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Paleobotanical remains from the Late Sarmatian and Maeotian age of the northern Scythian Platform

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Abstract

The Maeotian and Chersonian palaeofloristic assemblage is the first to be described for the Scythian Platform. The Chersonian palynological assemblage belongs to the Balta-Păun Formation and is dominated by the *Pseudoschizaea* genus, indicating a lacustrine/deltaic environment. The same biotope is revealed by the *Hydrosporis*, *Sparganium* and *Nymphaea* genera. In addition to these taxa, pollen of *Tilia, Ilex, Castanea, Eucommia,* vegetation occupying the middle altitude hilly areas around the sedimentation basin, has also been identified. Gymnosperms are poorly represented in the palynological assemblage, only rare specimens of the *Pinus* and *Picea* having been identified.
The fossil leaves described in the present paper originate from the Mînzaţi locality and are Maeotian in age. Seven taxa were determined, the largest belonging to the *Ulmus* and the *Carpinus* genera, which have formed a mixed mesophytic forest.
The palaeoclimate was deducted based on the palaeoflora identified using the "Coexistence Approach" method.

Keywords: Scythian Platform, palaeoflora, palaeoclimate, Chersonian, Maeotian.

Geological setting

The Scythian Platform is considered a younger platform, compared to the Moldavian Platform (Săndulescu, 1984), the two being separated by the Fălciu – Munteni – Plopana fault (Ionesi, 1994). In the south, the Scythian Platform comes into contact with the North Dobrogean Orogen through the Sf. Gheorghe – Oancea – Adjud fault, prolonged into the Carpathian Orogen by the Trotuş fault. In the west, this platform comes into direct contact with the molasse formation of the Eastern Carpathians. The last cycle of sedimentation started in the Upper Badenian, in a manner similar to that of the Moldavian Platform, with the exception that in the Scythian Platform the sedimentation continued until the Romanian period.

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On the Scythian Platform, between the Basarabian and the Chersonian stages, there was a short interruption of the sedimentation after the accumulation of the Şcheia Formation and its equivalent deposits (Ionesi, 1994; Ionesi et al., 2005). The deposition continued during the Chersonian stage in two different facies, namely: west of the Bârlad River, up to the Siret Valley, there was a **deltaic facies** with sands, silts and clays, with cross laminations, while east of the Bârlad Valley there was a **brackish facies**, with small mactra (*Mactra bulgarica, M. caspia, M. orbiculata, M. mingirensis* a.o.) (Jeanrenaud, 1971a). Ionesi et al. (2005) include the Chersonian deposits submitted in a deltaic facies (Jeanrenaud, 1971a), without fossils, in the Balta-Păun Formation. These deposits are widely spread between localities of Vaslui and Iaşi, while in the area between the Tutova and Bârlad valleys they gradually disappear under the erosion level of the valleys (Fig. 1). Petrographically, a monotonous succession of clays, sandy clays and sands can be encountered. Towards the upper side of this formation, one can identify intercalations of cineritic sands and andesite tuffs with reduced thickness (10 and 30 cm). It is hard to determine the lower limit of the Chersonian stage, as it does not appear in the outcrops, while the upper limit can be determined in many outcrops, where the cineritic levels of Nuţasca – Ruseni (which represent the lower part of the Maeotian) were identified. The thickness of the Chersonian deposits in the deltaic facies was determined by Jeanrenaud (1971a) in the Pungeşti locality (on the Racova Valley) at about 250 m.

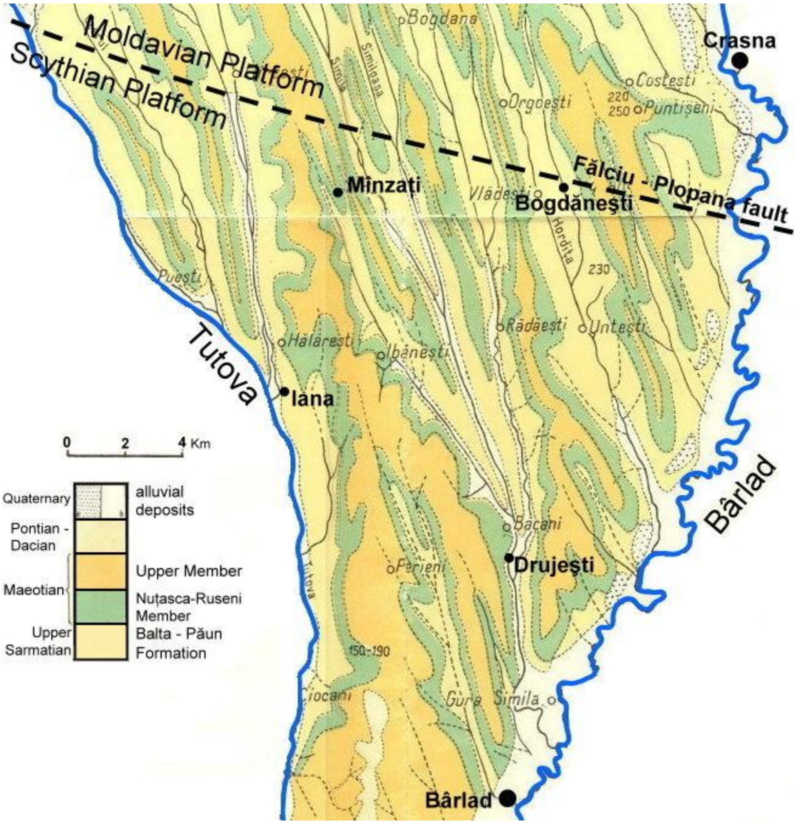

Fig. 1 Geological map of the Northern Scythian Platform, between the Tutova and Bârlad rivers (Jeanrenaud, 1971b; modified).

