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CLIMATE SIGNALS FROM NEOGENE TAXA IN EUROPEAN RECORDS REFERRED TO EAST ASIAN PLANTS

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Late Neogene floral change in Europe is generally referred to coeval climate cooling and regionally also to drying leading to declining biodiversity in the European vegetation. Various taxa considered warmth-loving and drought-intolerant that were common in the European plant fossil record throughout most of the Cenozoic successively disappeared along the Pliocene and Pleistocene glacial cycles while they persisted in the SE of Northern America and in East Asia. These taxa, no longer present in European flora, play an important role in plant-based palaeoclimate reconstructions. The successive extinction of these forms contributes to the cooling signal recorded, and in lower latitudinal regions of Europe their absence from the flora lists induces a drying signal.

In a recent study Martinetto et al. (in press) define a category of "humid thermophilous taxa of East Asian affinity, HUTEA" comprising taxa formerly known as "Pliocene elements" and trace their extinction throughout the Pliocene to early Pleistocene, especially considering central Italy as a centre of refuge. According to the definition provided by the authors, HUTEA elements at least require a mean annual temperature of 8 °C, and a mean annual precipitation of 700 mm. To allocate fossil plant taxa, the authors conducted a detailed study in order to identify minimum temperature requirements of modern East Asian plant taxa. Many of these taxa are important when reconstructing palaeoclimate from Neogene palynomorph records.

The identification of meaningful climatic limits of modern plants based on their distribution area is a crucial step in palaeoclimate analysis but not always uncritical, especially when defining these limits in regions with distinct relief and altitude. Here we discuss for selected taxa the applicability of the newly compiled cold limits regarding mean annual temperature, and the potential integration of these data in the NECLIME data base.

TAXONOMIC COMPOSITION OF LATE MIOCENE HYAENA COPROLITES FROM SOUTHWESTERN BULGARIA

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The results of pollen analyses of hyaena coprolites from the late Miocene sediments of Gotse-Delchev Basin near the village of Hadjidimovo in southwestern Bulgaria are presented. The survey of palynological research shows that coprolites contained fossil pollen. Although the pollen concentration was rather low, the presented analyses add considerably to the much-needed knowledge of the vegetation of the Balkans during the Miocene. The exact age of the sediments is dated as Turrolian (7.4 Ma) by mammal fauna. The present study pay attention on identification of pollen extracted from coprolites. Of particular interest to palaeoenvironmental study is the observation that pollen assemblages preserved in hyaena dung are likely to provide relatively unbiased characterizations of vegetation representative of the wide surroundings in which the hyaenas were active. This implies that preserved in coprolitest can provide palaeoenvironmental information extending beyond the immediate environs of the site in which they were found. Pollen analysis of the coprolites indicate warm temperate climatic conditions, as well as the co-existence of several biotopes which formed a mosaic landscape in the vicinity of the cave.

Key words: palynology, hyaena, coprolites, taxonomy, late Miocene, Bulgaria.

PALYNOLOGICAL INVESTIGATION OF THE LATE MESSINIAN SEQUENCE IN THE CAP FROM ÇANKIRI BASIN

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Turkey is broadly divided into the three tectonic belts (Pontides, Anatolides and Taurides) that as defined by Ihsan (1966). The Central Anatolian Plateau (CAP), which is cutting all those tectonic belts, extends in a wide area in between zone the Aegean extensional zone and Bitlis /Zagros compressional zone. The Bozkır formation deposited in the Çankırı Basin, which is localized in CAP, lies through the Sakarya continent in the north and the Kırşehir block in the south with thick Neogene sediments. This basin key to understand aridification plateau interior and it has developed firstly Oligocene to Quaternary time under terrestrial environments than in the middle Eocene the evolution of the Çankırı Basin continued under continental settings according to Kaymakçı 2000. Bozkır formation is a Messinian succession mainly by a 200 m-thick cyclic sequence of continental gypsum layers, clays and sandy clays in gypsum with different thicknesses crops out where represents the Bozkır formation.

