TRACING OF PALynomorphs IN THE EASTERN SLOVAKIAN KARST

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Abstract. Normapolles pollen, fern spores, recent fungi and other palynomorphs were traced and identified from a sample of calcareous/clayey deposits from the Gombasek Quarry in eastern Slovakia (Rožňava district). Normapolles, pollen of the extinct angiospermous plants, dominated the spectrum, spores of ferns were also frequent. Presence of these types indicate a Mesozoic (Upper Cretaceous) to Early Paleogene age of the source rocks. The assemblage is mixed with specimens of recent fungi spores, remains of algae and rare gymnosperm and angiosperm pollen grains (Pinus, Asteraceae). Significant Tertiary (Paleogene) taxa were not discovered there. The study produced several new records of taxa which had not been found at this locality previously.

Palynology, Cretaceous, Tertiary, Palaeokarst, Normapolles, Gombasek, Slovak Republic

Introduction

The Gombasek locality is situated in the Inner Western Carpathian Belt on the southern margin of the Plešivec Plateau (part of the Slovak Karst). Various sediments of the Slovak karst are mostly represented by Triassic limestones and shales. The local limestone underwent periods of intensive karstification during the Upper Cretaceous. It resulted in the formation of narrow fissure caves (sometimes with goethite flowstones) and larger sinkholes often filled with lakelets or wetlands. These sediments are described as the Gombasek Member (Santonian–Coniacian; Činčura 1973; Činčura and Köhler 1995). They characteristically consist of alternating “flyschoid” strata of dark-coloured shales and limestones that may correspond to monsoonal hydrological regimes. The occurrence of iron ores and desiccation cracks may document a relatively shallow lake environment with seasonally drying near-shore areas. It occurs in Gombasek Quarry in 200 m thick interval of beds which is probably non-tectonic interval.

The Gombasek Quarry is an active mine where every few years new karst cavities are discovered. The importance of collected samples is based on geomorphological implications of the same type of sediment that was found at the upper part of the quarry close under the surface of the karst plateau and the samples that were found and previously described from the middle part of the valley, more than 100 m below the new find. If these samples are contemporary we can prove not only the important Upper Cretaceous phase of karstification but the existence of complex and developed karst morphology as well.

The first systematic survey of the Gombasek Member was carried out by Mello and Snopková (1973), results of recent palynological studies were published by Svobodová (in Cílek and Svobodová 1999). The tectonics and structural geology of this locality were described by Sasvári et al. (2006).

The studied material represents sediments of an open karst depression laterally connected with fissure and cave systems filled by brown-coloured sediments (weathered clays with small pyrite nodules, Text-fig. 1). While the previous studied samples were taken from an extensive Gombasek outcrop behind the so-called Gombasek Needle (Gombasecká ihľa) situated approximately in the middle part of the wide valley, the present sample comes from a site located some 60 m below the level of the Plešivec karst plateau. Clayey and silty sediments of the Gombasek Member are usually intensively weathered, forming pale brown clayey/silty sands which were found in several large karst depressions at the Plešivec Plateau level. Younger sinkholes are filled with red rewashed terra rossa sediments.

On the basis of morphology of the relatively numerous and widespread caves and sinkholes which contain in situ or almost in situ Gombasek Member sediments we thus assume that already during the Upper Cretaceous – Lower Paleoen-
gene a period well developed, humid and morphologically diversified karst landscape emerged as a basis for repeated cycles of younger karst processes.

The aim of this research was to record the whole assemblage of palynomorphs in the organic content, assess the presence of pollen and spore taxa which are very rare in karst infill sediments and also the presence of more evolutionary advanced angiosperms significant for the Paleogene period. This is the first study on this part of the Gombasek quarry (Text-fig. 1).