The Maeotian deposits outcrop on the same surface as the Chersonian ones, the delineation of the two stages being difficult because of the lack of paleontological marker elements. It was, however, signalled in the area studied by Sevastos (1922) (south of the Vaslui locality, in the Zizinca Hill), David (1922), Macarovici (1960, 1965) and Jeanrenaud (1961, 1965, 1971a).

Jeanrenaud (1971a) separated the Maeotian deposits from the Central Moldavian Highlands into 2 members:

1. the Lower Member, with Nuţasca – Ruseni cinerites (10–80 m);
2. the Upper Member, with sands and clays (150–180 m).

The author considered that the Nuţasca – Ruseni cinerites are placed in the lower part of the Maeotian section, constituting a landmark that can be easily identified on the field, both in the deltaic facies area and in the brackish one.

The Maeotian formation was described in the geological sections from the Pogoneşti, Iveşti, Perieni and Băcani localities (situated south of the studied area) (Sava, 2011), and from the Plopana locality (upper Racova river). At the bottom, the lower member is composed of brown andesitic tuffs in paragenesis with cinerites, which gradually developed into yellow-greenish cineritic/tuffic sands. The maximum number of cineritic layers is three. Their thickness in the studied area does not exceed 5–7 m each.

The upper member is made of a complex of layers composed mainly of fine yellow sands, poorly sorted, clays and silts. Some sands show intercalations of lenticular sandstones that can achieve a diameter of 2.5 m, as identified on the Corbu and Ibana Valleys (near the Mânzaţi locality).

The mollusc fauna in the Maeotian section between the Siret and Prut is relatively poor, being mentioned in a few villages by Sevastos (1922) and Macarovici (1965). We mention taxa of *Congeria panticapaea* Andr., *Theodoxus* (*Calvertia*) *ştefãnescui* Font., *Unio moldavicus* Ştef., *Helix mrazeci* Sevas., *Cepaea krejcii* Wenz. etc.

The Sarmatian and Maeotian mammal fauna from the Moldavian Platform and the Scythic Platform consists of taxa such as the following: *Hipparion moldavicum* Grom., *Aceratherium incisivum* Kaup., *Tragoceras leskewitschi* Boris. (Sevastos, 1922), *Gazella deperdita* Gaudry (Macarovici, 1967), *Gazella brevicornis* Roth. et Wagner (Simionescu, 1904), *Deinotherium gigantissimum* Ştef. (Ştefãnescu, 1895), *Chilotherium* sp. (Codrea et al., 2011), and *Dihoplus* sp. (Sava, 2011) etc.

Methods and materials

6 samples from 4 drillings (Tab. 1) were used for the palynological analyses.

From this small-depth borehole we collected samples only from the intercalation of dark grey sandy clays. The amount of sediments used for analyses was approximately 50 g for each sample. The samples were treated with HCl (37%) in order to remove the carbonates and, afterward, with HF (48%) in order to remove the silicate minerals. The separation of palynomorphs from the resulted residue was achieved through centrifugation, using $ZnCl_2$, with a 2.00 g/cm^3 density, as heavy liquid. The resulting organic fraction was inserted into a mixture of glycerine and gelatine, 1–2 drops being mounted on the palynological slide. The visualisation of the palynomophs was accomplished by using a Leica DM1000 microscope, using amplifications of X100, X400.

The method used for palaeoclimatic estimations is the “Coexistence Approach” (CA), described by Mosbrugger and Utescher (1997). This method has been used frequently for the reconstruction of the European Tertiary paleoclimate. The “Coexistence Approach” applied for all taxa establishes the relative life conditions (NLR – Nearest Living Relative) and climate of tolerance (maximum and minim values) for the fossil flora, the respective variations of the climatic parameters (Mean annual temperature – MAT; Mean annual precipitation – MAP; Mean Temperature of the warmest month – WMMT and Mean Temperature of the coldest month – CMMT) a.o. These values of the coexistence intervals have been taken from Mosbrugger and Utescher (2010, personal communication), as well as the palaeoflora database (http://www.palaeoflora.de).

Tab. 1 Place of the samples from the analysed wells for the palynological study

No.	Wells	Sample depth (m)	Age
1	Mînzaţi	P1 (2.7m); P2 (4m); P3 (5.6m)	Chersonian
2	Iana	P4 (4.7m)	Chersonian
3	Drujeşti	P5 (2.3m)	Upper Chersonian
4	Bogdăneşti	P6 (3.2m)	Chersonian

The fossil leaves collected are well-preserved and they appear as compressions on sandy-clay rocks. The taxa are easy to use for detailed investigation, displaying a good conservation of the primary, secondary and tertiary ribs. These fossil leaves originate from a ravine located north of the Mînzaţi locality and are Maeotian in age (Fig. 2).

Paleofloristic data

One of the first paleobotanical papers in our country referring to a paleofloristic assemblage of the Moldavian Platform belongs to David (1916). From Hîrsova (Vaslui) and Buneşti (17 km north of Huşi), the author mentioned one association with *Fagus pristina* Sap., *Alnus latior* Sap., *Carpinus grandis* Heer, *Juglans vetusta* Heer, *Populus latior* Heer, *Populus tremula pliocenica* Sap., *Ulmus bronni* Ung., *Planera ungeri* Cow., *Laurus princeps* Heer etc. Reviewing the samples collected and the taxa identified by David at Hîrsova and Buneşti, Barbu (1934) established that some previously cited species are missing, and presented a series of taxa such as *Populus latior* Al. Br., *Populus latior cordifolia* Heer, *Fagus pristina* Sap., *Quercus robur-pliocenica* Sap., *Corylus mac-quarrii* Forb., *Carpinus grandis* Ung., *Laurus* (*Persea*) *princeps* Heer a.o. Ionesi (1991) determined that the age of the deposits with fossil plants from Hîrsova is Chersonian, and the one of those from Buneşti – Maeotian.