The Bozkır new road (145m thick) section, which is cutting Bozkır formation, was sampled for micropaleontological analyses and geochemical ($\delta^{18}\text{O}$ - $\delta^{13}\text{C}$ isotopes analyses and CaCO_3) to figure the paleoenvironmental and palaeoclimate changes occurred in the Çankırı Basin. CaCO_3 content reflects the environmental changes and their relationship to climate change. The higher percentage of CaCO_3 shows zones with cooling trends which are in correlation with quantified paleoclimate data and $\delta^{18}\text{O}$ - $\delta^{13}\text{C}$ isotopes values. In most pollen spectra the herbs and shrubs prevail (75%) and based on grasses (*Poaceae*), *Cyperaceae*, flowering herbs *Asteraceae*, *Apiaceae*, halophytes *Chenopodiaceae/Amaranthaceae*, *Oleaceae*, *Ephedra* and *Artemisia* presence the vegetation shows an well-developed open grassland environment with aquatic elements. In Çankırı Basin, the paleoclimate is humid warm temperature conditions during the Late Messinian based on coexistence analysis and $\delta^{18}\text{O}$ - $\delta^{13}\text{C}$ results.

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Keywords: Bozkır formation, Çankırı Basin, paleo-environmental, palynology, $\delta^{18}\text{O}$ - $\delta^{13}\text{C}$

INDICATIVE VALUE OF NON-POLLEN PALYNOMORPHS (NPPS) FROM PLIOCENE SEDIMENTS OF DOMBAYOVA GRABEN-CENTRAL ANATOLIA

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The aim of this study is to perform detailed palynological analysis of coaly sediments from the D-97 well, as well as the indicative value of non-pollen palynomorphs of the studied deposits. Moreover, its Ostracoda fauna is also described and interpreted for paleoenvironmental approaches.

Dombayova is one of the basins that hosted by Western Anatolian Extension Zone. D-97 well is located in the center of Dombayova Basin. It has a 90 meters thickness of coal with some alternations of siltstone and mudstone. Pliocene aged coaly sediments derived from D-97 drill core, were deposited in lacustrine to riparian environment as shown by relatively high abundance of freshwater algae and ostracoda fauna. During this study 110 palynological samples and 7 appropriate ostracoda selected samples are examined.

Defined palynological assemblage of D-97 well consisting of angiosperms (64 %), gymnosperms (11%), Pteridophytes (6%), and fresh-water algae (19%). Results of pollen analysis of the D-97 section point out the presence of Pteridophyta, coniferous forest, wetland and riparian vegetation, Mediterranean xerophitic and steppe elements, mixed mesophytic forests. NPPs are dominant through the section. Most of the recorded algae preferred meso- to eutrophic, stagnant shallow water. The presence of resting cells suggests that the water body might periodically dried out. Dominant species and their percentage ranges are: *Sigmopollis laevigatoides* (10-95%), *Ovoidites minoris* (10-90%), *Tetraporina* (5-90%), *Ovoidites elongatus* (10-60%), *Ovoidites gracilis* (10-50%). In our slides we have also *Stigmozygoidites*, *Ovoidites grandis*, *Cycloovoidites cyclus*, *Ovoidites spp*, *Diagonalites diagonalis*, *Concentricystes*, *Botryococcus braunii*, *Pediastrum boryanum*, *Sigmopollis pseudosetarius*, *Sigmopollis punctatus*, *Sigmopollis spp.*, *Spintetrapidites quadriformis*, *Tetraploa cf. aristata*, *Gaeumannomyces sp.* From comparison of the NPP results with pollen and spore curves from drillcore, ecological indicator values were derived.

In addition to palynological analysis five ostracod taxa belonging to three genera have been determined: *Candona negleta*, *Candona angulata*, *Heterocypris incongruens*, *Candona sp.*, *Amplocypris sp.* These ostracod taxa also indicates shallow, low temperature and low oxygenated freshwater.

**THE POLLEN OF *FUPINGOPOLLENITES WACKERSDORFENSIS* AND
MARGOCOLPORITES VANWIJHEI IN THE CENOZOIC DEPOSITS OF TURKEY**

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Fupingopollenites and *Margocolporites vanwijhei* pollen grains which are scattered through the Old World tropics have been recovered from as early as the Middle Eocene. Besides, these pollen are also recorded from the Oligocene-Miocene palynofloras in Asian and Europe. The palynofloral assemblage from the Early Oligocene sedimentary sequences in northern and eastern part of the Salt Lake, Central Anatolia, is recorded *Fupingopollenites wackersdorfensis* and *Margocolporites vanwijhei*. These pollen have been firstly observed during the Cenozoic in the Turkish palynofloras up to now.

