HARACEAS IN THE TRNJE PROFILE

HARACEJE V PROFILU TRNJE

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Izvleček

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Martin Knez: Haraceje v profilu Trnje

V kozinskih plasteh profila Trnje se, poleg različnih tipov haracejskih horizontov, pojavljajo le horizonti tipa "B: horizonti z oogoniji" - haraceje kažejo znake transporta. Predpostavlja se, da so oogonije prenašali vodni tokovi proti relativno globljim delom sedimentacijskega bazena. Na prehodu iz apnencev brez oogonijev v sedimente s številnimi oogoniji haracej ni sedimentoloških sprememb.

Ključne besede: geologija, paleoekologija, biostratigrafija, kozinske plasti, haraceje, Škocjanske jame, Slovenija

Abstract

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Martin Knez: Haraceas in the Trnje Profile

Within the Kozina beds of the Trnje profile there appear horizons of "Type B: oogonia horizons" among the various types of Haracea horizons; Haraceas evidence characteristics of transport. It is presumed that oogonia were carried along by water currents towards relatively deeper parts of the sedimentary basin. Within the limestone beds, at the transition from the parts with no oogonia into the sediments containing numerous oogonia of Haracea, there are no sedimentological changes.

Key words: geology, paleoecology, biostratigraphy, Kozina beds, Haraceae, Škocjanske jame Caves, Slovenia

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INTRODUCTION

This work was written during sedimentological research of the beds in the close vicinity of the Škocjanske jame Caves. With regard to lithology, petrology and biostratigraphy, the area of Cretaceous and Palaeogene beds within the classical Karst territory has not yet been completely researched. Beside the above-mentioned, the results of palaeoecological research of sedimentation conditions in the Cretaceous and Tertiary sedimentary basin could be an additional aid to speleogenetical interpretations. The research is not of classical karstological or speleological significance, but it is a positive contribution to knowledge of the best represented rocks in the Karst area.

The study was carried out within the project Karst in Slovenia I, financed by the Ministry of Science and Technology of Republic of Slovenia.

PREVIOUS RESEARCH IN THE AREA OF THE TRNJE PROFILE

LOCATION OF THE TRNJE PROFILE WITH REGARD TO BROADER GEOLOGICAL STRUCTURE

The Trnje profile is located in the south-western section of the Postojna Basic Geological Map (S. Buser, K. Grad & M. Pleničar, 1967), in the vicinity of Divača (Fig. 1).

The profile is located on the Trieste-Komen plateau (the Trieste-Komen anticline), which is a tectonic unit of lower grade (S. Buser, 1973) and is part of the Adriatic-Ionian folded zone (M. Pleničar, 1970). On the south-western edge, the tectonic unit of the Trieste-Komen plateau borders on the Brkini Tertiary (D. Šikić & M. Pleničar, 1975; M. Pleničar, A. Polšak & D. Šikić, 1973). The territory is part of the former Dinaric Carboniferous platform (K. Drobne et al., 1988; S. Buser, 1989). According to S. Buser (1988) this territory belongs to the range of Zunanji Dinaridi.

BRIEF CHARACTERIZATION OF THE LIBURNIAN FORMATION

In south-western Slovenia and Istria, predominantly the Carboniferous sediments which appear within the rudist limestones and limestones containing alveolines and nummulites were named the Liburnian stage or protocene by G. Stache in 1872. This succession of beds was given detailed research by G. Stache, who in 1889 divided it into three parts: lower foraminiferous (imperforative)

