fig. 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; Pseudocyclammina litus and Haplophragmoides joukowskyi Interval biozones.

Fig. 5. Trocholina sagittata Arnaud-Vanneau, Boisseau & Darsac, 1988; Berende Izvor (Kalotina) section, Slivnitsa Formation, sample N 130; Montsalevia salevensis Interval biozone.

Fig. 6. Trocholina cherchiae 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 cuillieri 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