Fupingopollenites wackersdorfensis is defined in the Early Oligocene samples collected from Şereflikoçhisar-Şihkuyusu and Era Mine in the eastern part of the Salt Lake (Central Anatolia). Palynoflora with this pollen is represented by abundance of the spores (*L. maxoides maxoides*, *L. maxoides minoris*, *Corrugatisporites multivallatus*, *Cicatricosisporites dorogensis*, *C. chattensis* and *Verrucatosporites* sp.). Percentages of the gymnosperm pollen (Pinaceae, *Pinuspollenites labdacus*, *Cathaya*, *Picea* and *Podocarpus*) are regularly increased during the sedimentary sequences in the Şereflikoçhisar-Şihkuyusu area. Angiosperm pollen is characterized by e.g. *Plicapollis plicatus*, *Fupingopollenites wackersdorfensis*, *Acacia*, *Mauritidites franciscoi*, *Slowakipollis hippophaëoides*, *Momipites punctatus*, *Caryapollenites simples*, *Ulmipollenites undulatus*, *Faguspollenites verus*, *Intratropopollenites insculptus*, *Tricolporopollenites megaexactus*, *Quercus* species and *Ilexpollenites margaritatus*. Abundance of the herb species are generally low and these are represented by Poaceae, Ephedraceae, Asteraceae, Chenopodiaceae and *Centaurea*. Palaeoclimatic condition according to the palynofloral content is humid and warm subtropical during deposition of the Early Oligocene in the eastern part of the Salt Lake, and also coexistence intervals of the Şereflikoçhisar-Şihkuyusu and Era Mine samples are the MAT: 17-19°C, CMT: 8-10°C, WMT:

24-27°C, MAP: 840-1423mm, and MAT: 14-18°C, CMT: 6-1°C, WMT: 23-24°C, MAP:840-1331mm respectively.

Margocolporites vanwijhei is recorded from the Early Oligocene samples collected from Yeniceoba-Acisuderesi in the western part of the Salt Lake (Central Anatolia). Yeniceoba-Acisuderesi palynoflora is represented by abundance and diversity of the spore species. Gymnosperm pollen are consisted of *Pinus*, *Pinus silvestris*, *Cathaya*, *Cedrus*, *Podocarpus*, *Tsuga* and *Sciadopits*. Percentages of the angiosperm pollen are low, however diversity of these pollen (*Juglandaceae*, *Engelhardia*, *Tilia*, *Myrica*, *Carya*, *Celtis*, *Corylus*, *Plicapollis pseudoexcelsus*, *Momipites quietus*, *Bohlensipollenites hohli*, *Cupanieidites eucalyptoides*, *Margocolporites vanwijhei*, *Bombacacidites*, *Reevesia*, Myrtaceae, Malvaceae, Malpighiaceae, *Proteacidites egerensis*, *Ulmus*, *Quercus*, *Salix*, Cyrillaceae and Sapotaceae) are observed in the Early Oligocene flora of Yeniceoba-Acisuderesi area. Abundances of the herb species are low in the Yeniceoba-Acisuderesi palynoflora and these are represented by the *Artemisia*, Chenopodiaceae, Asteraceae, Ephedraceae and Poaceae. Based on the spore and pollen distribution, palaeoclimatic condition could be humid and warm subtropical during the Early Oligocene, as the eastern part of the Salt Lake. Numerical climatic values of Yeniceoba-Acisuderesi palynoflora are the MAT: 17-23°C, CMT: 8-11°C, WMT: 24-27°C and MAP: 817-1200mm.

THE EOCENE COALY SECTIONS OF THE MIDDLE DNIEPER (UKRAINE) AND PROBLEMS OF THEIR CORRELATION WITH DEPOSITS OF THE WESTERN PARATETHYS

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Coaly sandy and clay deposits with spicules of the Upper Eocene sponges are discovered in the Middle Dnieper region. They are recorded in boreholes and Rybalsky quarry (Dnipropetrovsk). These deposits substitute unique Mandrykovka layers (Upper Eocene, zone NP 19 *Isthmolithus recurvus* on the scale of E. Martini) or cover them. There are need in detailed palynological researches of the Upper Eocene coaly sections, revision and new study of Mandrykovka layers' fauna. It will be a key for solve the problem of correlation the Upper Eocene in the Middle Dnieper and the Southern Ukraine with synchronous deposits of the Western Europe, in particular with the "Latdorf" stage of A. von Koenen.