Material and methods

The sample of grey claystone was processed in the Laboratories of the Czech Geological Survey (A. Tichá) using HCl, HF, KOH followed by acetolysis. Four prepared slides were scanned under a light microscope (Olympus BX50, magnification: ’40 and ’100, DCI). The spores and pollen were mostly well preserved, but were generally not abundant. Thus, it was not possible to perform a quantitative analysis and results of taxonomic analysis are presented only. Palynomorphs were identified by comparison with Mello and Snopková (1973), Góczán et al. (1967), and the widely known classical literature such as Couper (1953), Weyland et Krieger (1953) and Pflug (1953). A general overview of Normapolle morphology (Batten and Christopher 1981) and a specific chapter in Traverse (2008) were very helpful with regard to the higher alteration (carbonization) of thick pollen exines.

Systematic part

Fungi
Pl. 1

Several morphological types of fungal bodies including spores were observed. Among them unicellular, multicellular and rare dicellate bodies occurred, aporate or with pores. The appearance of many of the recorded remains resembles modern fungi, e.g. in their inner structure and surface patterns, composed of short spinae or granula (Pl.1, figs 14-17); rarely large dark empty dyads were present (Pl.1, fig. 4), also known from the Cretaceous and other fossil assemblages. Light-brownish or yellowish morula-like ‘polyads’ (Pl.1, figs 18,19, 25,26) may belong to both multicellular fungal bodies (figs 25,26) and/or cyanobacterial/algal colonies (fig. 18,19).

This fungi remains (Pl. 1, 1-3, 13, 14-17, 25, 26) are of Quaternary age or they are recent.

?Basidiomycota s.l.
Pl.1, figs 1-3

Remarks: Thick-walled spores, spherical to irregular in outline with several pores.

cf. Alternaria sp.
Pl.1, fig. 13

Remarks: It was compared with recent specimen (gen. Alternaria) which shows similarities with studied fossils in shape (they are club-shaped), the conidia have transversal and longitudinal septa and long nib.

cf. Dicellaesporites sp.
Pl.1, fig.4

Dicellate spore, wall smooth and thin, markedly large cells.

Remarks: Cretaceous, Paleocene, stratigraphically not significant.

?Cyanobacteria/Algae/(Fungi)
Pl. 1, figs 18,19

Remarks: Quaternary/contemporaneous sporomorphs.
Green Algae

Genus Ovoidites (POTONIÉ 1951) KRUTZSCH 1959

Ovoidites sp.

Remarks: Recent relation – Zygnemataceae. Algal zygospores and aplanospores were rarely recorded. Zygospores were observed as oval bodies with a slight longitudinal suture, Ovoidites sp. (recent Spirogyra, Zygnema), or rarely as spherical bodies of morula-like forms (Pl. 1, figs 18,19). These bodies resemble other forms, smaller and tightknit, probably Fungi (Pl. 1, figs 25,26). We took into account the colour variations in both cases (rather dark brown colour in the latter) as a more characteristic feature of the fungal remains.

Spores
All trilete spores belong to bryophytes or pteridophytes.

Genus Stereigranisporis (KRUTZSCH 1963) KEDVES 1982 in KEDVES et RUSSEL 1982

Syn.: Stereisporites THOMSON et PFLUG 1953 (Subgen. Stereigranisporis KRUTZSCH 1963)

aff. Stereigranisporis sp.
Pl. 2, fig. 4

Spore outline rounded triangular, trilete scar distinct, reaching the equatorial rim; surface ornamented by granula and low warts (partly coalescing), forming lines or valae along arms; isolated grana occur more densely in the middle of the proximal face. ?Cingulum or equatorial rim developed.

Relationships: Most probably Lygodium-types (Schizaeaceae). Some authors assigned the types figured in Pl. 2, figs 12,15 to Dictyophyllidites harrisi, but others to Deltoidospora. After comparison with Lygodium spores in situ, we assigned this type to the genus Leiotriletes. (Nevertheless, this assessment may be ambiguous, especially due to relative thinness of spore exines.)

Remarks: Discussion of the above mentioned morphological genera Dictyophyllidites, Cyathidites, and Leiotriletes and their relationships to recent families and macrofossil fern taxa, based on in situ spores and fern morphology, is given in van Konijnenburg-van Cittert (1989) and also in Traverse (2008).

