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## **The Rupelian in the area of Ravna Gora (northwestern Croatia) based on foraminiferous fauna**

Lidija ŠIKIĆ

*The Institute of Geology, Sachsova 2, pp. 283, YU — 41000 Zagreb*

On the basis of foraminiferal associations and comparison with Oligocene localities in Hungary and Slovenia it has been proved that the sandy marls of Prebukovje, on the southern slope of Ravna Gora, are of Rupelian age.

Na temelju zajednice foraminifera i usporedbe s lokalitetima oligocena u Mađarskoj i Sloveniji dokazana je rupelska starost pjeskovitih lapora lokaliteta Prebukovje na južnoj padini Ravne gore.

There has been only one documented piece of evidence on the presence of the Oligocene in northwestern Croatia so far, and it can be found in the study of the microfauna of Oligocene and Miocene sediments of the Pannonian Basin in Croatia (Muldini-Mamužić, 1965). Sediments in the area of Varaždinske Toplice, in the north of the ridge Koščevica, where the association of foraminifera with the *Clavulinoides szaboi* was found, were classified as Upper Oligocene sediments. Since recent research in this area has not confirmed the mentioned find, I shall return to the problem of the Oligocene in the area of Varaždinske Toplice in the conclusion to this paper.

By the examination of foraminifera, as part of the project of the Basic Geological Map of Yugoslavia, the sheet of Varaždin, I proved the presence of Oligocene sediments of Rupelian age on the southern slopes of Ravna gora (Text-fig. 1) in 1977. Information on this find were published in the works of Šimunić & al. (1979, 1981). The aim of the present paper is to give a detailed account of the association of foraminifera which proves the above mentioned age. Numerous samples have been examined from the outcrops of dark grey sandy to silty marls and subordinate worn sandstones, found south of the village Prebukovje. According to the information in Šimunić & al. (1979, 1981) the deposits on the southern slopes of Ravna Gora are tectonically wedged in between Upper Eocene and Lower Miocene (Eggenburgian) deposits. Scanty residues of shellfish have been found there, and only the species *Parvamussium duodecimlamellatum* (Bronn) has been determined with certainty, by K. Šikić.



Text-fig. 1. Situation map — Sl. 1. Položajna skica

#### THE COMPOSITION OF THE ASSOCIATION OF FORAMINIFERA

Among the samples examined only some contained a rich microfossil association, and with respect to the predominantly sandy sediment the fauna has been less well preserved. It contains foraminifera, sea-urchin spines and infrequent limonitized pelagic microgastropodes (Pteropoda).

Examples of foraminifera larger than 1 mm are most frequently agglutinate forms: *Rhabdammina robusta* (Grzybowski), *Rh. abyssorum* Sars, *Rh. cylindrica* Glaessner, *Bathysiphon* sp., then *Ammodiscus incertus* (d'Orbigny), *Cyclammina acutidorsata* (Hantken), *C. cancellata* Brady, *C. deformis* Guppy, *Haplophragmoides latidorsatus* Bornemann, *H. cf. carinatum* Cushman & Renz, *Tritaxia szaboi* (Hantken), *T. cf. alpina* Cushman, *Martinottiella communis* (d'Orbigny) and *Tritaxilina hantkeni* Cushman, and also calcareous foraminifers *Lenticulina arcuatostrata* (Hantken), *L. cultrata* (Montfort), *L. submamilligera* (Cushman), *Marginulina gladius* Philippi, *M. hirsuta* d'Orbigny, *M. granosa* Hantken, *Nodosaria acuminata* Hantken.

The foraminifera sized between 1 mm and 0.10 mm are numerous. Agglutinate forms make up about 30 % of the entire foraminifera content of the above size. They are:

- Saccammina barbaria* (Mjatliuk)
- Schizammina* sp.
- Ammodiscus incertus* (d'Orbigny)
- Haplophragmoides glomeratum* (Brady)
- H. latidorsatus* (Bornemann)
- Cyclammina placenta* (Reuss)
- C. acutidorsata* (Hantken)
- Ammobaculites agglutinans* (d'Orbigny)
- Spiroplectammina carinata* (d'Orbigny)
- Vulvulina pectinata* (Hantken)
- Textularia articulata* d'Orbigny
- Trochammina* sp.
- Verneuilina cf. limbata* Cushman



