GEOL. CROAT.	48/2	147 - 154	6 Figs.	1 Tab.	1 Pl.	ZAGREB 1995

Palynology of the Miocene Bentonite from Gornja Jelenska (Mt. Moslavačka Gora, Croatia)

Krešimir **KRIZMANIĆ**

Key words: Palynology, Paratethys, Bentonite, Miocene freshwater sediments, Mt. Moslavačka Gora, Croatia.

Ključne riječi: palinologija, Paratethys, bentonit, miocenske slatkovodne naslage, Moslavačka gora, Hrvatska.

Abstract

Deposits were studied from the bentonite clay mine in Gornja Jelenska on Mt. Moslavačka Gora where the remains of *Dinotherium bavaricum* KAUP had been found. It was established by palynological methods that sediments had been deposited during the Upper Karpathian - Lower Badenian stage (between 15.5 - 17 m.y. ago). The climate was warm, subtropical. Sedimentation took place in swamp which was surrounded by meadows and hill-side forests.

Sažetak

Proučeni su sedimenti u rudniku bentonitne gline u Gornjoj Jelenskoj na Moslavačkoj gori gdje su pronađeni ostaci vrste *Dinotherium bavaricum* KAUP. Palinološkim metodama utvrđeno je da su sedimenti nastali u doba od gornjeg karpata do donjeg badena (u razdoblju između 15.5 - 17 milijuna godina prije sadašnjosti). Klima je bila topla, suptropska. Sedimentacija se odvijala u močvari, okruženoj livadama i šumama na srednje visokim brdima.

1. INTRODUCTION

Vertebrate fossils have been found in Central Croatia on the Mt. Moslavačka Gora, about sixty kilometres east from Zagreb in the Draga pit of the bentonite clay mine Gornja Jelenska situated some ten kilometres north of small town Popovača (Fig. 1). Later, it was determined that the remains belong to *Dinotherium bavaricum* KAUP but the geological age and the palaeoenvironment remained undetermined. This is the subject of the present palynological study.

2. GEOLOGICAL SETTING

The geological composition of Mt. Moslavačka Gora is characterised by two totally different rock complexes. The core of the massif is composed of Hercynian-Alpine metamorphic-crystalline rocks, which have been studied by many authors. Probably the best reviews of these papers are those by PLETIKAPIĆ (1969) and PAMIĆ (1990). The second complex is composed of Tertiary-Quaternary rocks. These younger, cover sediments were first described by VUKOTINOVIĆ (1852a, 1852b) who showed them in relation to the crystalline base on the sketch entitled "*Kamenospisna slika Gore Moslavačke*" (Lithological picture of the Mt. Moslavačka Gora). A more serious stratigraphical survey of the area was made by KOCH (1899, 1906). He divided these rocks into two members: Archaic and Cenozoic. In the Cenozoic Era the Tertiary system, including Miocene and Pliocene, as well as the Diluvial system was distinguished. More recently, in relation to hydrocarbon exploration many geologists have been engaged in studies of the Tertiary complex (OŽEGOVIĆ, 1944, 1953). Most of these studies remain unpublished, stored in the Internal professional documentation of the national oil-company INA-Naftaplin.

In the following research of the Tertiary complex on Mt. Moslavačka Gora some of the papers directly relate to the Gornja Jelenska site. For example, KOCHANSKY-DEVIDÉ & SLIŠKOVIĆ (1978) undertook palaeontological analysis of cored clay-marl sediments from the borehole Novo Brdo, drilled in bentonite, located south of Gornja Jelenska. They determined an Ottnangian, possibly Karpathian, age for the shallower deposits. Deeper, darker sediments were assigned to the Lower Helvetian (Ottnangian). Outcrops of marls north of the village of Gornja Jelenska were studied by BAJRAKTAREVIĆ (1981). He established a Lower Badenian age for the sediments on the basis of foraminifera and calcareous nannoplankton analyses. The latest stratigraphical data on the Mt. Moslavačka Gora Tertiary rock complex were published in the Guide of the Geological Map, Sheet Bjelovar[1] (KOROLIJA et al., 1986).

INA-Naftaplin, Laboratory Research Dept., Lovinčićeva 1, HR-10000 Zagreb, Croatia.

[1] The locality of Gornja Jelenska should be printed on the yet unpublished Geological Map, Sheet Kutina, but one could use Geological Map, Sheet Bjelovar instead, since it contains 1/3 of entire area of the Mt. Moslavačka Gora.