Genus Cyathidites COUPER 1953

Cyathidites australis COUPER 1953
Pl.2, fig. 9

Remarks and Range: Cyatheaceous spores (Cyathaceae, Dicksoniaceae; Traverse 2008) with wide palaeogeographical distribution in the Mesozoic (tab.1) known from the early Tertiary of Africa.

Genus Leiotriletes KRUTZSCH 1959

Leiotriletes adriennis (POTONIÉ et GELLETICH 1933) KRUTZSCH 1959
Pl.2, figs 10-15


Genus Gleicheniidites Ross 1949

cf. Gleicheniidites sp.
Pl. 2, fig. 3

Remarks: Gleicheniidites spores display very wide palaeographical distribution in the Mesozoic.

Genus Dictyophyllidites COUPER 1958

emend. DETTMANN

Dictyophyllidites harrisi COUPER 1958
Pl. 2, figs 7,8

The exine has a conspicuously thin wall in contrast to the Leiotriletes triplane or semitriplane spores, and transparent elevated lips.

Relationship between fossil Dictyophylllum (fern leaves) and spores Dictyophyllidites. Dictyophylllum is of the Phleo-/opteris – type, a fossil fern from the family cf. Matoni aceae (Traverse 2008), Dipteridaceae family after Nemejc (1963), now containing only Dipteris (Tryon et Lugardon 1991); spores Dictyophyllidites were recorded in situ in the Jurassic fossil fern Dictyophylllum and display a cheirolepiaceous character (in comparison with recent fern spores); a general survey of the finds and their relationships is given in van Konijnenburg-van Cittert (1989) and Traverse (2008).

Range. Group of spores – Triassic, Jurassic, Cretaceous.

Genus Trilites COOKSON ex COUPER 1953

Syn. Corrugatisporites THOMSON et PFLUG 1953

Trilites sp.
Pl. 2, figs 5,6

Remarks: Corroded spore, remarkably tiny granula and rodlets on the surface and ghost residues of corrugae and ridges (?Schizaeaceae, ?Dicksoniaceae, Matonia-Matoniaceae), resembling Corrugatisporites. Its relatively thin exine differs from that of other spores (except for trilete spore in Pl. 2, figs 16,17).

Genus Deltoidospora (DELCOURT et SPRUMONT 1955)

DETTMANN et HUGHES 1963

cf. Deltoidospora sp.

Relationships: Fossil fern Onychiopsis Yoko-
YAMA, taxonomically indefinite type (Sukh-Dev 1980); Pteridaceae, Eocene-Oligocene sediments (Collinson 1978); Matoniaceae, Gleicheniaceae.

Genus Vadaszisporites DEÁK et COMBAZ 1967
cf. Vadaszisporites sp.
Remarks: Trilete foveolate spore only partly preserved.

cf. Vadaszisporites sacali DEÁK et COMBAZ 1967
Pl.2, figs 1,2
Remarks: The spore is comparable with the genus Vadaszisporites reported by Kedves (1984) as V. sacali, recorded in the rich assemblage from the Senonian deposits in southern Hungary (Upper Senonian, Csávoly-type assemblage, ibid). Vadaszisporites sacali is also known from the Upper Albian of Hungary (Juhász 1983). This taxon is distinguished by exine ornamentation patterns.

Relationships: Presumed to be related to the family Lycopodiaceae (Kedves 1984).

Sporae incertae sedis
Pl. 2, figs 16,17
Remarks: Trilete spore, with relatively thin, translucent exine, trilete scar with long arms reaching the equator. Exine with low verrucate and granulate/foveolate pattern. Corrosion and poor preservation did not permit taxonomic classification.

Gymnosperms
Pinus silvestris – type
Pl. 1, fig. 10
Remarks: Only isolated saccus, probably Quaternary or recent.

Angiosperms
Normapolles PFLUG 1953
Triporate brevaxone pollen grains with protruding complex apertures.
The recorded Normapolles (pollen of extinct plants) were documented in light microscope microphotos (Plate 3, figs 1-17). Cílek and Svbodová (1999) also reported results from SEM observations together with micrographs. They clearly documented the type of coarse exine pattern seen in several Normapolles taxa.