*Gaudryina haeringensis* Cushman  
*Tritaxia szaboi* (Hantken)  
*Dorothia filiformis* (Berthelin)  
*Karrerella hantkeniana* Cushman  
*K. siphonella exilis* Hagn  
*Clavulina parisinensis* d'Orbigny  
*Martinottiella communis* (d'Orbigny)  
*Tritaxilina hantkeni* Cushman

The rest are calcareous foraminifera amongst which there prevail benthic species present in a larger or smaller number of specimens:

*Triloculina tricarinata* d'Orbigny  
*Milionella* sp.  
*Nodosaria budensis* Hantken  
*N. latejugata* Gümbel  
*N. spinicosta* d'Orbigny  
*N. longiscata* d'Orbigny  
*Chrysalogonium longicostatum* Cushman & Jarvis  
*Chrysalogonium* sp.  
*Dentalina fissicostata* d'Orbigny  
*D. budensis* Hantken  
*D. subtilis* Hantken  
*D. vasarhelyii* Hantken  
*Lagena striata* (d'Orbigny)  
*Lenticulina gibba* (d'Orbigny)  
*L. cultrata* (Montfort)  
*L. arcuatostrata* (Hantken)  
*L. inornata* d'Orbigny  
*L. submamilligera* (Cushman)  
*L. vortex* (Bornemann)  
*Marginulina behmi* Reuss  
*M. gladius* Philippi  
*M. granosa* Hantken  
*M. fragaria* Gümbel  
*M. subbullata* Hantken  
*Saracenaria hantkeni* Cushman  
*Ramulina globulifera* Brady  
*Globulina gibba* d'Orbigny  
*Glandulina laevigata* d'Orbigny  
*Sphaeroidina bulloides* d'Orbigny  
*Sph. problema* d'Orbigny  
*Stilostomella elegans* (d'Orbigny)  
*S. consobrina* (d'Orbigny)  
*Bulimina truncana* Hantken  
*Globobulimina pyrula* (d'Orbigny)  
*Uvigerina hantkeni* Cushman  
*U. farinosa* Hantken  
*Discorbis tholus* (Galloway & Heminway)  
*Discorbitura* sp.

*Planulina compressa* Hantken  
*P. costata* Hantken  
*P. marialana* Hadley  
*P. renzi* Cushman & Stainforth  
*Cibicides westi* Howe  
*Globocassidulina subglobosa* (Brady)  
*Chilostomella cylindroides* Reuss  
*Florilus incisum* (Cushman)  
*Pullenia bulloides* (d'Orbigny)  
*Alabamina* cf. *wolterstorffi* (Franke)  
*Gyroidina soldanii* d'Orbigny  
*G. dissimilis* Cushman & Renz  
*Gyroidinoides girardanus* (Reuss)  
*Anomalina affinis* (Hantken)  
*A. cryptomphala* (Reuss)  
*Anomalinoides grosserugosus* (Gümbel)  
*A. alazanensis* (Nuttall)  
*Cibicoides ungerianus* (d'Orbigny)  
*C. pseudoungerianus* (Cushman)  
*Heterolepa mexicana* (Nuttall)  
*H. perlucida* (Nuttall)  
*H. praecincta* (Karrer)  
*Melonis soldanii* (d'Orbigny)  
*M. affinis* (Reuss)  
*Queraltina* sp.

Plankton foraminifera are rare and represented by single specimens of the species *Globigerina ampliapertura* Bolli, *G. gortanii* (Borsetti), *G. officinalis* Subbotina, *G. ouachitaensis* Howe & Wallace, *G. selli* (Borsetti), *G. tripartita* Koch, *Globigerina* sp., ?*Globigerinoides* sp., *Globorotalia opima* Bolli and *G. increbescens* (Bandy).

The listed association of foraminifera, its composition and manner of preservation, as well as the sediments in which it occurs point to a relatively agitated environment with ample transport and sedimentation of terrigenous detritus (sand, silt, clay), which is located in the area of a somewhat deeper part of the sublittoral with a marked influence of the open sea (plankton).