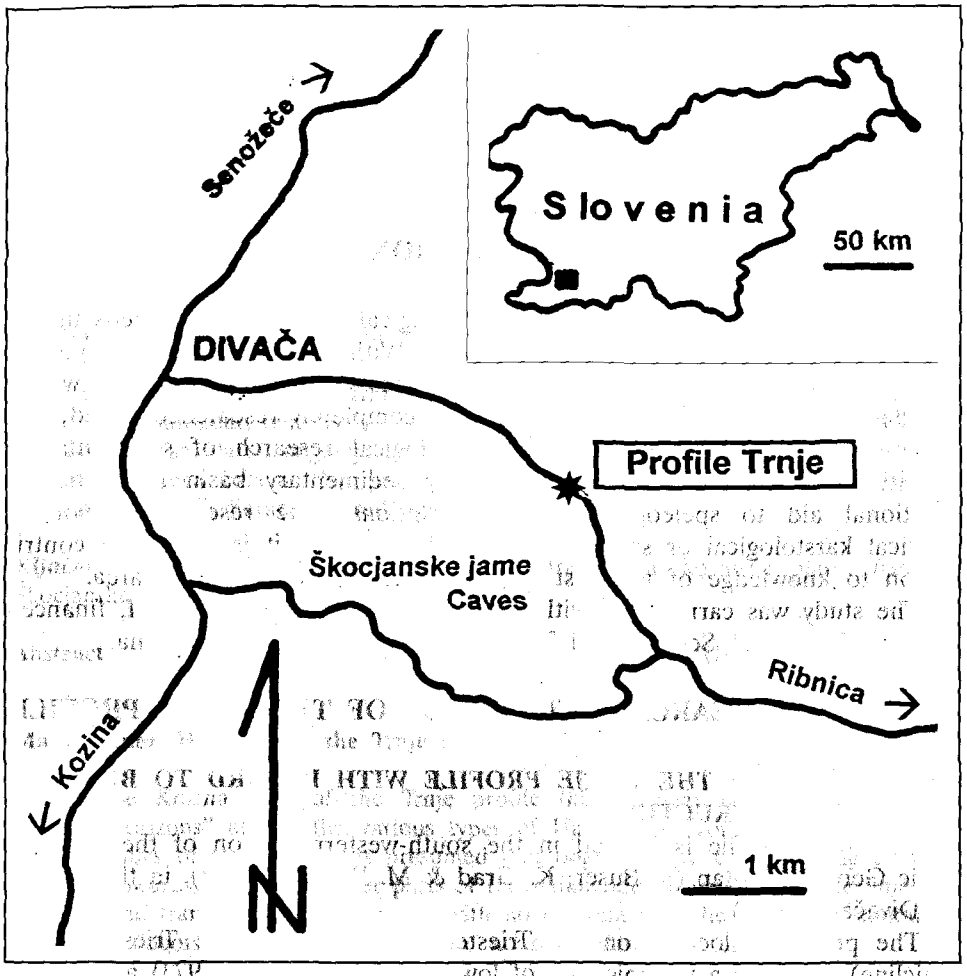

Fig. 1: Location of the profile Trnje
Sl. 1: Položaj profila Trnje

limestones, the Kozina beds with inliers of the major Haracea, limestone, and upper imperforative (milliolidic) limestone. The Liburnian formation (R. Pavlovec & M. Pleničar, 1979, 1981) is a chronolithological conception, which means that also lithologically and facially similar beds from the same development stage (from the Maastrichtian up to the Thanetian) are included into the Liburnian formation.

THE KOZINA BEDS

At present, the succession of beds is known as the Liburnian formation, which in its lower part is composed of the Vreme beds of Upper Maastrichtian age, in the middle part of the Kozina beds of Danian age and in its upper part of milliolidic limestones of Thanetian age (R. Pavlovec, 1963; K. Drobne, 1979; G. Bignot, 1972; M. Hötzl & R. Pavlovec, 1981; R. Pavlovec & M. Pleničar, 1983; R. Pavlovec & K. Drobne, 1991; M. Knez, 1994). G. Stache (1859) primarily knew only the middle part (the Kozina beds) of the succession of beds, although he distinguished between the lower and upper foraminiferous limestones.

The lower and the upper levels of the Kozina beds were divided by G. Stache (1859) into stomatopsis limestones and Haracea limestones respectively. Subsequently, the middle part of the beds was named by G. Stache (1889) the Kozina beds after the settlement of Kozina. This name has been retained up to the present time (K. Drobne & R. Pavlovec, 1991).