Another poor Maoetian paleoflora was cited by Ştefârţă (1997), referring to the Seimen fossiliferous point (SE of the Republic of Moldova). The list of taxa contains 16 species belonging to 8 genera and 7 families. We can, however, notice the lack of taxa from the subtropical deciduous forests, as well as that of archaic thermophile gymnosperms (*Sequoia, Cupressus, Taxodium*). The predominant element is the temperate deciduous forest, with *Fraxinus, Acer, Ulmus, Crataegus, Sambucus* and *Vitis*. According to Ştefârţă, in the Miocene, on the river banks grew groups of willows, in the floodable meadows – the poplar, and on the highlands – maples, elms and ash.

Up to the present moment, no one has quoted a Chersonian or Maeotian paleofloristic assemblage from the Scythic Platform in the literature. According to the research conducted in the Mînzaţi area, deposits attributed to the Chersonian and Maeotian have indeed been identified (Fig. 2). The Upper Chersonian appears in a quarry located south of Mînzaţi, with a series of grey clays at the bottom, above which there are fine sands (about 3 m thick) with intercalations of dark quartzitic sandstones (strongly oxidized). In this sand layer (at an altitude of 167 m), a fossil rhinoceros belonging to the *Dihoplus* sp. was discovered (Sava, 2011). Above it, there is a series of cinerites and andesite tuffs (20–30 cm thick) alternating with quartzitic sandstones, and the profile in the quarry ends, in the upper part, with fine sands, sometimes ferruginous, with an intercalation of sequences of rolled clay boulders, which point out to the existence of hydrographic networks in the area, networks that have transported this material.

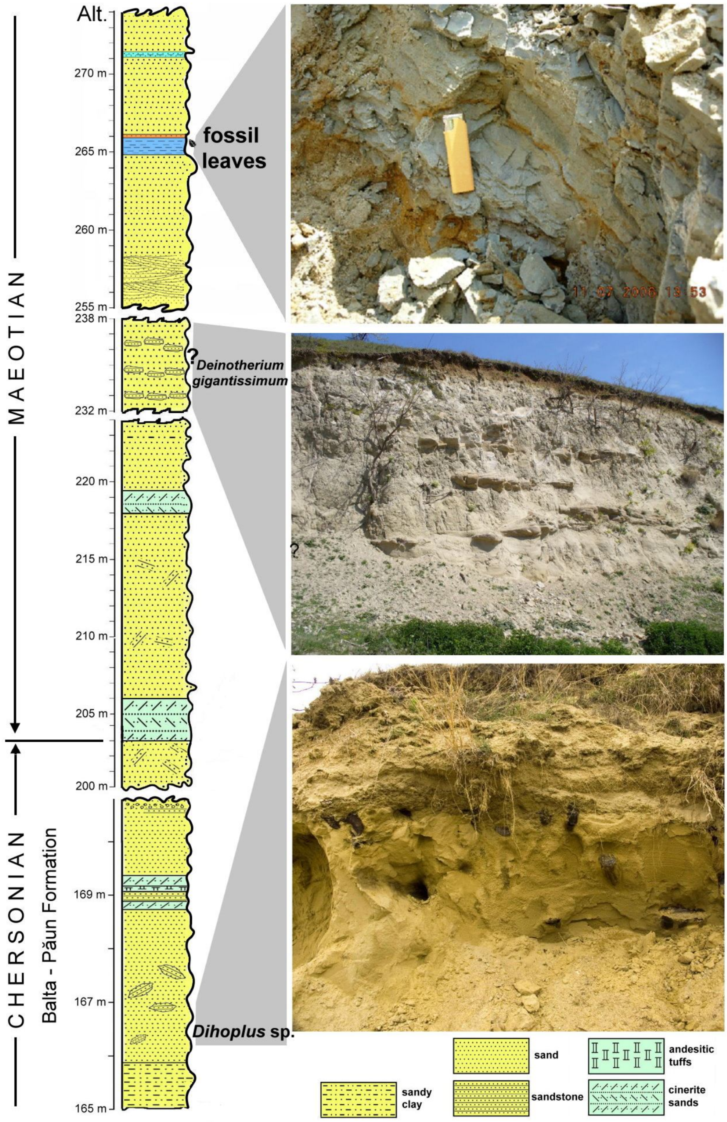

Fig. 2 Synthetic lithological column of the Chersonian and Maoetian deposits from the Mînzaţi area.

The geological profile can be further traced in the Corbului Valley, south-west of the Mânzaţi locality, at altitudes of 200–238 m (Fig. 2). The succession of the sediments begins with a layer of fine sands alternating with sandstones, set as plates, at altitudes of 200–203 m. Between 203 and 206 m, there is a layer of cineritic clay sands, greenish and compact, which we consider to have been formed at the basis of the Maeotian (the first cineritic level of Nuţasca – Ruseni). This cineritic level was signalled by Macarovici (1960) in the same valley, yet the author believes that it was found at an altitude of 220 m, which is, nevertheless, also the basis of the Maeotian. Up to 218 m, there are poorly consolidated sands, interbedded with sandstones, then a second cineritic level about 1.5 m thick.

The geological section continues in the upper part of the Corbului Valley, at altitudes of 232–238 m (Fig. 2). In this outcrop, there are mainly white fine sands with intercalations of elongated sandstone lens up to 2–2.5 m long. These alternations of lentiliform sandstones are set at 3 successive horizontal levels and it is interesting to notice the unidirectional display of these elongated lenses (the longest axes of the lenses are approximately parallel). Jeanrenaud (1971a) frequently mentions, in the Maeotian between Tutova and Bârlad, cineritic sands with intercalations of lentiliform sandstones of big dimensions. Macarovici (1960) mentions that the *Deinotherium gigantissimum* Ştef. found by Grigore Ştefănescu at Mânzaţi originates in the stratigraphic level outcropping north of this village, on the left slope of the Ibana Valley.