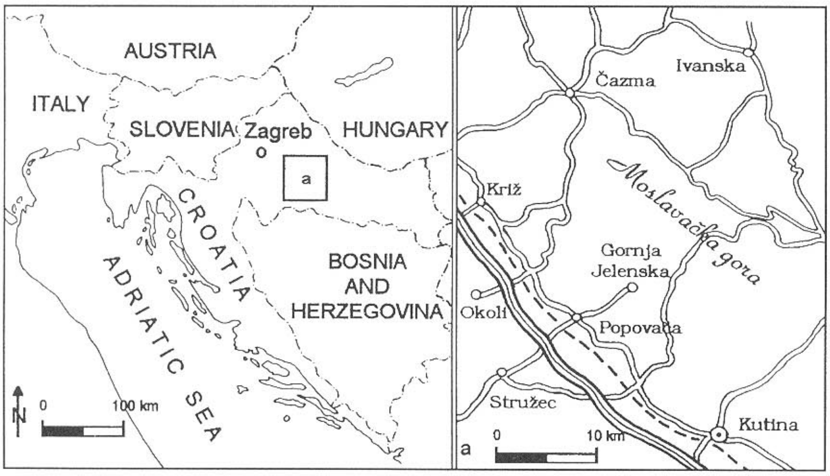


Fig. 1. Location map.

3. LITHOLOGY

The sampled bentonite is composed of the phyllosilicates of montmorillonite - smectite group, with a very small amount of remaining unaltered crystalloclasts of quartz, feldspars, muscovite and biotite (Figs. 2, 3).

Bentonite is the alteration product of acid to neutral tuff under lower pH conditions. Beneath the bentonite beds is an argillaceous sediment of smectite-chlorite-calcite-illite composition (Figs. 4, 5).

It is probably the result of diagenesis of the tuffitic deposits which were a mixture of pelitic sediments and volcanic materials.

4. PALYNOLOGY

4.1. METHODS AND MATERIALS

Rock samples for palynological analysis were taken in situ from the layer in which the bones of *Dinotherium* had been found at about 100 metres deep in the clay mine Gornja Jelenska and overlying and underlying strata.

Sediments were treated by the normal palynological method of maceration. Carbonates were dissolved in 18% HCl and the silicates in 48% HF. The obtained organic residuum was separated by flotation in $ZnCl_2$ (s.g. = 2.1 kg/l) and sieved using a 15μm sieve. Palynological slides were mounted using glycerine-jelly.

By counting 300 palynomorphs in each macerate statistical data on the quantitative proportions of the particular Phylum representatives in the entire microflora associations were obtained (Fig. 6).

4.2. KEROGEN AND MICROFLORA CONTENT

Total organic residuum in macerates is very well represented. Lignohumic kerogen clasts occur as equidimensional, oxidised, black, opaque fragments, as well as irregular brown higher plant debris in which the woody structure can be observed. Together they consti-

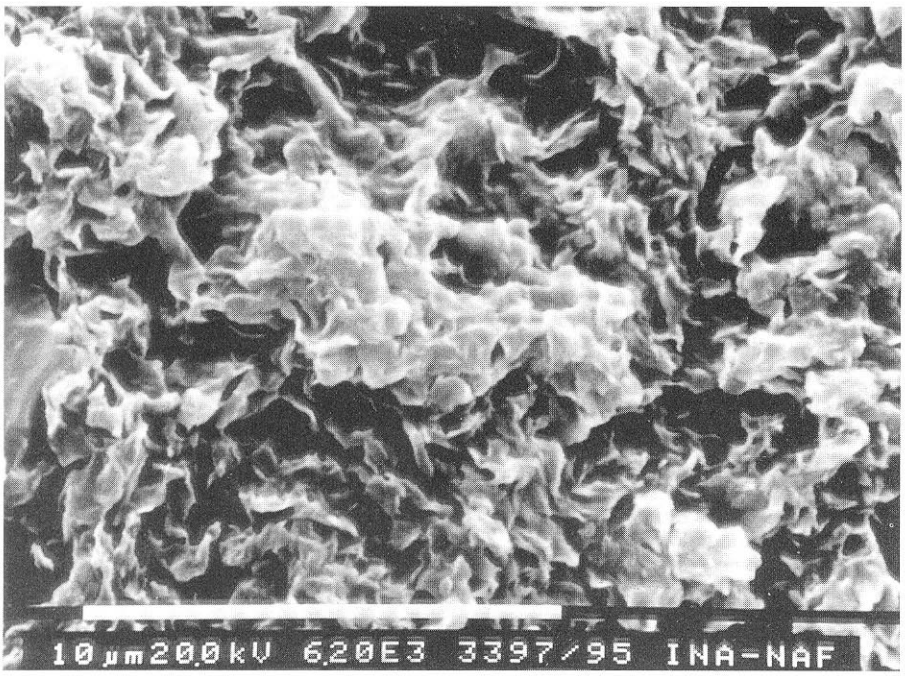


Fig. 2. SEM photo of bentonite sample from the Gornja Jelenska Clay Mine, 6200x.

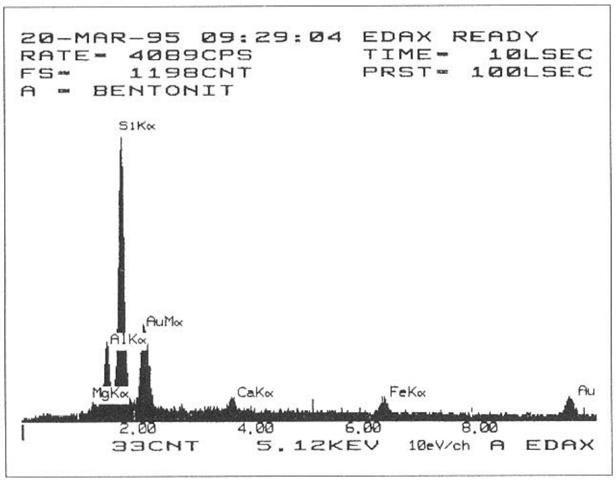


Fig. 3 EDAX of bentonite (shown on Fig. 2) from the Gornja Jelenska Clay Mine.

tute approximately 40% of the total organic content. Amorphous matter represents about 30%, comparable with the liptinite kerogen component which is for the most part composed of microfloral remnants.