Genus Oculopolis PFLUG 1953
Oculopolis sp.
Pl. 3, figs 1,9,10
Remarks: Large-sized pollen with massive oculi.

cf. Oculopolis sp.
Pl. 3, figs 11,12
Remarks: Large-sized pollen with massive oculi, very similar to the genus Oculopolis.

Oculopolis cf. zaklinskaiae GÓCZÁN 1964
– Oculopolis cf. semimaximus KRUTZSCH 1968
Pl. 3, figs 16,17
Remarks: Large-sized pollen with massive oculi covering part of the exine surface. Exine coarsely scabrate.

Oculopolis concentus PFLUG 1953 vel Semioculopolis sp.
Pl. 3, figs 3,4

Genus Pseudoculopolis GÓCZÁN,
KRUTZSCH et PAULTOVÁ 1967

aff. Pseudoculopolis principalis
(WEYLAND et KRIEGER 1953) KRUTZSCH 1967
Pl. 3, fig. 2

cf. Pseudoculopolis principalis
(WEYLAND et KRIEGER 1953) KRUTZSCH 1967
Pl. 3, fig. 13
Remarks: The above pollen grains of Pseudoculopolis also resemble Oculopolis (former synonym for the genus and species principalis); the connection between oculi across the pole area is not clear in our specimens. This species is known from the Middle Santonian to Early Campanian.

Genus Trudopollis (PFLUG 1953)
emend. KRUTZSCH 1967

Trudopollis pertrudens
(PFLUG in THOMSON et PFLUG 1953) PFLUG 1953
Pl. 3, figs 5-8
Remarks: The genus and related species were common in the Late Cretaceous and may also occur in Palaeocene and Early Eocene spectra.

Genus Krutzschipollis GÓCZÁN 1967

Remarks: Stratigraphic range of the genus – Santonian to Maastrichtian.

Krutzschipollis magnoporus GÓCZÁN 1967
Pl. 3, figs 14,15
Remarks: The pollen is characterized by large size, thick exine and projecting anuli. Its occurrence is characteristic for the Cretaceous, Early Maastrichtian deposits from Hungary.

Angiosperms – non Normapolles
Genus ?
Pl. 3, figs 18,19
Remarks: Unidentified pollen grain, equatorial view.
**Aster-type, Tubiflorae, Asteraceae**  
Pl.1, figs 21,22

Remarks: Pollen grain displays opalescent exine, short spinae and it is of tricolpate/tricolporoide type (only one specimen recorded). Asteraceae are widespread and common in Quaternary sediments and also confirmed by numerous fossil achenes in Pliocene sediments e.g. from Poland (Kristofovic 1957, Němejc 1975).

cf. **Graminidites** sp., cf. Poaceae  
Pl. 1, figs 11,12

Remarks: Quaternary/contemporaneous sporomorphs.

?

**Graminidites** sp., ?Poaceae  
Pl. 1, figs 23,24

Remarks: Recent palynomorph (according to wall character), specific assessment was not possible.

?? **Cyperaceaeopollis** sp.  
Pl. 1, figs 7,8

Remarks: Angiospermous pollen grain. The compression and fixation of pollen during preparation did not allow their assessment. According to the exine character, it could be considered as both a Quaternary and pre-Quaternary plant provenance.

**Incertae sedis**  
Pl. 1, figs 5,6,9,20

Remarks: Quaternary/contemporaneous sporomorphs.

**Results and discussion**

Our data contribute to discussion of the palynological content and dating of karst infills in the Rožňava Region. However, it is only possible to use them for approximate estimation of age. Identified palynomflora was relatively scarce, which is in accordance with the results of a number of previous studies. The observed spectrum contains predominantly pollen of extinct taxa with a thick exine and prominent oculi. More precise dating requires further analyses of continuous sedimentary sequences and evaluation of gradual changes in richer fossil communities.

Fossil angiosperm pollen grains generally indicate a Late Cretaceous to Paleogene age for the studied sediments; however, only a few identified taxa may indicate an Early Paleogene age. With regard to the environment, fossil pollen and spores were derived from terrestrial vegetation, marine plankton was not recorded. Taking into account the plant habitus, tree and climbing ferns dominated among the pteridophytes, probably in contrast to the habit of the extinct Normapolles plants. Normapolles mother plants might have been epiphytic, parasitic plants, grassy forms or of arborescent habit (Zaklinskaya 1981).