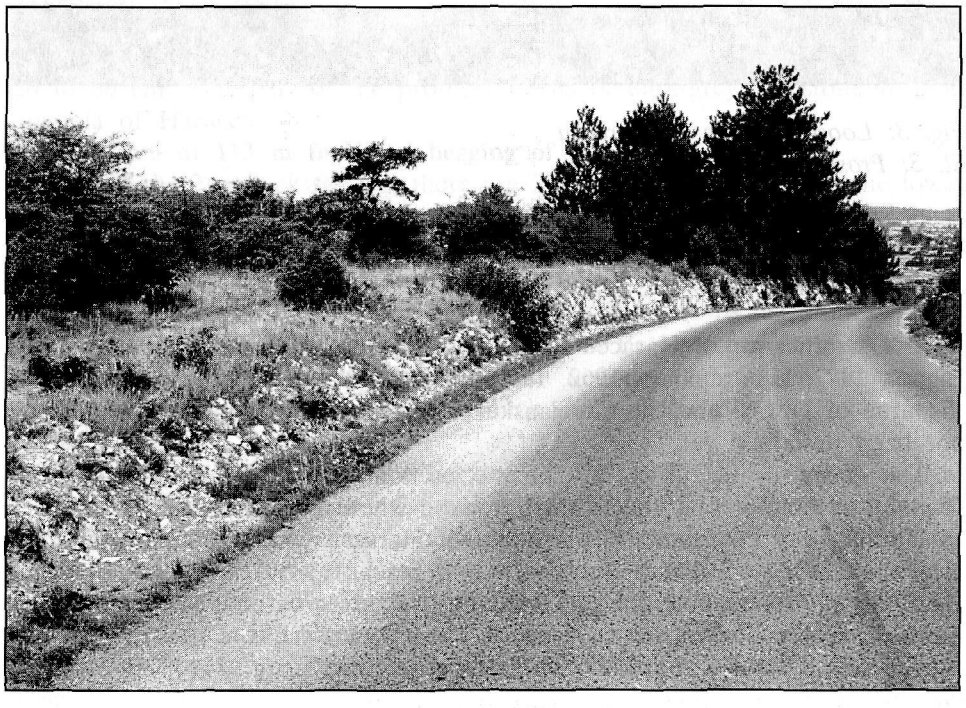

Fig. 2: The Trnje profile
Sl. 2: Profil Trnje

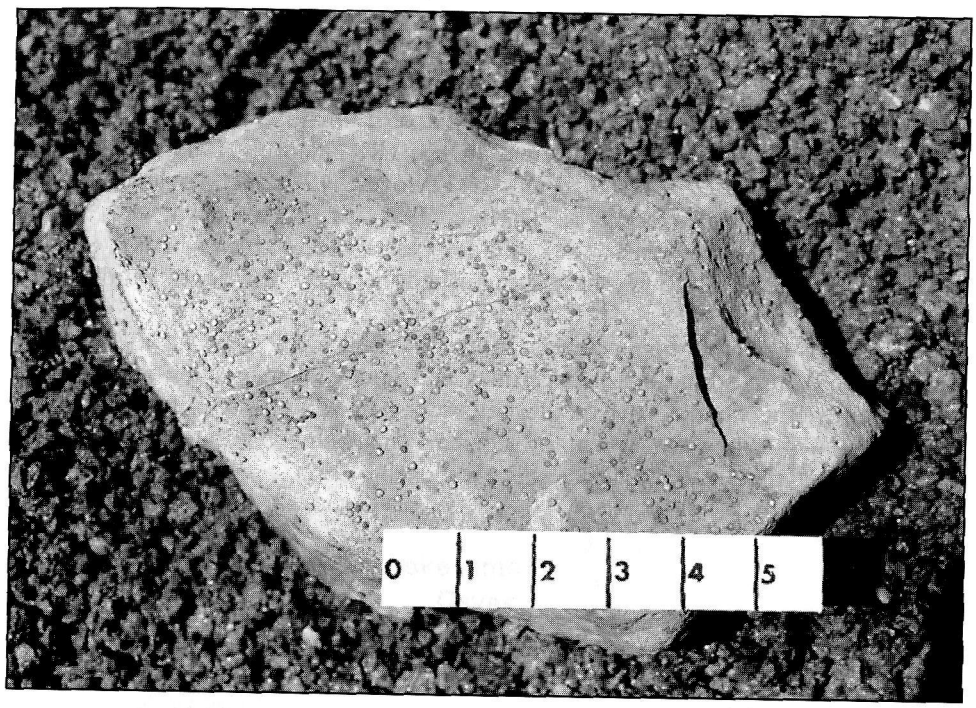

Fig. 3: Loose oogonia of Haracea
Sl. 3: Prosti oogoniji haracej

THE TRNJE PROFILE

The significance of Haracea has been discussed by numerous authors (G. Bignot, 1972; L. Grambast, 1962, 1965 and others) who did some research in the area of Divača and the Škocjanske jame Caves, but the Trnje profile has not been described yet.

The Trnje profile (Fig. 2) consists predominantly of Haracea oogonia (Fig. 3), except for one 10 cm thick horizon where beside oogonia also thalli of Haracea can be found. The oogonia of Haracea which appear within the Trnje profile were called Porochara by G. Stache (1889). G. Bignot and L. Grambast (1969) suppose that all oogonia of Haracea within the older part of the Kozina beds belong to the species Porochara stacheana. As this species can be found also in the youngest Palaeocene parts, they are of the opinion that this species was preserved particularly due to the fact that it was probably dependent and related to specific local ecological conditions or particularities of the genera Porochara.