Eocene section of the Middle Dnieper region includes marine, transitional and continental facies. They are represented by such deposits as brown coal, coaly sandy-clayish and calcareous/non-calcareous clayish rocks, gravel sands, quartz-glaucopitic sands with/without siliceous sponges spicules, glaucopitic sandy clays with sponge spicules and diatoms, siltstones, mudstones with calcareous fauna (mollusks, corals, foraminifera, etc.), nummulitic clays, coral sands (Mandrykovka layers), etc.

Eocene formation of the Middle Dnieper used for correlation with the deposits of the West (Central) Paratethys since the end of the XIX century. Mandrykovka layers are the most famous location of the Upper Eocene fauna here. They drilled by boreholes and cropped out in Rybalsky granite quarry (the southern area of the Dnipropetrovsk). Mandrykovka layers contain calcareous nannoplankton (Upper Eocene, zone NP 19 *Isthmolithus recurvus* on the scale of E. Martini), foraminifera, corals, bryozoans, mollusks (bivalves, gastropods, cephalopods, loricates, skaphopods), the remains of crustaceans, brachiopods, fish otoliths, oncolites, paleobacterial mats. Mandrykovka layers traditionally correlated with the "Latdorf" stage of A. von Koenen in the Northern Germany. However there are disagreements on this subject at present. The solution of this problem will be possible after the paleontological and palynological additional investigation and revision of Mandrykovka layers and their facial analogies.

Recently coaly rocks are found in Rybalsky career on the same hypsometric level with Mandrykovka layers. Coaly formations represented by dark gray and brown clayish, sandy-clayish deposits with spicules and skeletons of siliceous sponges. Thin layers (thickness is

about 2 cm) of brown coal with the remains of fossil insects and plant seeds (fig. 1) are recorded in strata of these deposits too.

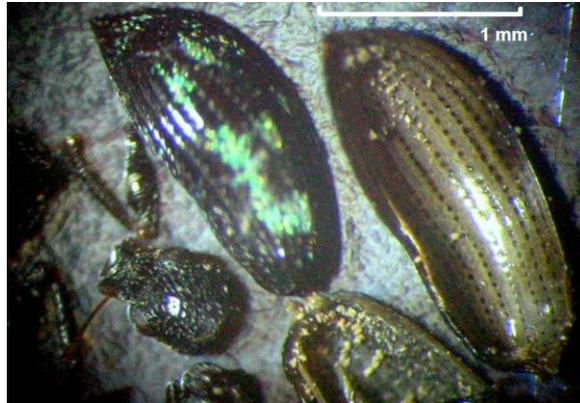


Figure 1. Fragments of fossil insects and plant seeds in the brown coal layer from strata of coaly deposits (Upper Eocene, Rybalsky career, Dnipropetrovsk, Ukraine)

Late Eocene age of coaly strata is defined by sponge spicules contained therein, as well as foraminifera of underlying Mandrykovka layers. There are most numerous foraminifera such as *Pararotalia lithothamnica lithothamnica* (Uhlig.) and different Miliolida. Other taxa belong to the genera: *Robulus*, *Globulina*, *Anomalina*, *Lobatula*, *Asterigerina*, *Sphaerogypsina*, *Rotalia*, *Stomatorbina*, *Biapertorbis*, *Halkyardia*, *Nummulites*, *Operculina*, *Reussella*, etc. Sponge spicules, which are found in the dark gray and brown coaly sandy-clayish sediments, belong to the "soft" and lithistid demosponges. There are most common spicule morphotypes: large oxeas, triaenes with the thickened rhabds, mesotriaenes, phyllotriaenes, tetracrepid desmas, triders, rhizoclones. Spicules association is similar to that one of the Upper Eocene coaly rocks of the Ukrainian Shield depressions (Ivanova (Stefanska), Stefanskyi, 2008; Ivanova (Stefanska), 2014).