In the microflora taphocoenose, spermatophyte taxa prevail, where the gymnosperms predominate over the angiosperms (Fig. 6). The greater genus and species abundance and diversity of the angiosperms over the gymnosperms must be noted (Table 1). Among the rest of determined taxa representatives of the Pteridophyta stand out. Representatives of the Bryophyta, Mycophyta and Chlorophyta were also recognised (Fig. 6).

4.3. PALAEOCLIMATE

In order to determine the palaeoclimatic conditions, particular macrofloral genus and species as well as the entire fossil flora assemblages were compared to recent floral taxa and vegetation taking into consideration their ecological requirements. The botanical affiliation of the palaeomicroflora was made on the basis of palynological papers by KRUTZSCH (1963-1971), PLANDEROVÁ (1990) and NAGY (1969, 1985, 1992).

The microflora is characterised by an abundance of tropical taxa in palynoassociation (37%). The tropical mosses *Saxosporis gracilis* and *Rudolphisporis rudolphi*, different species of the club-moss genus *Echinatisporis*, several species of fern genera *Osmundacidites*, *Mecsekisporites* and *Bifacialisporites* were observed. The tropical angiosperms *Sapotaceoidaepollenites* and *Engelhardtioidites microcoryphaeus* were also recognised (Table 1).

Subtropical palaeovegetation is considerable too (31%) represented by different species of the fern genera *Leiotriletes* and *Laevigatosporites*. Regarding subtropical spermatophytes the taxa of both angiosperms and gymnosperms are present. Fossil microflora remains of Mediterranean vegetation are poorly represented (5%). Plants which characterise moderately warm climate areas comprise 27% of the assemblage. In this group floral species of moderate realm and arcotertiary plants are included together. In recent northern polar regions in pre-Tertiary time a relatively warm climate existed. During global climate change the representatives of this vegetation (e.g. *Pinus, Salix, Betula, Quercus, Acer*,...) intruded towards the south and after the Oligocene they inhabited the rest of Europe as well. The arctotertiary, moderately thermofilous flora become the base from which the recent European flora outside the Mediterranean basin has been developed. Due to the fact that both of these groups represent plants of the moderate climate areas, they were collated together regardless of their origin.

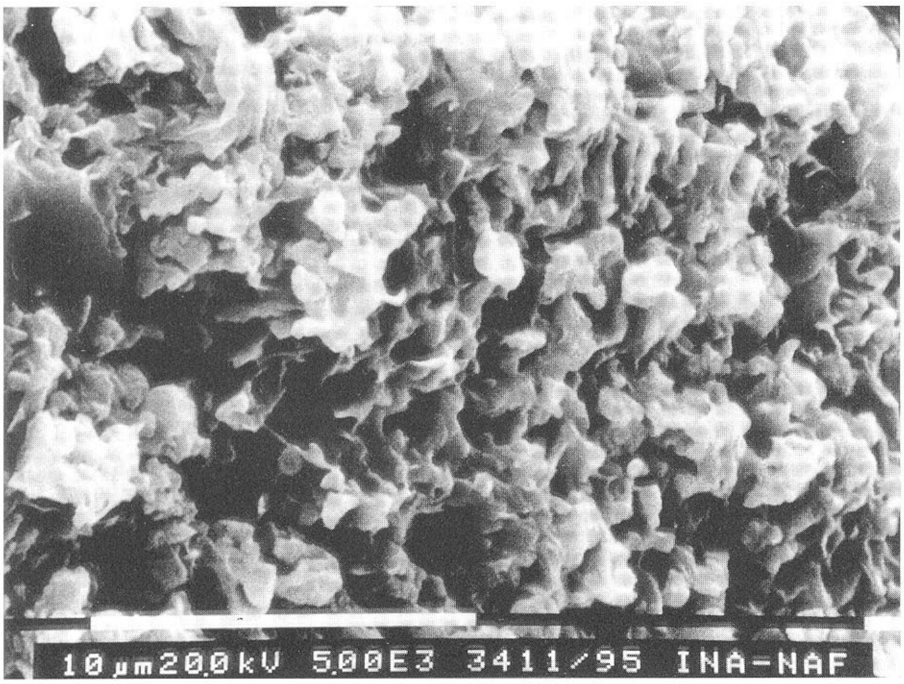


Fig. 4 SEM photo of a sediment sample from the underlying bentonite layer from the Gornja Jelenska Clay Mine on which the foliate bentonite associated with allotriomorphous grains of calcite can be observed. 5000x.