#### CONCLUSION

The association of foraminifera in the dark grey sandy marls of Prebukovje can be compared in full with the foraminiferal fauna of Rupelian age from well known deposits of Kiscell clays in Hungary (Hantken, 1875; Majzon, 1962; Nagy-Gellai, 1973, 1983; Horváth, 1983). The age is primarily determined by the Hantken species: *Tritaxia szaboi*, *Nodosaria budensis*, *Dentalina budensis*, *Bulimina truncana*, *Uvigerina farinosa*, *Planulina compressa*, *P. costata*, as well as other Oligocene species: *Marginulina behmi*, *Uvigerina hantkeni*, *Anomalina cryptomphala*, *Planulina marialana*, and species with a wider Younger Paleogenic age range: *Gaudryina haeringensis*, *Clavulina parisinensis*, *Tritaxilina hantkeni*, *Marginulina gladius*, *Planulina renzi*, *Anomalinoides alazanensis*, *Hete-*



*rolepa perlucida* etc. Among the few plankton foraminifera the important ones are conducting zonal species *Globigerina ampliapertura* and *Globorotalia opima* (Bolli, 1957; Bolli & Premoli Silva, 1973).

In the introduction there was mentioned the only documented find of Oligocene in this part of Croatia, and it refers to the locality of Košćevica near Varaždinske Toplice (Muldini-Mamužić, 1965). The listed species of foraminifera (*Clavulinoides szaboi*, *Karrieriella hantkeniana*, *Marginulina behmi*, *Robulus arcuatostratus*, *Uvigerina hantkeni*, *Planulina renzi* and others) suggest that the localities of Prebukovje and Košćevica are of the same age. In the more recent research of Tertiary sediments in the vicinity of Varaždinske Toplice, including the locality of Košćevica, however, not a single association of foraminifera of Rupelian age has been found. So far all recent analyses in this area show that the oldest sediments of the Tertiary belong to the Egerian.

On the territory of Slovenia marine Oligocene sediments have been known for a long time. The first data on the Oligocene association of foraminifera with the *Tritaxia szaboi* in marls and clays («sivica») were given by: Hamrla (1954, 1955), from the area of the Tertiary valley east of Laško and the foot of Rudnica, Papp (1954, 1955) from Zagorje on the Sava and the valley of Tuhinja, who was also first to notice the similarity of foraminiferal associations in sivica and Kiscell clays, and Kuščer (1955) from Gorenjska (Radovljica, Medvode) and the folds of Posavina (the vicinity of Zagorje). This is followed by numerous accounts (Majzon, 1958; Rijavec, 1958, 1965; Kuščer, 1967; Cimerman, 1967, 1979; Pavlovec, 1973; Rijavec & Pleničar, 1979; Cimerman & Pavšić, 1979) where the association of foraminifera with *Tritaxia szaboi* from marine marls and clays, from numerous localities of Gorenjska, the folds of Posavina and the southern regions of Styria, are compared to the foraminiferal fauna of Kiscell clays in Hungary, and are assigned to the Rupelian. This sediment find on the southern slopes of Ravna Gora is a new contribution in support of the existence of an integrated marine space that during the Oligocene connected the present regions of northern Slovenia and northwestern Croatia and Hungary.

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### Rupel u području Ravne gore (sjeverozapadna Hrvatska) na temelju faune foraminifera

L. Šikić

Zajednica foraminifera iz tamnosivih pjeskovitih lapora Prebukovja može se u potpunosti usporediti s faunom foraminifera rupelske starosti iz poznatih nalazišta kiseljskih glina Mađarske (Hantken, 1875; Majzon, 1962; Nagy-Gellai, 1973, 1983; Horváth, 1983). Starost prvenstveno određuju prisutne Hantkenove vrste: *Tritaxia szaboi*, *Nodosaria budensis*, *Dentalna budensis*, *Bulimina truncana*, *Uvigerina fari-nosa*, *Planulina compressa*, *P. costata* itd., kao i druge oligocenske vrste: *Marginulina behmi*, *Uvigerina hantkeni*, *Anomalina cryptomphala*, *Planulina merialana*, te vrste sa širim mladepaleogenskim rasponom starosti: *Gaudryina haeringensis*, *Clavulina parisinensis*, *Tritaxilina hantkeni*, *Marginulina gladius*, *Planulina renzi*, *Ano-*



*malinoides alazanensis*, *Heterolepa perlucida* i mnoge druge. Među rijetkim planktonskim foraminiferama značajne su provodne oligocenske zonske vrste *Globigerina ampliapertura* i *Globorotalia opima* (Bolli, 1957; Bolli & Premoli Silva, 1973).