Further integrated paleontological and palynological study of described coaly section, stratigraphic and paleoclimatic analysis will allow to solve a number of stratigraphical problems and to clarify paleoclimatic reconstructions for the Eocene-Oligocene boundary within Paratethys.

NON-POLLEN PALYNOMORPHS FROM THE MIOCENE SINKHOLES IN THE OPOLE REGION (SW POLAND) AND THEIR PALAEOENVIRONMENTAL SIGNIFICANCE

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Palynological analysis of deposits filling two Miocene palaeosinkholes excavated in the Tarnów Opolski and Górażdże quarries confirmed the presence of small water bodies in both studied sinkholes. Non-pollen palynomorphs are important components of both assemblages studied. They are strongly dominated by freshwater algal microfossils, whereas only a few animal-related palynomorphs and fungal spores were encountered.

During the studies a total of 40 species of algal microfossils were identified, including 32 species from 16 genera in the Tarnów Opolski samples and 34 species from 17 genera in the Górażdże samples. Most of the taxa are frequent non-pollen palynomorphs occurring in Neogene deposits. The algal assemblages resemble each other in many respects. They are dominated by *Sigmopollis*, *Botryococcus* and resting cells (zygospores) of members of the Zygnemataceae family (fossil genera *Cycloovoidites*, *Diagonalites*, *Megatetrapidites*, *Ovoidites*, *Stigmozygodites*, and *Tetrapidites*). In both palaeosinkholes desmid zygospores (fossil genera *Closteritetrapidites*, *Monopunctites*, and *Planctonites*), freshwater dinoflagellate cysts, and Prasinophyceae (*Leiosphaeridia*) were also found. Presence of relatively abundant and diverse planktonic algae, such as *Pediastrum* and *Tetraedron*, in samples from the Górażdże sinkhole, suggests small differences in the water bodies' habitats (e.g. water depth).

Correct identification of the algal microremains is very important in interpretation of the sediments' origin and the *in situ* occurrence of the palynomorph assemblages. These palynomorphs potentially are valuable palaeoenvironmental indicators but they require more study. For example the optimal environment for species of *Sigmopollis* (in Quaternary deposits often identified as Type 128) is eutrophic slowly flowing or stagnant water. Similarly, in the Zygnemataceae, zygospore formation occurs mostly in the spring in clean, oxygen-rich, shallow, relatively warm, fresh water. Unfortunately, little is known about the ecology of the individual species of Zygnemataceae.

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EXCEPTIONALLY PRESERVED BADENIAN POLLEN - PLASMOLYSIS CAPTURED IN SALT

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Since the Middle Ages the Polish part of Carpathian Foreland basin has been known for its deep salt mines. The salt was deposited in the Paratethys, a shallow sea that infilled the Carpathian Foredeep in Miocene, and is of evaporite origin. The palynological investigation of the salt collected in the Bochnia Salt Mine revealed an exceptionally well-preserved pollen. Inside pollen grains rounded and angular structures are present. On the basis of the similarity with plasmolized pollen grains of modern plants, these structures are considered to represent cytoplasm plasmolized in the condensed brine prior to fossilization. Two forms of plasmolized cytoplasm (concave and convex) can be observed in modern pollen and both are distinguished in the investigated fossil material.

The percentage of pollen with fossilized cytoplasm within individual taxa is also a valuable environmental indicator, as it depends on the proximity of the pollen-producing plant assemblages to the depositional setting.

BRYOZOAN ASSEMBLAGES VERSUS CLIMATIC EVENTS IN THE LA MESETA FORMATION (EOCENE), SEYMOUR ISLAND, ANTARCTIC PENINSULA

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The bryozoan diversity through time reveals two phases of cladogenesis (Late Cretaceous and Eocene), connected with the substantial evolutionary Paleocene-Eocene turnover of the bryozoans, where the cheilostome replace cyclostomes as a dominant order.

The late Early Eocene bryozoans in the lower part of the La Meseta Formation (Telm1), Seymour Island, shows the spectacular diversification, composed mostly by massive, multilamellar colony forms, of higher taxonomical levels (20 families and 30 genera), enhanced by a great radiation of a new taxa. The most significant bryozoans in the taxonomic composition of the Telm1 are cerioporine cyclostomes - reminiscent of the Cretaceous in the Northern Hemisphere, and cheilostomes considered to have originated during the Early Eocene (Hara 2001), and then becoming widespread through Neogene to the Recent.