The upper part of the Maeotian from the Mînzaţi area can be identified north of the locality, on the right slope of the Ibana Valley. In a ravine from this area, a succession of sands with clay intercalation has been identified at altitudes of 255–275 m (Fig. 2). The fossil leaves cited in the present paper come from this clay intercalation (265 m altitude). The degree of conservation of the fossil leaves is good and 7 taxa have been identified (Tab. 2).

According to our evaluations, most types belong to the *Ulmus* and *Carpinus* genera, to which we add *Juglans, Ostrya, Planera* and *Platanus*. The determined taxa belong to a mixed mesophytic forest, being Arcto-Tertiary elements widely spread in the Miocene and Pliocene of Europe. Considering their present correspondents, we may conclude that this forest made up a stage located at altitudes of 100–200 m.

Tab. 2 Taxonomical list of the Maeotian paleoflora identified on the Ibana Valley

No.	Taxa	Number of taxa
1.	*Carpinus grandis* Ung.	11
2.	*Ulmus braunii* Heer	12
3.	*Ulmus pyramidalis* Goepp	2
4.	*Juglans* sp.	3
5.	*Ostrya oeningensis* Heer	2
6.	*Planera ungeri* Heer	1
7.	*Platanus* sp.	1

Based on these taxa, we could determine the Mean Annual Temperature (MAT) using the “Coexistence Approach” method (Mosbrugger and Utescher 1997). We have determined a MAT between 6.6 and 17.6°C (Fig. 3), with an average of about 12°C.

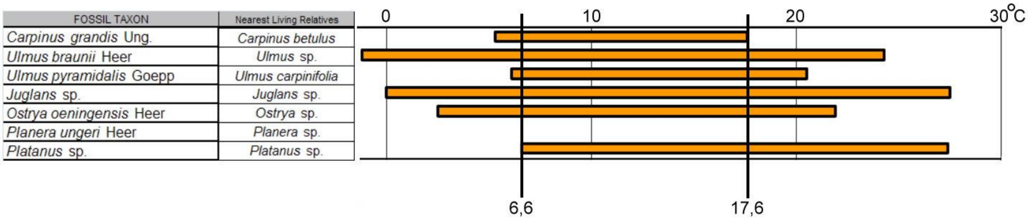

Fig. 3 Mean Annual Temperature determined through the „Coexistence Approach” method on the macroflora from Mânzaţi.

The palynological contents come from the analysis of 6 samples of clay collected from 4 drillings, all of Chersonian age, situated under the first level of the cinerites of Nuţasca – Ruseni (Table 1; Fig. 1). The list of identified taxa is presented in Table 3.

Tab. 3 The Chersonian palynological association identified in the 4 analysed drillings

Taxa	Mînzaţi well (2.7m)	Mînzaţi well (4m)	Mînzaţi well (5.6m)	Iana well (4.7m)	Drujeşti well (2.3m)	Bogdă-neşti well (3.2m)
PHYTOPLANCTON						
Pseudoschizaea sp. (=*Concentricystes*)	62	63	7		1	14
PTERIDOPHYTA						
Laevigatisporites haardti (Potonie et Venitz 1934) Thomson et Pflug 1953			1			
Laevigatosporites gracilis Wilson – Webster 1946	1					
Hydrosporis levis Krutzsch 1962	2					
Hydrosporis azollaënsis azollaënsis Krutzsch 1962	4					
Retitriletes lusaticus Krutzsch 1963			1			
Retitriletes sp.				1		4
Hyphae			2	1		
Gleicheniidites sp. (reworked)			1			
GYMNOSPERMATOPHYTA						
Pinuspollenites sp.			1			
Sciadopityspollenites sp.		1				
Sequoiapollenites sp.				2		
Piceapollis sp.				1		
ANGIOSPERMATOPHYTA. MONOCOTYLEDONATAE						
Sparganiaceaepollenites polygonalis Thiergart 1937	1		1			
Graminidites sp.					1	
ANGIOSPERMATOPHYTA. DICOTYLEDONATAE						
Ericipites sp.	1					
Populus sp.	1					
Tilia sp.	2	1				
Ilexpollenites sp.	1					
Artemisiaepollenites sp.		1				
Tricolporopollenites microhenrici (Potonie 1930) Krutzsch 1960		1				
Tricolporopollenites sp.				1		

Taxa	Mînzaţi well (2.7m)	Mînzaţi well (4m)	Mînzaţi well (5.6m)	Iana well (4.7m)	Drujeşti well (2.3m)	Bogdă-neşti well (3.2m)
Nymphaeaepollenites sp.			1	2		
Compositoipollenites sp.				1		
Alnus sp.				1		
Chenopodipollis sp.				1		
Castanea sp.				1		
Eucommia sp.	1					
Reworked palynomorphs	4			14		2

Taking into account all the palynological data from the analyses of these samples, the following conclusions emerge:

– the Chersonian palynological association is dominated by the taxa *Pseudoschizaea*, which appears frequently in the investigated samples, with the exception of in the drilling from Iana. This genus comes from a freshwater alga which lived in a lacustrian/deltaic environment (Scafati et al., 2009). It is easily determinable under the microscope, as it has a subcircular form and ornamentation similar to a fingerprint. The taxa attributed to *Hydrosporis, Sparganium* and *Nymphaea* were part of the same biotope.

– the swamp area is barely represented in the palynological association, more exactly by a few specimens of ferns (*Laevigatosporites, Retitriletes*), *Sequoia, Alnus.*

– the medium-altitude hilly areas can be inferred from the presence of the taxa *Tilia, Ilex, Castanea, Eucommia* and *Populus*, which lived in the areas near the hydrographic arteries (riparian forest).