Quaternary elements were for the first time indicated in the assemblage (fungi, algal cysts, incertae sedis palynomorphs, pollen), as scarce recent admixture (tab. 1). It is remarkable that Mesozoic chiolepidaceous conifers or Abietinae were absent in this assemblage, while specimens of the angiosperm group Normapolles were relatively frequent. The studied association was dominated by genera related to *Oculopollis* (Pl. 3). Noteworthy was the co-occurrence of the significant genus *Krutzschipollis*, present at two sites from Gombasek Quarry (Mello and Snopková 1973) and also in the important sequence from Hostovce (Cílek and Svobodová 1999); similarly co-occurrence of the specimens of the *Oculopollis* cf. *zaklinskaiae* in Gombasek (Mello and Snopková 1973). Both the above mentioned taxa are known from several sites in Hungary (Góczán 1964, Góczán in Góczán et al. 1967), corresponding to a Santonian-Maastrichtian age. *Oculopollis semimaximus* is abundant in the Santonian of southern France, in the non-boreal Cretaceous province (Krutzsch 1968). Normapolles indicate a stratigraphic range from the Late Cretaceous (predominantly) to Paleogene (exceptionally). Their peak occurrence falls in the Maastrichtian. The recorded taxa predominantly show a stratigraphic range from the Santonian to the Maastrichtian, *Trudopollis* (*T. pertrudens*) specimens may appear up to the Paleocene (Pflug 1953) and then up to the early Eocene (chart for Central Europe, Krutzsch in Góczán et al. 1967 and other authors; Text-fig. 2). Identified fern spores were widespread throughout the Mesozoic; their recent analogues occur mostly in tropical and subtropical forests (Central America, south-western China). Common ferns in both the Mesozoic and particularly Tertiary Flora are represented by *Lygodium*-type lianas (Scythraeaceae). Stripped *Mohria* spores, occurring predominantly in the tectonic Cretaceous to early Tertiary palyno-and lithofacies, were not recorded. The absence of *Classopolis* pollen, a characteristic group of gymnosperms from the Jurassic
Acknowledgements

For the studied sample might be inferred from the presence of advanced descendents, Post-Normapolles. A Paleogene age (Russel 1982, Portnyagina 1981, a.o.), mixed with more prominent and protruding (Pl. 3, figs 1-17), they are similar to taxa characteristic for the Late Upper Cretaceous (Góczán et al. 1967, Krutzsch and Vanhoorne 1977, Kedves and Russel 1982, Portnyagina 1981, a.o.), mixed with more advanced descendents, Post-Normapolles. A Paleogene age for the studied sample might be inferred from the presence of Trudopollis also occurringin Paleocene (e.g. Menat in France, Kedves and Russel 1982). However, the majority of identified palynomorphs indicate an Upper Cretaceous age (probably Maastrichtian). Similar conclusions were already reported in the previous palynological studies (Snopková in Mello and Snopková 1973, Svobodová in Cílek and Svobodová 1999). The significant advanced angiosperm pollen, e.g. Stephanoporopollenites forms, were not recorded. The post-Cretaceous period of karstification may be evidenced by the intense corrosion of some spore exines in the assemblage, caused by oxidation (Pl. 2, figs 5, 6, 16, 17) or by sulphides (Pl. 2, figs 15, 16).

In addition to the above listed taxa, modern sporomorphs were recorded in the studied association as well as the rare elements – *Pinus*, Asteraceae, cf. Poaceae, morphologically differentiated Fungi, algal spores (aplanospores, zygospores), and evidently recent palynomorphs incertae sedis (Pl. 1). Organic remains also displayed a different carbonization level: more carbonized and less or uncarbonized organic fragments were associated together.

Further search for fossiliferous samples in the Gombasek Quarry might reveal new stratigraphically significant taxa and permit more precise dating of geological and geomorphological evolution of this region.