U području Slovenije marinski sedimenti oligocena već su dugo poznati. Podatke o oligocenskoj zajednici foraminifera s *Tritaxia szaboi* u laporima i glinama (sivica) naveli su: Hamrla (1954, 1955), Papp (1954, 1955), Kuščer (1955, 1967), Majzon (1958), Rijavec (1958, 1965). Rijavec & Pleničar (1979), Cimerman (1967, 1979), Cimerman & Pavšić (1979) i Pavlovec (1973). Nalaz ovih sedimenata i na južnim padinama Ravne gore, novi je priloig o postojanju jedinstvenog marinskog prostora koji je za oligocena povezivao današnje predjele sjeverne Slovenije, sjeverozapadne Hrvatske i Mađarske.

Primljeno: 15. 12. 1984.

PLATE — TABLA I

1. *Saccamina barbaria* (Mjatliuk), x 50
2. *Ammobaculites agglutinans* (d'Orbigny), x 50
3. *Clavulina parisinensis* d'Orbigny, x 60
4. *Tritaxia szaboi* (Hantken), x 60
5. *T. cf. alpina* Cushman, x 20
6. *Tritaxilina hantkeni* Cushman, x 20
7. *Verneuilina cf. limbata* Cushman, x 20
8. *Karrieriella siphonella exilis* Hagn, x 50
9. *K. siphonella* (Reuss), x 50
10. *Vulvulina pectinata* (Hantken), x 50
11. *Karrieriella hantkeniana* Cushman, x 50
12. *Cyclammina acutidorsata* (Hantken), x 13

Taken by (Foto): N. Rendulić



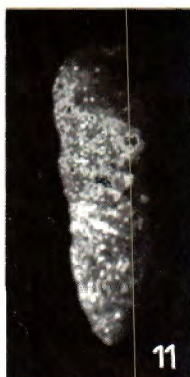


PLATE — TABLA II

1. *Cyclammina placenta* (Reuss), x 50
2. *Haplophragmoides latidorsatus* Bornemann, x 16
3. *Cyclammina cancellata* Brady, x 50
4. *C. deformis* Guppy, x 13
5. *Ramulina globulifera* Brady, x 50
- 6, 7. *Lenticulina arcuatostrata* (Hantken), 6 = x 50, 7 = x 40
8. *L. vortex* (Bornemann), x 50
9. *Lagena striata* (d'Orbigny), x 50

Taken by (Foto): N. Rendulić





PLATE — TABLA III

1. *Dentalina fissicostata* Gümbel, x 50
2. *Nodosaria acuminata* Hantken, x 17
3. *N. scalaris* Batsch, x 50
- 4, 5. *N. spinicosta* d'Orbigny, 4 = x 65, 5 = x 60
6. *Marginulina behmi* (Reuss), x 60
7. *M. hirsuta* d'Orbigny, x 17
8. *M. granosa* Hantken, x 20
9. *M. fragaria* Gümbel, x 50
10. *M. gladius* Philippi, x 20

Taken by (Foto): N. Rendulić





PLATE — TABLA IV

1. *Dentalina vasarhelyii* Hantken, x 50
- 2, 3. *Marginulina subbullata* Hantken, x 50
4. *Uvigerina hantkeni* Cushman, x 50
5. *U. farinosa* Hantken, x 50
6. *Planulina renzi* Cushman & Stainforth, x 50
7. *P. marialana* Hadley, x 50
- 8, 9. *Anomalina cryptomphala* (Reuss), x 50

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PLATE — TABLA V

1. *Heterolepa praecincta* (Karrer), x 50
- 2, 3. *Globigerina tripartita* Koch, x 50
- 4, 5. *G. officinalis* Subbotina, x 70
6. *G. ouachitaensis* Howe & Wallace, x 70
7. *G. ampliapertura* Bolli, x 90
- 8, 9. *Globorotalia increbescens* (Bandy), x 50
- 10—12. *G. opima* Bolli, x 70

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