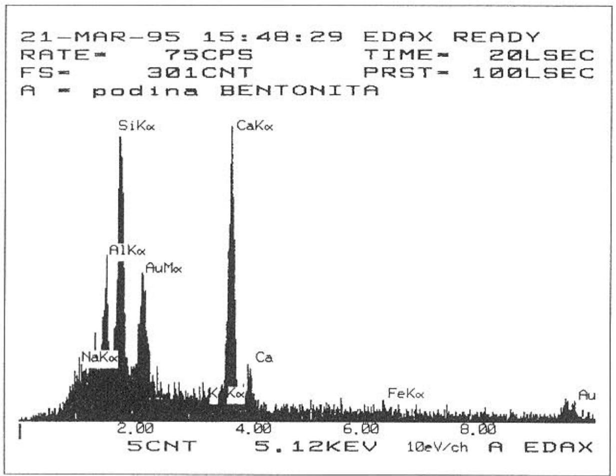


Fig. 5 EDAX of rock sample (shown on Fig. 4) from the Gornja Jelenska Clay Mine.

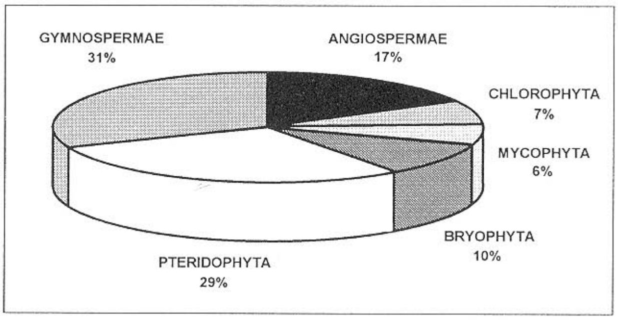


Fig. 6 Quantitative portion of the phyla representatives in the studied microflora assemblages.

Finally, the palaeofloral composition indicates that during sedimentation of the studied rocks from Mt. Moslavačka Gora the climate was warm and subtropical.

Such a definition of the palaeoclimate in the Upper Karpathian to Lower Badenian period - including sometimes the Middle Badenian as well (NAGY 1993) - corresponds to research in Slovakia (PLANDEROVÁ, 1990), Hungary and neighbouring areas (NAGY, 1992). A relatively large proportion of moderate region vegetation surely is connected with global cooling from the Oligocene to the Pliocene. Such a situation is also supported by a slightly cooler climate in the Upper Ottnangian and Lower Karpathian age. The explanation for the appearance of the great number of tropical species is related to the fact that a large number of tropical species from pre-Tertiary time were still not extinct so the warm climate of the Upper Karpathian and Lower Badenian again gave the opportunity for them to flourish (PLANDEROVÁ, 1990),

4.4. PALAEOENVIRONMENT

The vegetation of a certain area mostly depends on ecological conditions, thus any floral association is characteristic for a specific environment.

The fossil microflora assemblage in Gornja Jelenska is rich in autochthonous green algae. Cosmopolitan algae such as *Botryococcus braunii*, but also taxa of diverse species of freshwater thread-like chlorophytes from the *Zygnematacea* family have been observed. The swamp cypress *Taxodium* and leafy swamp plant *Nyssa* (both common in deep swamps) were also determined. Fossil pollen of water plants which inhabit the shallower parts of swamps, water-lilies and lotuses from the family *Nympheaceae* were also recognised.

A riparian marsh area was defined by numerous moss taxa. The most important is the genus *Stereisporites* which botanically belongs to the genus *Sphagnum*. *Sphagnidae* are peat-moss plants. They live on marshy spots building big pillows or even covers. Those on the surface grow from year to year while deeper layers die gradually eventually becoming peat. Peat-moss is calcifobic and requires a certain acidity, that is, an acid substratum of pH 3-4.

Riparian vegetation from nearby freshwater areas were indicated by the existence of numerous liver-wort spores of the genus *Rudolphisporis* (botanically *Anthoceros*), which makes moss-like mats. Also there are some thermophillous ferns (e.g. *Mecsekisporites*, *Bifacialisporites*), gymnosperm pollen (*Pinuspollenites*) and angiosperms (e.g. genera *Carya, Alnus, Quercus, Salix*).

The discovery of a herbaceous pollen (*Chenopodipollis*, *Graminidites*) illustrates the existence of meadows in the vicinity of a swamp or in open forest areas. The ancient piedmont forests with a drier substratum were determined by the angiosperm genera *Tricolpoporopollenites*, *Momipites*, *Intratriporopollenites*, *Zelkovaepollenites*, *Sapotaceoidaepollenites* and gymnosperm genera *Podocarpidites*, *Pinuspollenites*.

Both, autochthonous and allochthonous microflora taxa in the palynoassociation of the microflora suggest an environment with developed forests on surrounding hills of medium altitude and meadows which were partly flooded and temporarily a low marshy area. The depositional environment was the swamp with gently inclined shores, allowing the existence of floating hydrophytes of the genera *Nymphaeapollenites* (FERGUSON 1993), but probably with deeper water areas.