Conclusions

Normapolles pollen, fern spores, recent Fungi and other palynomorphs were traced and newly identified from a sample of the calcareous/clayey deposits from the Gombasek Quarry in eastern Slovakia (Rožnava District). Normapolles, pollen of extinct angiospermous plants, dominate the spectrum, spores of ferns are also frequent. Both testify to a Mesozoic source of the rocks, predominantly the Upper Cretaceous, some indicate a Cretaceous/Early Paleogene age.

The significant Tertiary (Paleogene) taxa were not discovered in Gombasek. The study produced several new records of taxa which had not been found previously at this locality.

Acknowledgements

We express our gratitude to M. Kováčová (Comenius University, Slovakia) for Mello and Snopková’s publication, to E. Břízová (Czech Geological Survey, Prague) for consultation (Cyperaceae pollen) and M. Svobodová (Institute of Geology AS CR, v.v.i., Prague) for kindly providing the preparations. Special thanks to Jiří Kvaček (National Museum, Prague) for microscopy facilities. M. Svobodová and M. Kováčová are also acknowledged for their reviews and useful suggestions. This work was financially supported by the research program AVOZ 30130516 of the Institute of Geology, AS CR, v.v.i. and project No. IAA304070701.

References


**Explanation of the plates**

**PLATE 1**
Fungi, Fungi – ?Algae and *Incertae sedis* palynomorphs, scale bar = 10 µm (*’1000*).

1, 2. Fungi, ?Basidiomycota s.l.; two focus levels.
5, 6. *Incertae sedis*, palynomorph with fine striae; two focus levels.
7, 8. ?*Cyperaceaepollis* sp., angiospermous pollen at two focus levels; not determinable in the fixed medium.
9. *Incertae sedis*, spherical palynomorph, incertae sedis; in color and light opalescent wall comparable with other specimens except Fungi and angiospermous pollen (figs 7, 8).
11, 12. cf. *Grauminidites* sp.; two focus levels.
14, 15. Fungi, *incertae sedis*; two focus levels;
16, 17. Fungi, spore with long slit, *incertae sedis*; two focus levels.
18, 19. ?Cyanobacteria/Algae/Fungi, light brown-yellow morula-like polyade, *incertae sedis*; two focus levels.
20. *Incertae sedis*, Fungi or Algae, two cells with plasma content.
21, 22. Asteraceae, Tubiflorae, *Aster*-type, ubisch bodys on the surface; two focus levels, Quaternary.
23, 24. ?Poaceae, deposits on the grain are secondary granulae; two focus levels, Quaternary.
25, 26. Fungi, dark brown morula-like polyade, *incertae sedis*; two focus levels.

**PLATE 2**
Pteridophytes, Filicinace – spores; scale bare = 10 µm (*’1000*).
1, 2. cf. *Vadaszisporites sacali* DEÁK et COMBAZ, Lycopodinae (after Deák and Combaz 1967), Pteridophytes; two focus levels.
3. cf. *Gleicheniidites* sp.
4. cf. *Stereigranisporis* sp., Pteridophyta
5, 6. Corroded trilete, likely corrugate spore (ex *Trilites*/syn. *Corrugatisporites*); two focus levels.
7, 8. *Dictyophyllidites harrisii* COUPER – “*Triplanosporites*” – morphotype, triplane aspects; two focus levels.
9. *Cyathidites australis* COUPER, Schizaeaceae, Cyatheaceae, Dicksoniaceae
10, 11. *Leiotriletes adriennis* (POTONIÉ et GELLETICH) KRUTZSCH; two focus levels.
12, 15. *Leiotriletes adriennis* (POTONIÉ et GELLETICH) KRUTZSCH; triplane aspects.
13, 14. *Leiotriletes adriennis* (POTONIÉ et GELLETICH) KRUTZSCH, semi-tripline aspects; two focus levels.
16, 17. Pteridophytes, trilete spore; two focus levels.