The Trnje profile is located within a cutting of the road connecting the settlements of Famlje and Divača, about 550 m before the crossroads of the road already mentioned and another road leading to the settlement of Brežec. The profile is located in the close vicinity of a topographical feature called Trnje; for that reason I named it the Trnje profile.

DESCRIPTION OF THE TRNJE PROFILE

Due to a gentle dip of beds (mostly about 10 degrees, in places even less), better connection of individual parts of the profile, and due to very thin layers which occur only occasionally, I decided to describe the profile in nine interconnecting sections (Fig. 4). The dip of beds is mostly 180/10.

Section 1 at 68 m from the begging of the profile

In the lower half of the 180 cm thick section there are 10 to 20 cm thick limestone beds; in the upper half the beds are 40 cm thick.

In the lower part of the profile up to a thickness of 90 cm there is dark-brown slightly bituminous limestone without oogonia of Haracea. At 90 cm thickness, the first individual oogonia can be found. A similar density of Haracea oogonia (approx. 5 per 100 cm^2) can be followed to a thickness of 180 cm.

Section 2 at 88 m from the begging of the profile

The thickness of limestone beds within the 220 cm thick second section is 20 to 60 cm. This part of the profile consists of dark-grey limestone without oogonia of Haracea.

Section 3 at 113 m from the begging of the profile

Within the 2 m thick section, there are 30 to 40 cm thick beds in the lower third of the section; in the upper two thirds the beds are 10 to 50 cm thick.

The lower part consists of black dense limestone which contains individual oogonia of Haracea 30 cm above the margin of the section, in a some-centimetre-thick horizon. Upwards there follows dark-brown limestone without Haracea. Individual Haracea reappear at 120 cm. Between 120 cm and 190 cm there appears dark-brown limestone without oogonia. At 200 cm, oogonia of Haracea and their fragments appear much more frequently and make up a horizon.

Section 4 at 140 m from the begging of the profile

The thickness of beds in this section is 140 cm. Within the lower 50 cm part, light-grey compact and nonbituminous limestone appears without any fossils. At 50 cm it turns into dark-brown to black bituminous limestone interwoven with numerous stylolite stitches. Oogonia of Haracea, partly whole and partly fragmented, appear in the same limestone at 120 cm.

Section 5 at 148 m from the begging of the profile

In the lower part, the beds are 5 to 40 cm thick, and in the upper 70 cm. The total thickness of the section is 150 cm. At 20 cm, numerous oogonia particles appear in dark-brown limestone. Stylolite stitches are distributed in various directions.