4.5. PALYNOSTRATIGRAPHY

Index-fossils *Rudolphisporis mecsekensis* (Pl. I, Fig. 33), *Mecsekisporites zengoevarkonyensis* (Pl. I, Fig. 32), *Mecsekisporites miocaenicus*, as well as the species which appeared for the first time, like *Vaclavipollis sooiana* (Pl. I, Fig. 30), *Echinatisporis spinosus*, *Echinatisporis wiesaensis* and so on (NAGY, 1985, 1992; PLANDEROVÁ, 1990) in association with other determined taxa (Table 1) show that sedimentation occured 15.5 to 17 m.y. ago between the Upper Karpathian and Lower Badenian (STEININGER et al., 1988). As vegetation is related to the climate, it is very rarely possible to define the age of the strata on the basis of fossil spores and pollen, which ideally correspond to one particular stage in the chronostratigraphic division. It is

CHLOROPHYTA

Botryococcus braunii KÜTZIG 1849
Zygnemataceae div. sp.

MYCOPHYTA

Ustilaginales sp.

BRYOPHYTA

Saxosporis sp. (Pl. I, Fig. 5)
Saxosporis gracilis W. KRUTZSCH & PACLTOVA 1963 (Pl. I, Fig. 8)
Rudolphisporis rudolphi (W. KRUTZSCH 1959) W. KRUTZSCH & PACLTOVA 1963 (Pl. I, Fig. 9)
Rudolphisporis mecsekensis NAGY 1968 (Pl. I, Fig. 33)
Stereisporites stereoides stereoides (R. POTONIÉ 1934) THOMSON & PFLUG 1953
Stereisporites stereoides stereis (W. KRUTZSCH 1959) W. KRUTZSCH 1963
Stereisporites sp. (Pl. I, Fig. 7)
Stereisporites intrastructuris W. KRUTZSCH 1963 (Pl. I, Fig. 22)
Bryophyta gen. et sp. indet. (Pl. I, Fig. 4, Fig. 17)

PTERIDOPHYTA

Lycopodiumsporites (*Retitriletes*) sp.
Verrucingulatisporites undulatus NAGY 1963 *undulatus* (Pl. I, Fig. 27)
Verrucingulatisporites sp.
Echinatisporis echinoides W. KRUTZSCH 1963
Echinatisporis longechinus W. KRUTZSCH 1959 (Pl. I, Fig. 21)
Echinatisporis miocaenicus W. KRUTZSCH & SONTAG 1963
Echinatisporis wiesaensis W. KRUTZSCH 1963
Echinatisporis hidasensis NAGY 1985 (Pl. I, Fig. 25)
Echinatisporis spinosus NAGY 1985
Echinatisporis sp.
Osmundacidites sp.
Osmundacidites primarius (WOLFF 1934) NAGY 1985
Osmundacidites nanus (WOLFF 1934) NAGY 1985 (Pl. I, Fig. 15)
Leiotriletes sp.
Leiotriletes microsinusoides W. KRUTZSCH 1962 (Pl. I, Fig. 2)
Leiotriletes seidewitzensis W. KRUTZSCH 1962
Leiotriletes triangulatoides W. KRUTZSCH 1962 (Pl. I, Fig. 23)
Leiotriletes wolffi W. KRUTZSCH 1962 *wolffi* (Pl. I, Fig. 13)
Polypodiaceoisporites torosus NAGY 1969
Polypodiaceoisporites sp.
Polypodiaceoisporites corrutoratus NAGY 1985 (Pl. I, Fig. 29)
Polypodiaceoisporites triangularis NAGY 1985 (Pl. I, Fig. 28)
Polypodiaceoisporites gracillimus NAGY 1963 (Pl. I, Fig. 26)
Bifacialisporites murensis NAGY 1963 minor (Pl. I, Fig. 18)
Mecsekisporites zengoevarkonyensis NAGY 1968 (Pl. I, Fig. 32)
Mecsekisporites sp.
Mecsekisporites miocaenicus NAGY 1968
Mecsekisporites aequus NAGY 1968
Laevigatosporites haardti (R. POTONIÉ & VENITZ 1934) THOMSON & PFLUG 1953 (Pl. I, Fig. 14)
Laevigatospotites sp.
Laevigatosporites gracilis WILSON & WEBSTER 1946
Polypodiisporites favus (R. POTONIÉ 1931) R. POTONIÉ 1933 (Pl. I, Fig. 24)
Polypodiisporites sp.
Macroleptolepidites krutzschi NAGY 1961

SPERMATOPHYTA

GYMNOSPERMAE

Pinuspollenites peuceformis (ZAKLINSKAJA 1957) PLANDEROVÁ 1990 (Pl. I, Fig. 1)
Pinuspollenites sp. (Pl. I, Fig. 10)
Pinuspollenites labdacus (R. POTONIÉ 1932) R. POTONIÉ 1958
Taxodiaceaepollenites sp.
Cupressacites bockwitzensis W. KRUTZSCH 1971
Podocarpidites sp. (Pl. I, Fig. 31)
Bisaccites gen. et sp. indet.