– the grassy vegetation characteristic for the drier open areas is represented by *Chenopodipollis, Artemisia, Compositoipollenites, Graminidites.* Their frequency in the palynological association is fairly reduced, however.

– the high altitude area (the mountains) is weakly represented in the palynological spectrum, as we have identified only a few specimens of *Pinus* and *Picea*. We can infer that this lack of gymnosperms during the sedimentation of the sample analysed may be due to volcanic phenomena in the Carpathian zone affecting the vegetation in that area. In the Lower and Middle Sarmatian from the Moldavian Platform, gymnosperms are very frequent, generally accounting for more than 50% of the taxa identified (Ţabără, 2008).

– the Mean Annual Temperature (MAT) calculated on the palynological taxa identified in the six samples by applying the "Coexistence Approach" method is situated between 9.1 and 16.5°C (Fig. 4), with an average of about 12.8°C. It is necessary to mention that the MAT determined for the Maeotian macroflora identified in the profile from the area north of Mânzaţi was established at about 12°C. Other palaeoclimatic parameters determined using the same method include the Mean Annual Precipitations (MAP), with values between 641 and 1520 mm (Fig. 5), Mean Temperature of the warmest month of the year (18.1–28.1°C; Fig. 6), and Mean Temperature of the coldest month of the year (-2.7–13.3°C; Fig. 7).

– the palynofacies identified in all the samples analysed is dominated by continental phytoclasts (black coal fragments, vegetal tissue, yellowish-brown fragments, cuticles, amber granules). This type of palynofacies is characteristic to a deltaic, lacustrian or lagoon environment (Carvalho et al., 2006), the abundance of specimens of *Pseudoschizaea* found in the samples analysed supporting this deduction.

Fossil taxa	Nearest living relative
Retitriletes lusaticus	Lycopodium sp.
Hydrosporis levis	Salviniaceae
Ilexpollenites div. sp.	Ilex sp.
Intratriporopollenites instructus	Tilia sp.
Piceapollis div. sp,	Picea sp,
Pityosporites macroinsignis	Pinus sp.
Sequoiapollenites sp.	Taxodiaceae

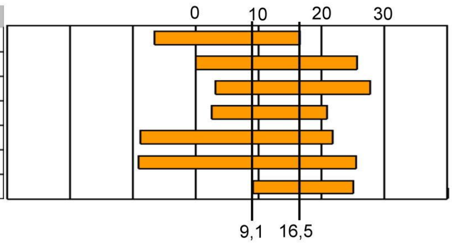

Fig. 4 Mean Annual Temperature determined through the „Coexistence Approach" method on the microflora identified in the four analyzed drillings.

Fossil taxa	Nearest living relative
Hydrosporis levis	Salviniaceae
Ilexpollenites div. sp.	*Ilex* sp.
Intratriporopollenites instructus	*Tilia* sp.
Piceapollis div. sp,	*Picea* sp,
Pinuspollenites sp.	*Pinus* sp.
Sequoiapollenites sp.	Taxodiaceae

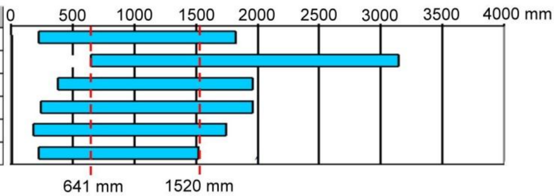

Fig. 5 Mean Annual Precipitations determined on the palynological association, established through the „Coexistence Approach" method.

Fossil taxa	Nearest living relative
Hydrosporis levis	Salviniaceae
Ilexpollenites div. sp.	*Ilex* sp.
Intratriporopollenites instructus	*Tilia* sp.
Piceapollis div. sp,	*Picea* sp,
Pinuspollenites sp.	*Pinus* sp.
Sequoiapollenites sp.	Taxodiaceae

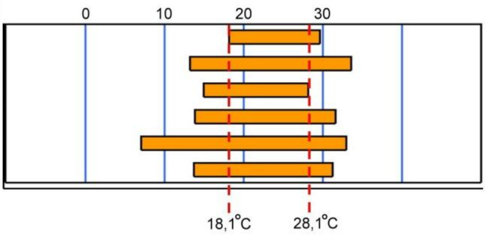

Fig. 6 Mean Temperature of the warmest month of the year established on the palynological taxa.

Fossil taxa	Nearest living relative
Hydrosporis levis	Salviniaceae
Ilexpollenites div. sp.	*Ilex* sp.
Intratriporopollenites instructus	*Tilia* sp.
Piceapollis div. sp,	*Picea* sp,
Pinuspollenites sp.	*Pinus* sp.
Sequoiapollenites sp.	Taxodiaceae

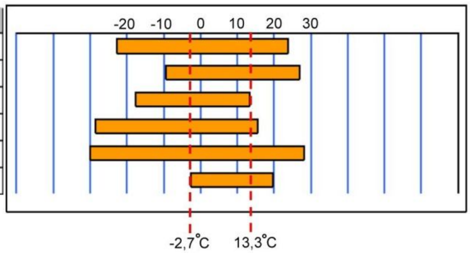

Fig. 7 Mean Temperature of the coldest month of the year determined on the palynological association.

– the degree of conservation of the palynomorphs is good for the organisms developed in aquatic environments (algae). The pollen produced by the continental vegetation is more weakly represented, both in quantity and quality.

Conclusions

The geological and paleofloristic study presented in the present paper was carried out on deposits of Chersonian and Maeotian age, located in the geographic area between the Tutova and Bârlad valleys. Along the study area, the Chersonian deposits are sedimented in a deltaic facies containing freshwater fauna, and they belong to the the Balta – Păun Formation. The Maeotian deposits are widespread in the research area, being divided into two members: the Lower Member (the cinerites of Nuţasca – Ruseni), placed in the lower part of Maeotian, and the Upper Member, made of a complex of strata, mainly represented by fine sands, clays and silts.