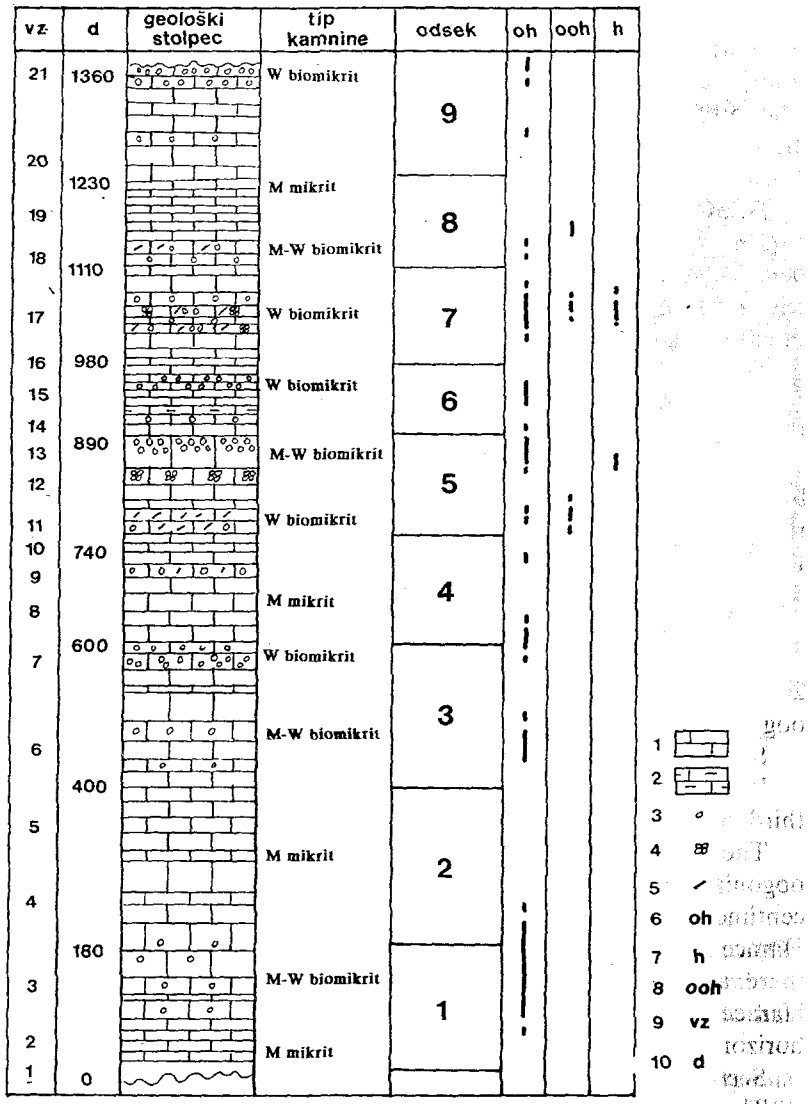

Fig. 4: Geological column of the Trnje profile. 1 - limestone, 2 - marly limestone, 3 - oogonia, 4 - oogonia with algae parts, 5 - oogonia fragments, 6 - oogonia of Haracea, 7 - oogonia and other parts of Haracea, 8 - fragments of Haracea oogonia, 9 - sample, 10 - thickness (in cm)

Sl. 4: Geološki stolpec profila Trnje. 1 - apnenec, 2 - laporni apnenec, 3 - oogoniji, 4 - oogoniji z deli steljke, 5 - odlomki oogonijev, 6 - oogoniji haracej, 7 - oogoniji in drugi deli haracej, 8 - odlomki oogonijev haracej, 9 - vzorec, 10 - debelina (cm)

Fragmented and broken oogonia particles prevail between 20 cm and 40 cm. The majority of oogonia lack one half and some up to three fourths of the whole size. Within this horizon there are almost no undamaged oogonia of Haracea. At 40 cm, limestone turns lighter. Here no oogonia fragments can be found. The last individual whole oogonia within this horizon appear at 50 cm. In dark-brown dense limestone at 90 cm and 140 cm, there appear two thinner, about 10 cm thick horizons with well preserved oogonia.

At 148 cm there is the 15 cm thick first horizon, which besides two other horizons is the richest in oogonia of Haracea. The limestone instantly contains numerous oogonia. Parts of the horizon containing distributed oogonia of Haracea can be well seen. These parts of the horizon are parallel to each other and to the limestone beds (Fig. 5).

Section 6 at 154 m from the begging of the profile

In the lower part of the sixth segment the thickness of beds is about 30 cm; the profile between 30 cm and 90 cm consists of 3 to 10 cm thick beds.

Within the lower 20 cm part of a highly bituminous dark-brown and compact limestone, whole oogonia of Haracea and their fragments can rarely

Fig. 5: The first horizon containing Haracea. It is parallel to the succession of beds.
Sl. 5: Prvi horizont s haracejami. Horizont je vzporeden s plastnatostjo.

Fig. 6: Thin-bedded limestone within Section 7
Sl. 6: Drobnoplastnat apnenec v sedmem odseku

be found. At 30 cm there appears a 3 cm thick marl bed with whole oogonia of Haracea. Between 30 cm and 70 cm of the limestone, there appear individual oogonia and their fragments. At 70 cm there is a horizon of light-brown limestone which contains whole oogonia of Haracea.

Section 7 at 165 m from the begging of the profile

The thickness of limestone beds in the lower 70 cm part of the seventh section is 3 to 8 cm; between 70 cm and 130 cm the thickness is 10 to 20 cm (Fig. 6).

In the lower 40 cm part, the limestone is almost black, dense, solid, slightly bituminous and does not contain Haracea or other fossils. Within the subsequent 10 cm, the number of oogonia rapidly increases. The part between 50 cm and 70 cm contains so many oogonia and some other parts of plants that it can be considered as a Haracea horizon.

Among the oogonia fragments which can be found in this horizon there are also broken particles of Haracea thalli. At 100 cm thickness, only oogonia of Haracea can be seen.

Section 8 at 171 m from the begging of the profile

The thickness of the beds within the lower 40 cm is 10 cm to 20 cm, and upwards to the top of the section the thickness is 1 cm to 5 cm. In the profile, bedding planes between individual beds are often undulating, but in general they are parallel to the succession of beds.

In the lower 30 cm of dark-brown, highly bituminous limestone there are individual oogonia of Haracea and their numerous fragments. At 30, cm the oogonia fragments gradually disappear. Ten centimetres upwards in the profile there are only individual oogonia to be found in brown bituminous limestone. The thin-bedded limestone contains numerous stylolites.