The lowermost part of the La Meseta Formation (Telm1) on Seymour Island includes loosely encrusting (membraniporiform) or unizoidal flexible articulated or rooted colonies (catenelliform) from the base of LMF, which are either taxonomically and morphologically different from the overlying fauna from the lower part of the LMF. This biota composed of bryozoans, benthic foraminifers and ostracods occurs at the very base of the sandy, transgressive series in the lowermost part of Telm1. At the present day such bryozoans are widely distributed in the tropical-warm temperate latitudes and interpreted as deposited in the shallow-water settings (Hara 2015).

The presence of the distinct, lunulitiform, free-living bryozoans, which develop disc-shaped colonies is characteristic for the middle part of the La Meseta Formation (Telm4-Telm5). Environmentally, lunulitids are known to occur in warm, shallow-shelf conditions in temperature of 10-29°C, on coarse, sandy to muddy bottom, with a low to moderate deposition, in fairly high velocity, and they are absent when the temperature of the bottom sediments are lower than 10-12°C.

The bryozoan fauna from the upper part of the La Meseta Formation (Telm6-Telm7) is scarce. In the Telm6 it was recognized in the fine-grained sandstone, where the colonies form a biostome layer up to 5 cm thick in the life position. A few poorly-preserved sole bryozoan colonies in the Telm7 are associated with vertebrates such as

penguins and fish remains. This distinct decline in the T_{elm7} marks the proximity of the Eocene-Oligocene boundary, when a severe decrease in temperatures occurred in the southern oceans.

The late Early Eocene-Late Eocene paleoclimatic events are well-seen in the changes of the biotic bryozoan assemblages in the stratigraphical column of the La Meseta Formation (T_{elm1}-T_{elm7}), ranging from the Early Eocene (EECO) - Middle Eocene (MECO) to the upper part of the LMF, with a well-marked EOT (Eocene-Oligocene Transition).

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MIOCENE OYSTER BUILDUPS OF EUROPE AND THEIR PALAEOENVIRONMENTAL SIGNIFICANCE

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Depending on the shape, size and taphonomic character, the oyster buildups can be divided into bioherms, biostromes and proper reefs. The recent oyster colonies are dominated by two species: American *Crassostrea virginica* (Gmelin) and Japanese/Chinese *C. gigas* (Thunberg). The recent species are capable to accommodate wide range of salinities (8-30‰) although prefer the typical, brackish conditions (18-20‰). The Mesozoic history of the true oyster buildups reveals directional changes in optimum palaeoenvironmental conditions since their appearance in the Middle Jurassic in brackish environments. In the same time, however, small bioherms grew in Poland, in the open-sea salinity conditions, similarly to Kimmeridgian oyster beds in Central Poland. Since the Early Cretaceous the general trend with preferences to less salinity (brackish conditions) has been very delicate but distinct and persistent. It was lasting and became more pronounced also in the Late Cretaceous and has continued in the Cenozoic up to Recent, exclusively brackish conditions. The fossil oyster buildups are most common in the Neogene (Miocene mainly) and are known from all the continents, especially from brackish environments. They apparently preferred the brackish deltas, bays, lagoons, mangrove swamps, and rarely low-tide zone. In Europe most popular are Miocene “oyster reefs” known for example from Portugal (Tagus Basin), France (Loupian region), Switzerland (Alpine Foredeep), Hungary (Borsod Basin), Romania (Transilvanian area) and Greece (Macedonia and Crete) where *Crassostrea gryphoides* (Schlotheim) is dominating species (occurring almost always alone). The another species – *Hyotissa squarrosa* (de Serres) – formed a buildups, also as monospecific assemblages, within west European Miocene basins.