ANGIOSPERMAE

Magnoliaepollenites sp.
Nymphaeaepollenites pseudosetarius (W. KRUTZSCH 1970) PLANDEROVÁ 1990
Nymphaeaepollenites sp.
Nyssapollenites sp.
Aceripollenites sp.
Ilexpollenites propinquus (R. POTONIÉ 1934) R. POTONIÉ 1960
Tricolporopollenites sp.
Intratriporopollenites insculptus MAI 1961 (Pl. I, Fig. 20)
Intratriporopollenites instructus (R. POTONIÉ 1931) THOMSON & PFLUG 1953
Intratriporopollenites sp.
Oleoidearumpollenites sp.
Cichoreacidites gracilis (NAGY 1969) NAGY 1985 (Pl. I, Fig. 6)
Chenopodipollis multiplex (WEYLAND & PFLUG 1957) W. KRUTZSCH 1966
Vaclavipollis sooiana NAGY 1973 (Pl. I, Fig. 30)
Sapotaceoidaepollenites sp.
Porocolpopollenites latiporis PFLUG & THOMSON 1953 (Pl. I, Fig. 3)
Zelkovaepollenites potoniei NAGY 1969
Alnipollenites verus R. POTONIÉ 1934 (Pl. I, Fig. 16)
Faguspollenites sp.
Quercopollenites sp.
Tricolpopollenites sp.
Caryapollenites simplex (R. POTONIÉ 1931) RAATZ 1937 (Pl. I, Fig. 19)
Engelhardtioidites microcoryphaeus (R. POTONIÉ 1931) R. POTONIÉ 1960 (Pl. I, Fig. 12)
Platycaryapollenites miocaenicus NAGY 1969 (Pl. I, Fig. 11)
Momipites sp.
Myricipites sp.
Myricipites rurensis (PFLUG & THOMSON 1953) NAGY 1969
Myricipites intermedius (KEDVES 1974) PLANDEROVÁ 1990
Salixipollenites sp.
Graminidites sp.

Table 1 Systematic list of the microflora taxa.

especially the case with sediments in Paratethys due to the fact that the climate, although showing a general trend of cooling, has oscillated. Therefore a few warmer Miocene time periods in Paratethys are well known (NAGY, 1992, 1993; PLANDEROVÁ, 1990). One such warmer period was that which lasted through the Upper Karpathian and Lower Badenian, so the vegetation of these times were very similar and must be interpreted uniquely.

5. CONCLUSIONS

On the basis of the palynological analyses the following data have been gathered about the stratigraphy, palaeoecology and depositional environment in which the studied bentonite deposits from the clay mine Gornja Jelenska on Mt. Moslavačka Gora were formed:

- the sediments were deposited during the Upper Karpathian to Lower Badenian (in the period between 15.5 - 17 m.y. ago);
- the climate was warm, subtropical;
- sedimentation took place in a swamp with gently inclined shores, but with existing deeper water areas;
- the forests on surrounding medium elevated hills were developed together with meadows which were partially flooded and turned into a low marshy areas.

Acknowledgements

I am grateful to geological technicians Ivanka TOLJAN and Ljerka JURATOVAC for making the palynological slides. Thanks go also to my colleagues Renata SLAVKOVIĆ and Željka MARIĆ-ĐUREKOVIĆ for SEM interpretation as well as petrographical and lithological analyses. They are all employees of INA-Naftaplin.

I would like to thank Dr. Eszter NAGY (Hungarian Geological Institute, Budapest), Dr. Miklós KEDVES (Attila József University, Szeged) and one anonymous referee for their very helpful suggestions, comments and critical reviews of the manuscript.

6. REFERENCES

BAJRAKTAREVIĆ, Z. (1981): Donji baden (donji "torton") južnog dijela Moslavačke gore.- Geol. vjesnik, 34, 9-13.

FERGUSON, D.K. (1993): Plant Taphonomic Studies with Special Reference to Messel.- Kaupia, Darmstädter Beiträge zur Naturgeschichte, 2, 117-126, Darmstadt.

KOCH, F. (1899): Prilog geoložkom poznavanju Moslavačke gore.- Rad JAZU, 139, 1-28, Zagreb.

KOCH, F. (1906): Geologijska prijegledna karta Kraljevine Hrvatske - Slavonije. Tumač geologijske karte Ivanić Kloštar - Moslavina (Zone 23 col. XV), M 1:75000.- Nakl. Kr. zemalj. vlade, Odjela za unutarnje poslove, 1-22, Zagreb.

KOCHANSKY-DEVIDÉ, V. & SLIŠKOVIĆ, T. (1978): Miocenske kongerije Hrvatske, Bosne i Hercegovine.- Palaeontologia Jugoslavica, JAZU, 19, 1-98, Zagreb.

KOROLIJA, B., VRAGOVIĆ, M., CRNKO, J. & MAMUŽIĆ. P. (1986): Tumač za Osnovnu geološku kartu SFRJ 1:100000, list Bjelovar.- Institut za geološka istraživanja, Zagreb, Sav. geol. zavod, Beograd, 45p.