Between 30 cm and 40 cm there is a thin-bedded, slightly marly limestone containing individual oogonia of Haracea. Due to weathering, the beds of the 3 cm to 7 cm thick bedded limestone contain a lighter upper and lower margin, the middle part of the beds is darker.

Individual oogonia of Haracea and their occasional fragments can again be found at 80 cm of the 5 cm thick horizon. There follows a highly marly limestone, which at 100 cm thickness turns into a black, bituminous, dense and compact limestone without oogonia of Haracea or other fossils.

Section 9 at 179 m from the begging of the profile

The thickness of the ninth section is 130 cm. The thickness of beds in the lower half is about 30 cm and in the upper half between 5 cm and 30 cm.

The lower 30 cm of the last section within the Trnje profile is composed of dense, dark-brown to black micrite limestone without any fossils. At 30 cm, the limestone is exceptionally bituminous. Numerous Haracea which appear instantly can be seen between 30 cm and 40 cm. Here the oogonia of Haracea are so numerous that they make up a horizon. At 50 cm, the Haracea gradually disappear. Oogonia here are perfectly preserved, but they are mostly firmly imbedded into the rock. Their surface consists of a typical spiral structure.

At 50 cm, a lighter brown micrite limestone without any Haracea is covered with numerous stylolites which run in various directions; approximately one half of them is parallel to the beds, the other half is perpendicular to the beds.

At 70 cm there is a 10 cm thick bed of recrystallized limestone. Above the bed there is a 10 cm thick horizon containing less numerous, well-preserved oogonia of Haracea. Between 70 cm and 80 cm, the grey limestone contains also rare oogonia fragments. Light-grey limestone without any fossils can be found upwards up to the 120 cm of the profile.

The last horizon containing oogonia of Haraces is at 120 cm above the bottom of the section. The number of Haracea increases with the darkness of the limestone. A slightly marly limestone is dark - to grey-brown.

PALAEOECOLOGICAL OBSERVATIONS

PALAEOGEOGRAPHICAL AND PALAEOECOLOGICAL PROPERTIES OF THE LIBURNIAN FORMATION

The beds of the Liburnian formation were formed in the period from the Maastrichtian to the Thanetian (R. Pavlovec & K. Drobne, 1991). M. Pleničar, A. Polšak and D. Šikić (1973) say that the region of the Slovenian Littoral was influenced by the Laramian folding at the end of the Cretaceous. During the Danian and the Palaeocene, the sea transgraded into the already formed synclines. According to D. Šikić and M. Pleničar (1975), this part of the territory is characteristized by general rising at the end of the Cretaceous. In the transitional period between the Cretateous and the Tertiary, the sea bed oscillated many times.

After sedimentation of beds with rudists there followed regression, due to which the Vreme beds started to form in Slovenia (R. Pavlovec, 1981).

According to the latest research, the beds of the Liburnian formation are neither completely marine nor completely of fresh-water origin. Above the Vreme beds there are limestones containing numerous Haracea. These limestones evidence the proximity of freshwater or brackish environments (R. Pavlovec, 1981).

THE KOZINA BEDS

Types of horizons containing haracea

Individual horizons containing Haracea have not been separately dealt with by most of the authors. Haracea do not appear within one or more beds, they appear in horizons which represent one or more beds.

Within the Kozina beds of the Trnje profile there appear only horizons of "Type B: oogonia horizons" among the various types of Haracea horizons (M. Knez, 1996). With Type B, I characterize the Haracea horizons which evidence characteristics of transport. Of the whole plant only oogonia are preserved (Fig. 7).

Interpretation of the haracea horizons

When speaking of Haracea, it is necessary to take into account that they are quite easily carried along by water streams and waves. For this reason only resedimented Haracea of Type B can be found within most of the limestones of the Kozina beds. Due to fragility, parts of algae are broken during the transport and integrate into the sediment. Mostly only their oogonia are preserved at secondary sites. A. Carozzi (1953) is of the opinion that only those horizons can be considered as autochthonous which beside oogonia contain also parts of whole algae. This opinion is shared also by R. Pavlovec (1963), saying that most of the Haracea remains within the Liburnian sediments can be found at secondary sites. The remains of Haracea meadows are only those Haracea horizons which beside oogonia contain also many other preserved parts of plants.