The Maeotian macroflora discovered north of Mânzaţi is dominated by the *Ulmus* and *Carpinus* genera, as well as by *Juglans, Ostrya, Planera* and *Platanus*. Hence, we have identified a mixed mesophytic forest specific to hills with altitudes between 100 and 200 m. Considering these taxa, we have estimated a Mean Annual Temperature between 6.6 and 17.6°C, with an average of about 12°C. We must emphasize the fact that, up to the present moment, the macroflora described for Mânzaţi is the first one to be quoted for the Scythian Platform.

The palynological studies were conducted on a series of six samples collected from four low-depth drillings. The palynological association of Chersonian age is dominated by the *Pseudoschizaea* genus, which is frequent in the samples investigated. This genus comes from a freshwater alga living in a lacustrian/deltaic environment. The taxa attributed to *Hydrosporis, Sparganium* and *Nymphaea* lived in the same biotype. The same sedimentation environment, deduced based on the palynological association, was indicated by Ţabără (2008), who cites an abundance of palynomorphs of *Nymphaea, Botryococcus* and *Pediastrum* for the Upper Chersonian from Vaslui and Oţeleni (south of Huşi).

The swamp area is barely represented in the palynological association, namely by a few specimens of ferns (*Laevigatosporites, Retitriletes*), *Sequoia, Alnus*. The medium-altitude hilly areas can be inferred from the presence of the *Tilia, Ilex, Castanea, Eucommia* taxa, as well as that of *Populus*, which lived near the hydrographic arteries (riparian forest). The grassy vegetation characteristic for the drier open areas is represented by *Chenopodipollis, Artemisia, Compositoipollenites, Graminidites* (with reduced frequency), and gymnosperms appear seldom, in the form of specimens of *Pinus* and *Picea*.

The Mean Annual Temperature calculated based on the palynological taxa identified is between 9.1 and 16.5°C, with an average of about 12.8°C. Other palaeoclimatic indicators which could be identified are the following: Mean Annual Precipitations, with values between 641 and 1520 mm, Mean Temperature of the warmest month of the year (18.1–28.1°C), and Mean Temperature of the coldest month of the year (-2.7–13.3°C).

The palynofacies identified in all the samples analysed is dominated by continental phytoclasts, indicating a deltaic, lacustrian or lagoon environment.

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CAPTION OF PLATES

Plate I

1–5. *Pseudoschizaea* sp. (=*Concentricystes*)
6, 7. *Algae*
8. *Tricolporopollenites microhenrici* (Potonie 1930) Krutzsch 1960
9. *Laevigatisporites haardti* (Potonie et Venitz 1934) Thomson et Pflug 1953
10, 11. *Hydrosporis levis* Krutzsch 1962
12, 13. *Hydrosporis azollaënsis azollaënsis* Krutzsch 1962
14. *Retitriletes lusaticus* Krutzsch 1963
15–17. *Hyphae*
18. *Compositoipollenites* sp.

Plate II

1. *Piceapollis* sp.
2. *Pinuspollenites* sp.
3, 4. *Sequoiapollenites* sp.
5. *Sparganiaceaepollenites polygonalis* Thiergart 1937
6. *Graminidites* sp.
7. *Ericipites* sp.
8. *Eucommia* sp.
9. *Ilexpollenites* sp.
10, 11. *Tilia* sp.
12. *Artemisiaepollenites* sp.
13. *Chenopodipollis* sp.
14. *Alnus* sp.

Plate III

1. Image with palynofacies from sample of Mînzaţi well (5.6m depth). Black coal remains with rods form are predominant plus yellow-brown fragments.
2. Abundance of small fragments and rounded of black coal from Bogdăneşti well (3.2m depth).

Plate IV

1, 2. *Carpinus grandis* Ung. (scale in mm)
3, 4. *Ulmus braunii* Heer
5. *Juglans* sp.