Measurements of carbon and oxygen isotope composition were undertaken on oyster shells that were screened for possible diagenetic alteration by using trace element technique and Scanning Electron Microscope (SEM) observations. Obtained $\delta^{18}\text{O}$ and $\delta^{13}\text{C}$ shell profiles do not probably reflect all palaeoenvironmental changes. Nevertheless, concomitant changes of the $\delta^{18}\text{O}$ and the $\delta^{13}\text{C}$ values of some shells may be interpreted as seawater-freshwater mixing trend. Palaeosalinity reconstructions are based on mean isotope composition of oyster shells. The shell isotope composition has been compared with predicted isotope composition of marine and estuarine water.

**SOME REMARKS ABOUT SUBTROPICAL POLLEN ELEMENTS OF *EDMUNDIPOLLIS*
KONZALOVÁ, SŁODKOWSKA & ZIEMBIŃSKA-TWORZYDŁO, 2014**

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Palynological literature of terrestrial sediments since the Eocene to Pliocene mentions frequently occurrence of *Araliaceopollenites edmundi* or *Tricolporopollenites edmundi* pollen grains. This name is used to describe pollen grains of widely varying morphology. The morphological structure of *edmundi* type, apparently exhibits its' similarity to pollen grains of Araliaceae, Cornaceae, Nyssaceae or Mastixiaceae families, now occurring mostly in the tropics and subtropics.

Taking into consideration the great diversity of morphological forms belonging to the species *T. edmundi* was raised it to the rank of genus *Edmundipollis* Konzalová, Słodkowska & Ziemińska-Tworzydło 2014.

Features of the *edmundi* morphotype pollen grains are hexagonal/rhomboidal outline, meridionally swellings of the exine with deep incised colpi. An important elements is also very thick exine and structure of pores and colpi aperture unite. In the family Cornaceae forming the H-shaped pores and colpi unite and the double funnel-shaped in the Araliaceae family (Tab. 1, next page).

Various and clearly different morphological forms that were included into the *edmundi*-group are to be sanctioned as morphological species within the genus *Edmundipollis*

A large share of the pollen grains similar in structure to *Edmundipollis* genus points to the importance of the subtropical elements in the thermophilic Miocene flora.

species	size	outline	apocolpia	colpi	pores	colpi/pores unite	sculpture
<i>Cornaceaepollis satzveyensis</i>	43-54 /28-40 μm	oval, prolate	narrowly rounded	deep, arcuate, not bent at equator, lack of meridionally swellings	lalongate	H shaped colpi/pores unite	scabrate
<i>Edmundipollis edmundi</i>	40-50 /28-42 μm	hexagonal /rhomboidal subprolate to prolate	flat	long, deep incised into meridionally swellings	oval, 10/5 μm lalongate	H shaped colpi/pores unite	scabrate
<i>E.mastixioides</i>	40-50 /22-47 μm	rhomboidal, nearly circular oblate spheroidal to prolate spheroidal	broadly rounded	meridionally swellings with deep incised long colpi parallel to the outline	lalongate 12/5 μm	H shaped colpi/pores unite	scabrate
<i>Araliaceopoll. amplus</i>	45-60 /36-47 μm	broadly oval subprolate	small, narrow rounded	long, deep, arcuate lack of meridionally swellings	circular 5-10 μm in diameter	double funnel-shaped aperture unite	reticulate
<i>E.megagranatus</i>	45-58 /38-42 μm	oval-rhomboidal subprolate to prolate	broadly rounded	arcuate, deep incised into meridionally swellings	lalongate 5-7 μm in equatorial diameter	double funnel-shaped aperture unite	rugulate-reticulate
<i>E.grossularius</i>	35-45 /27-35 μm	hexagonal /rhomboidal subprolate to prolate	flat to slightly rounded	deep incised into meridionally swellings	nearly circular 5-8 μm in diameter	double funnel-shaped aperture unite	reticulate
<i>E. vitiosus</i>	37-44 /30-37 μm	hexagonal /rhomboidal subprolate	flat to slightly pointed	arcuate, deep incised into meridionally swellings	nearly circular up to 5- μm in diameter	double funnel-shaped aperture unite	microreticulate
<i>Tricolporopoll. mangiferoides</i>	36-52 /26-32 μm	hexagonal /rhomboidal prolate, perprolate	flat to broadly rounded	arcuate, parallel to outline lack of meridionally swellings	oval, lalongate 5/12 μm	lack of specific design	scabrate

Tab.1. Features of the *edmundi* morphotype pollen grains

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