**PLATE 3**
Angiosperms – pollen; scale bare = 10 µm (*’1000*).
1. *Oculopollis* sp., Normapolles.
3, 4. *Oculopollis concensus* PFLUG, Normapolles; two focus levels.
5–8. *Trudopollis pertrudens* (Pflug in Thomson et Pflug) Pflug, Normapolles, figs 5-7, one specimen, three focus levels; fig. 8, another specimen.

9,10. *Oculopollis* sp., Normapolles; two focus levels.

11,12. cf. *Oculopollis* sp., Normapolles; two focus levels.


14,15. *Krutzschipollis magnaporus* Góczán, Normapolles; two focus levels.

16, 17. *Oculopollis* cf. zaklinskaiae Góczán – *Oculopollis semimaximus* Krutzsch – types, Normapolles; two focus levels.

18, 19. Angiospermous pollen grain, equatorial view; two focus levels.
Table 1. List of fossil palynomorphs, their botanical affinity and stratigraphy.

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<td><em>Pteridophyta</em>,</td>
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<td>Pl. 2, fig. 4</td>
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<tr>
<td>Trilites sp.</td>
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<td>extinct plants</td>
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<td>Pl. 3, fgs 3,4</td>
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<tr>
<td></td>
<td><em>aff. Pseudoculopollis principulis</em></td>
<td>extinct plants</td>
<td></td>
<td>Pl. 3, fig. 2</td>
</tr>
<tr>
<td></td>
<td><em>Oculopollis cf. zaklinskyae – O. cf.</em></td>
<td>extinct plants</td>
<td></td>
<td>Pl. 3, fgs 16,17</td>
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<td></td>
<td><em>Oculopollis sp.</em></td>
<td>extinct plants</td>
<td></td>
<td>Pl. 3, fgs 1,9,10</td>
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<tr>
<td></td>
<td>cf. <em>Oculopollis sp.</em></td>
<td>extinct plants</td>
<td></td>
<td>Pl. 3, fgs 11,12</td>
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<tr>
<td></td>
<td><em>cf. Pseudoculopollis principulis</em></td>
<td>extinct plants</td>
<td></td>
<td>Pl. 3, fig. 13</td>
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<tr>
<td></td>
<td><em>aff. Pseudoculopollis principulis</em></td>
<td>extinct plants</td>
<td></td>
<td>Pl. 3, fig. 2</td>
</tr>
<tr>
<td></td>
<td><em>Trudopolis pertrudens</em></td>
<td>extinct plants</td>
<td>Late Cretaceous-Early Eocene</td>
<td>Pl. 3, fgs 5-8</td>
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<tr>
<td>Angiosperm: non</td>
<td>not identified (tricolpate-tricolporate)</td>
<td>extinct plants</td>
<td></td>
<td>Pl. 3, fgs 18,19</td>
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</tbody>
</table>

| Fungi                  | ?Basidiozymota s.l.                       | Quaternary, might be also in non Quaternary deposits | Pl. 1, fgs 1-3, 25-26 |
|                        | Fungi varia, *incertae sedis*             | Quaternary, might be also in non Quaternary deposits | Pl. 1, fgs 14-17, |
|                        | cf. *Alternaria* sp.                      |                                                             | Pl. 1, fig. 13 |
| ?Cyanobacteria/Algae/Fungi |                                          |                                                             | Pl. 1, fgs 18,19 |
| Gymnosperms            | *Pinus silvestris* - type                 | *Pinaceae*                                               | Pl. 1, fig. 10 |
| Angiosperms            | *Aster - type*                            | *Asteraceae*                                             | Pl. 1, fgs 21,22 |
|                        | *?Graminiidites sp.*                      | *Poaceae*                                                | Pl. 1, fgs 23, 24|
|                        | cf. *Graminiidites sp.*                   | *Poaceae*                                                | Pl. 1, fgs 11,12 |
|                        | *?Cyperaceaepolis sp.*                    | *?Cyperaceae*                                            | Pl. 1, fgs 7,8  |
|                        | *incertae sedis*                          |                                                             | Pl. 1, fgs 5,6,9,20 |

<table>
<thead>
<tr>
<th>Mesozoic - Quaternary sporomorphs</th>
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<tbody>
<tr>
<td>Algae</td>
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