KRUTZSCH, W. (1963-1971): Atlas der mittel und jungtertiären dispersen Sporen und Pollen sowie der Mikroplanktonformen des nordlichen Mitteleuropas.- VEB Deutscher Verlag der Wissenschaften & VEB Gustav Fischer Verlag, Lieferung 2-7, Berlin, Jena.

NAGY, E. (1969): Palynological Elaborations of the Miocene Layers of the Mecsek Mountains.- MAFI, 52/2, 285-650, Budapest.

NAGY, E. (1985): Sporomorphs of the Neogene in Hungary.- Geologica Hungarica, Series Palaeontologica, 47, 1-471, Budapest.

NAGY, E. (1992): A Comprehensive Study of Neogene Sporomorphs in Hungary.- Geologica Hungarica, Series Palaeontologica, 53, 1-379, Budapest.

NAGY, E. (1993): Paleofloristic and paleoclimatic changes in the Hungarian Neogene.- Paleofloristic and Paleoclimatic changes during Cretaceous and Tertiary, Bratislava, Sept. 14-20. 1992, 131-132, Bratislava.

OŽEGOVIĆ, F. (1944): Prilog geologiji mladeg tercijara na temelju podataka iz novijih bušotina u Hrvatskoj.- Vjestnik Hrv. drž. geol. zavoda i Hrv. drž. geol. muzeja, 2/3, 391-491, Zagreb.

OŽEGOVIĆ, F. (1953): O geologiji i paleogeografiji SW dijela Moslavačke gore.- Geol. vjesnik, 5-7 (1951-1953), 185-200.

PAMIĆ, J. (1990): Alpinski granitoidi, migmatiti i metamorfiti Moslavačke gore i okolne podloge Panonskog bazena (Sjeverna Hrvatska, Jugoslavija).- Posebna izdanja Razreda za prir. znan. JAZU, 10, 7-121, Zagreb.

PLANDEROVÁ, E. (1990): Miocene microflora of Slovak Central Paratethys and it's biostratigraphical significance.- Dionyz Štur Institute of Geology, 1-144, Bratislava.

PLETIKAPIĆ, Ž. (1969): Stratigrafija, paleogeografija i naftoplinonosnost Ivanić-grad formacije na obodu Moslavačkog masiva.- Unpublished Ph.D. Thesis, University of Zagreb, 71p.

STEININGER, F.F., MÜLLER, C. & RÖGL, F. (1988): Correlation of Central Paratethys, Eastern Paratethys, and Mediterranean Neogene Stages.- In: ROYDEN, L.H. & HORVÀTH, F. (eds.): The Pannonian Basin. A Study In Basin Evolution. AAPG Memoir 45, The American Association of Petroleum Geologists & The Hungarian Geological Society, 79-87, Tulsa.

VUKOTINOVIĆ, Lj. (1852a): Sitzung vom 13. Jänner (Abhandlung über die geolog. Beschaffenheit des

Moslaviner Gebirges).- Jahrb. geol. Reichsanst., 3/1, 171-172, Wien.

VUKOTINOVIĆ, Lj. (1852b): Das Moslaviner Gebirge in Croatien.- Jahrb. geol. Reichsanst., 3/2, 92-95, Wien.