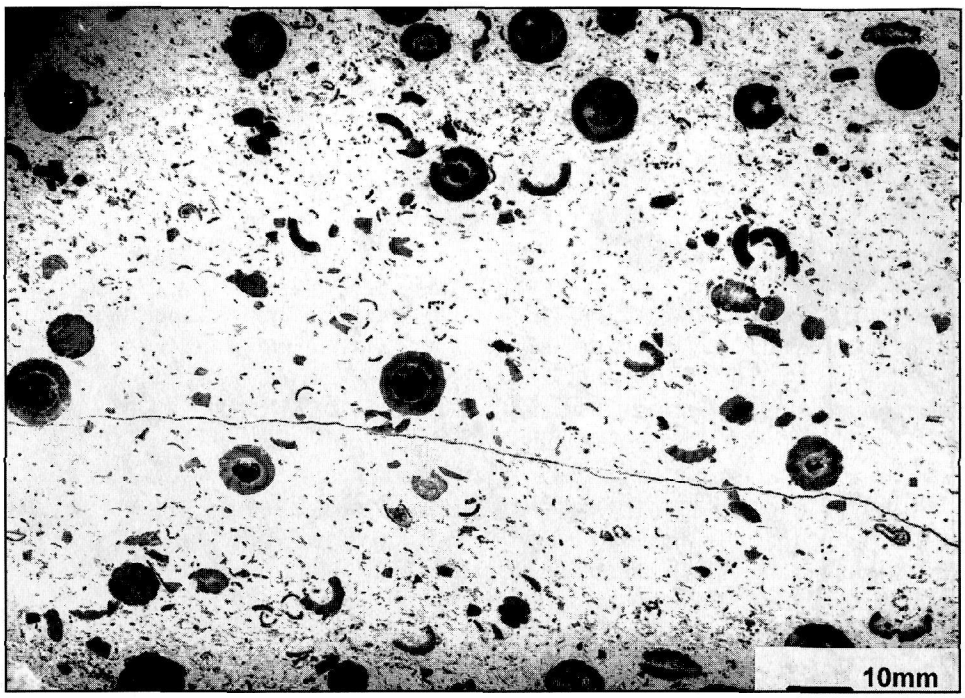

Fig. 7: Haracea indicating the signs of transport. Of the whole plant only oogonia are preserved
Sl. 7: Haraceje kažejo znake transporta. Od celotne rastline so ohranjeni samo oogoniji

Within the Trnje profile, only oogonia of Haracea can be found. There are no major sedimentological changes within the beds of limestones and slightly marly limestones containing no oogonia, as well as in the sediments with numerous oogonia of Haracea (Fig. 8), which means that during deposition of the material there were no major changes in sedimentation. The micrite basis evidences that the environment of sedimentation was relatively calm and shallow, but not calm and shallow enough for oogonia to be preserved in the environment, which on the contrary is the case within the Divača profile. Presumably, the dead remains of Haracea suffered a short transport towards a relatively deeper (with regard to the environment of sedimentation in the Divača profile) part of the sedimentary basin. Here only the most resistant parts of Haracea - oogonia - were preserved. Within the Trnje profile, the other parts of thalli can only exceptionally be found.

Within the Trnje profile, I have discovered only three horizons containing an extreme number of Haracea oogonia. In these horizons, in places also a