Plate I

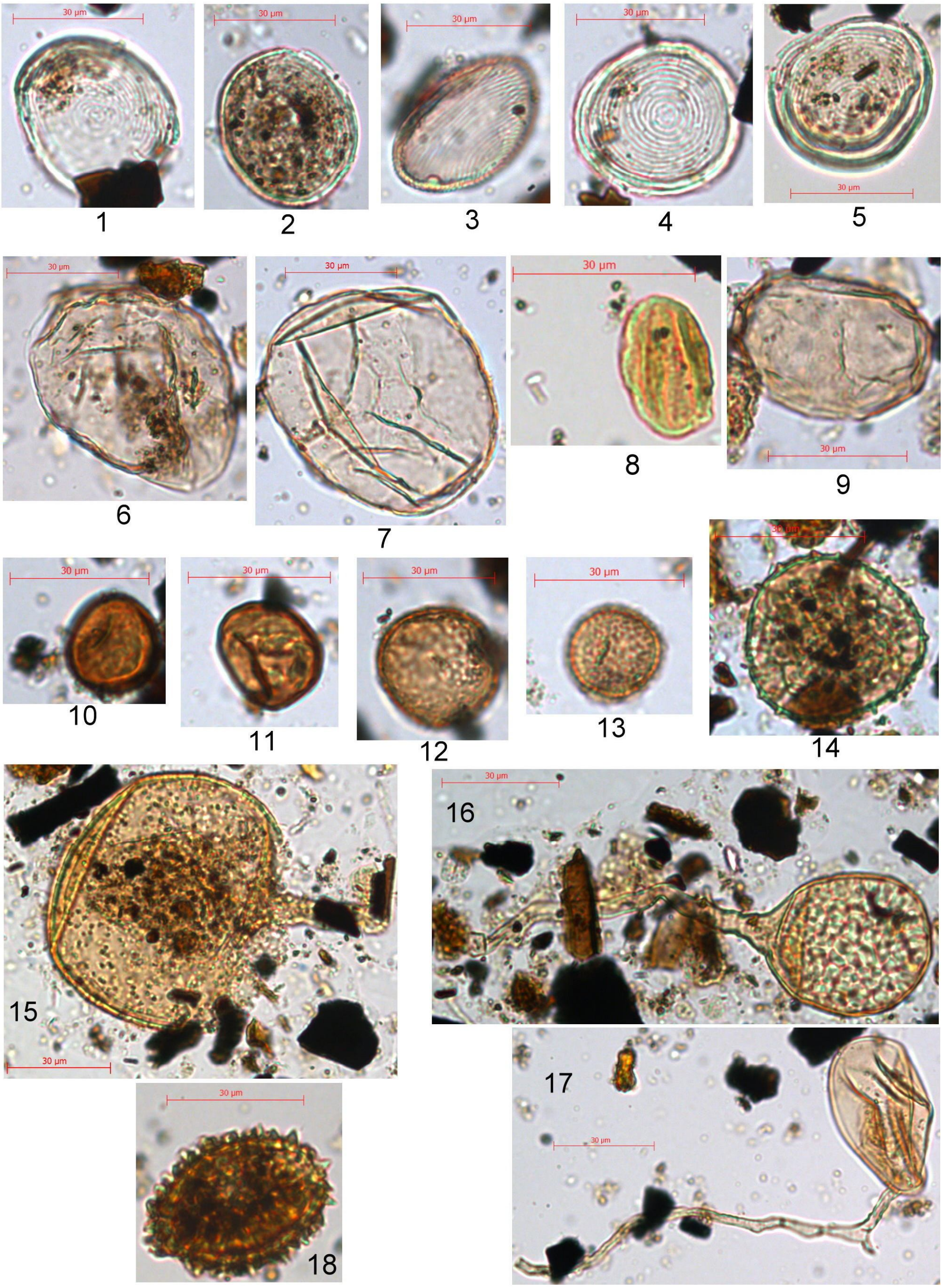

Plate II

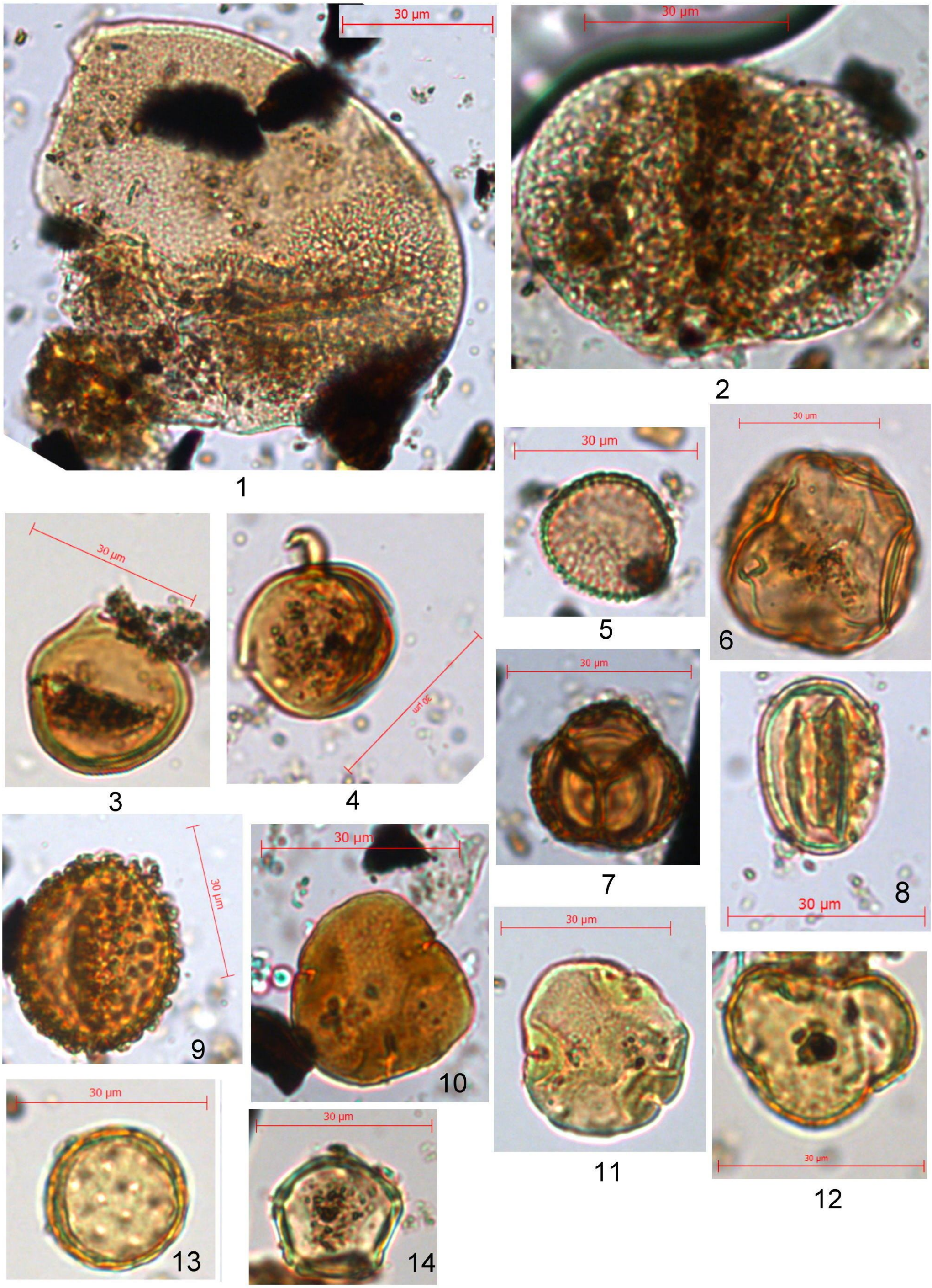

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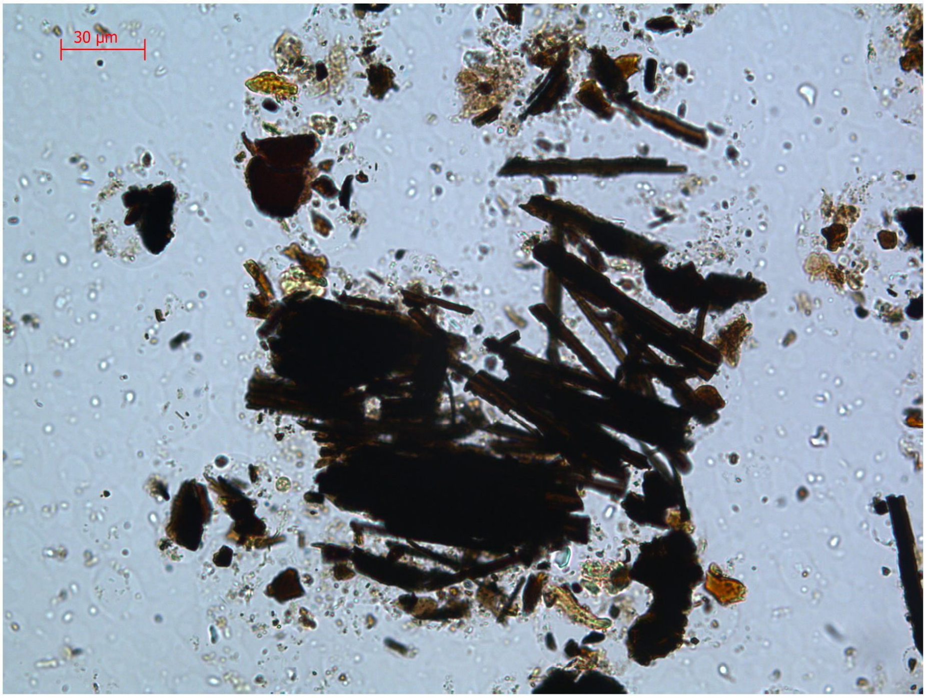
Plate III



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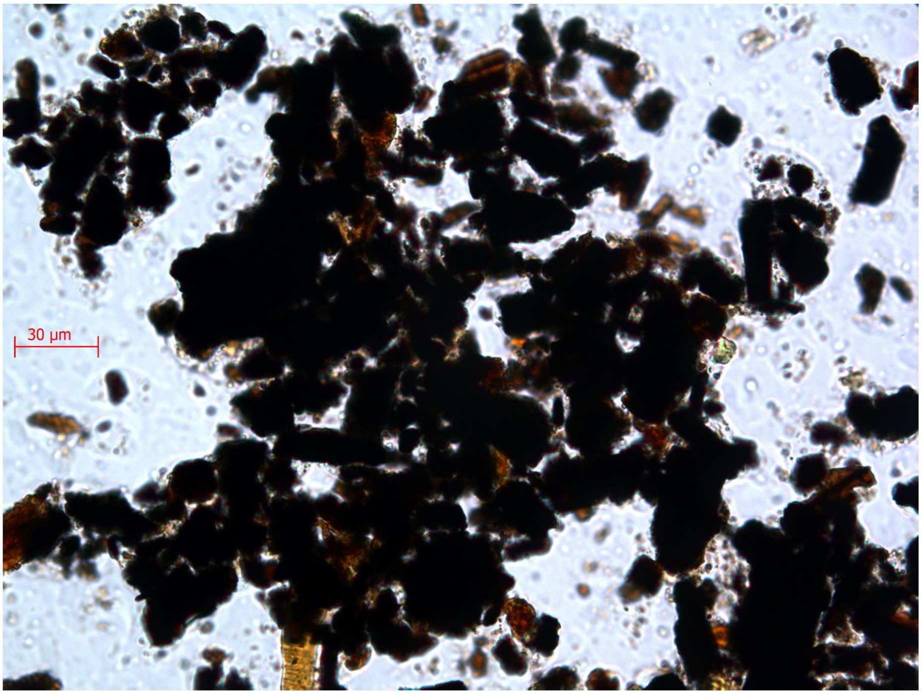

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Plate IV

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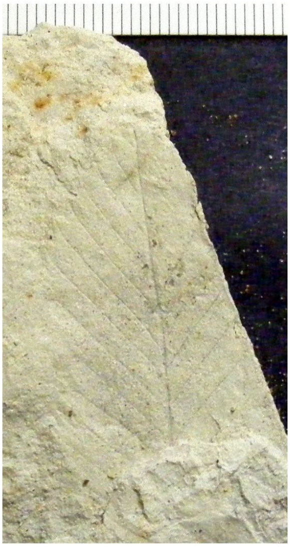

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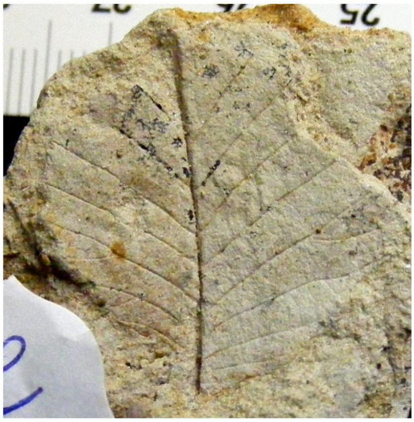

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