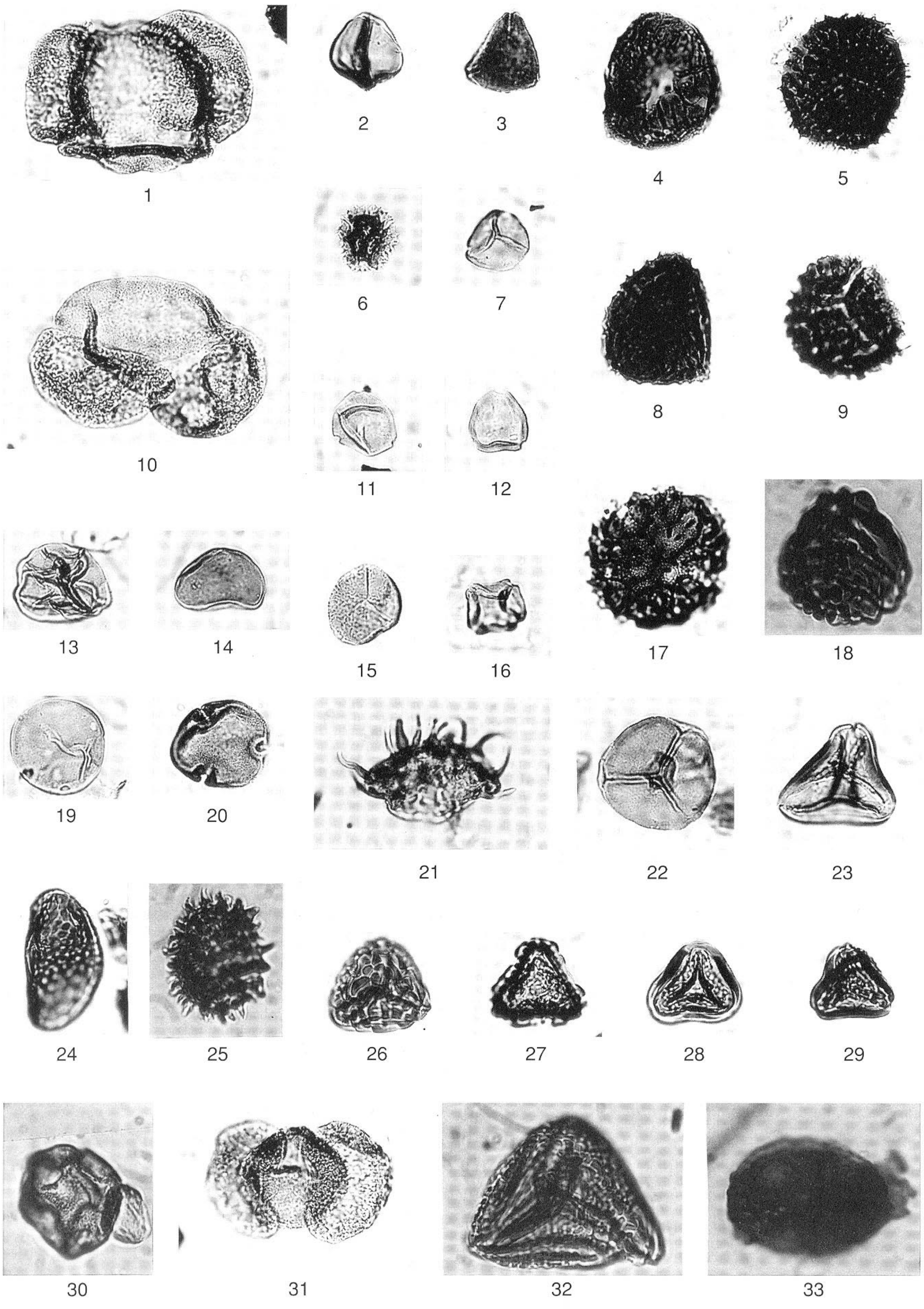
Manuscript received May 17, 1995.
Revised manuscript accepted November 10, 1995.

PLATE I

The Gornja Jelenska Clay Mine Floral Assemblage

Upper Karpathian - Lower Badenian

1 *Pinuspollenites peuceformis* (ZAKLINSKAJA 1957) PLANDEROVÁ 1990, 500x.
2 *Leiotriletes microsinusoides* W. KRUTZSCH 1962, 500x.
3 *Porocolpopollenites latiporis* PFLUG & THOMSON 1953, 500x.
4 *Bryophyta* gen. et sp. indet., 500x.
5 *Saxosporis* sp., 500x.
6 *Cichoreacidites gracilis* (NAGY 1969) NAGY 1985, 500x.
7 *Stereisporites* sp., 500x.
8 *Saxosporis gracilis* W. KRUTZSCH & PACLTOVA 1963, 500x.
9 *Rudolphisporis rudolphi* (W. KRUTZSCH 1959) W. KR. & PACLTOVA 1963, 500x.
10 *Pinuspollenites* sp., 500x.
11 *Platycaryapollenites miocaenicus* NAGY 1969, 500x.
12 *Engelhardtioidites microcoryphaeus* (R. POTONIÉ 1931) R. POTONIÉ 1960, 500x.
13 *Leiotriletes wolfi wolfi* W. KRUTZSCH 1962, 500x.
14 *Laevigatosporite hardti* (R. POT. & VENITZ 1934) THOMSON & PFLUG 1953, 500x.
15 *Osmundacidites nanus* (WOLFF 1934) NAGY 1985, 500x.
16 *Alnipollenites verus* (R. POTONIÉ 1934) *medius* PLANDEROVÁ, 500x.
17 *Bryophyta* gen. et sp. indet., 500x.
18 *Bifacialisporites murensis* NAGY 1963 *minor* NAGY 1969, 750x.
19 *Caryapollenites simplex* (R. POTONIÉ 1931) RAATZ 1937, 500x.
20 *Intratriporopollenites insculptus* MAI 1961, 500x.
21 *Echinatisporis longechinus* W. KRUTZSCH 1959, 750x.
22 *Stereisporites intrastructuris* W. KRUTZSCH 1963, 500x.
23 *Leiotriletes triangulatoides* W. KRUTZSCH 1962, 500x.
24 *Polypodiisporites favus* (R. POTONIÉ 1931) R. POTONIÉ 1933, 500x.
25 *Echinatisporis hidasensis* NAGY 1985, 750x.
26 *Polypodiaceoisporites gracillimus* NAGY 1963, 500x.
27 *Verrucingulatisporites undulatus* NAGY 1963 *undulatus* W. KRUTZSCH 1967, 500x.
28 *Polypodiaceoisporites triangularis* NAGY 1985, 500x.
29 *Polypodiaceoisporites corrutoratus* NAGY 1985, 500x.
30 *Vaclavipollis sooiana* NAGY 1973, 750x.
31 *Podocarpidites* sp., 500x.
32 *Mecsekisporites zengoevarkonyensis* NAGY 1968, 750x.
33 *Rudolphisporis mecsekensis* NAGY 1968, 750x.


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33