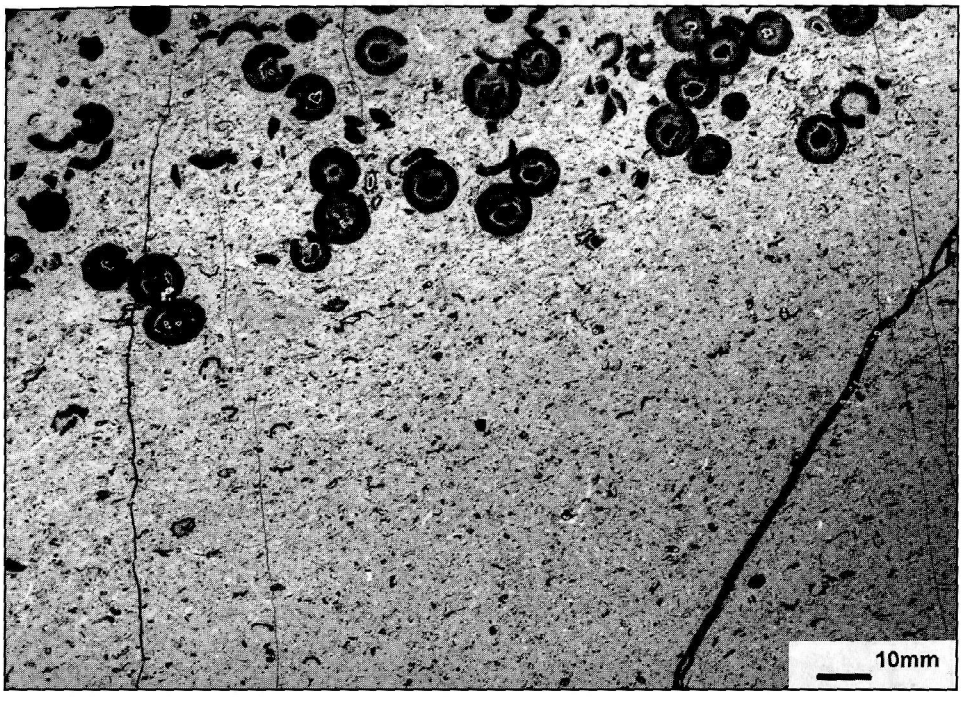

Fig. 8: Transition from the beds with no oogonia remains into the sediments containing numerous oogonia of Haracea - here no lithological and sedimentological changes occur
Sl. 8: Na prehodu iz plasti, v katerih ni oogonijev v sedimente s številnimi oogoniji haracej, ni litoloških in sedimentoloških sprememb

great number of oogonia fragments can be found among well preserved whole oogonia. As conditions within the sediment are almost the same as those in the sediment with horizons containing Gyropleura (M. Knez, 1994), I presume that numerous Haracea were brought to the site of sedimentation by stormy waves and water currents.

CONCLUSION

The basic aim of my research work was to study the environment of bed sedimentation in that part of the Kozina beds which contains Haracea. I have come to the following conclusions:

1. In the Kozina beds of the Trnje profile, I discovered exclusively only the specimens of resedimented Haracea particles (oogonia).

2. I presume that oogonia were carried along by water currents towards relatively deeper parts of the sedimentary basin.
3. Within the limestone beds, at the transition from the parts with no oogonia into the sediments containing numerous oogonia of Haracea, there are no sedimentological changes.

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HARACEJE V PROFILU TRNJE*

Povzetek

Profil Trnje leži v vseku ceste, ki povezuje vas Famlje z Divačo, približno 550 m pred križiščem s potjo, ki vodi v vas Brežec. Ker je profil v neposredni bližini topografskega imena Trnje, sem ga tako tudi imenoval. Profil je na jugozahodnem robu Osnovne geološke karte, list Postojna (Buser, S., Grad, K. & Pleničar, M. 1967).

Zaradi položnega vpada plasti (večinoma okrog 10 stopinj, ponekod tudi manj), zaradi boljše povezave posameznih delov profila in zaradi ponekod zelo drobne plastnatosti, sem profil opisal v devetih odsekih, ki so med seboj povezani. Vpad plasti je večinoma 180/10.

V profilu Trnje najdemo le oogonije haracej. V apnencih in rahlo lapornatih apnencih na prehodu iz plasti, v katerih ni oogonijev v sedimente s številnimi oogoniji haracej ni večjih litoloških in sedimentoloških sprememb. To pomeni, da med odlaganjem materiala ni bilo večjih sprememb v sedimentaciji. Mikritna osnova kaže, da je bilo okolje sedimentacije relativno mirno in plitvo (energijski indeks 1 do 2). Kljub temu pa ne toliko, da bi se oogoniji obdržali v svojem življenjskem položaju, kot je to primer v profilu Divača. Predvidevam, da so odmrli ostanki rastlin haracej pretrpeli krajši transport proti relativno globljemu (glede na okolje sedimentcije v profilu Divača) delu sedimentacijskega bazena. Pri tem so se ohranili le najodpornejši deli haracej - oogoniji. Ostale dele talusov najdemo v profilu Trnje le izjemoma.

V profilu Trnje sem našel tri horizonte, kjer so oogoniji haracej izredno številni. Med dobro ohranjenimi celimi oogoniji je v teh horizontih ponekod tudi veliko njihovih odlomkov. Ker so razmere v sedimentu skoraj enake s sedimentom, ki sem ga opisal v horizontih z giroplevrami, predvidevam, da so številne haraceje na mesto sedimentacije prav tako prinesli navihtni valovi in tokovi.

V kozinskih plasteh profila Trnje se, poleg različnih tipov haracejskih horizontov, pojavljajo le horizonti tipa "B: horizonti z oogoniji" - haraceje kažejo znake transporta. Predpostavlja se, da so oogonije prenašali vodni tokovi proti relativno globljim delom sedimentacijskega bazena. Na prehodu iz apnencev brez oogonijev v sedimente s številnimi oogoniji haracej ni sedimentoloških sprememb.

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