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PALYNOLOGICAL STUDY OF THE RBN 4 BOREHOLE (MOLDAVIAN PLATFORM)

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Abstract

In the present paper, 10 samples have been analyzed and the resulting palynological assemblages have been interpreted in order to determine the palaeoclimatic conditions during the sedimentation of the studied deposits. In the RBN 4 borehole, we have identified taxa such as the following: *Pityosporites labdacus*, *Pityosporites alatus*, *Pityosporites insignis*, *Pinuspollenites miocaenicus*, *Abiespollenites* sp., *Myricipites bituitus*, *Tricolpopollenites liblarensis*, *Tricolporopollenites henrici*, *Carpinipites carpinoides*, *Engelhardtioides microcoryphaeus*, *Leiotriletes* sp. a.o. The method used for palaeoclimatic estimations is the "Coexistence Approach", described by Mosbrugger et Utescher (1997) and frequently used throughout the past decade for the reconstruction of the European tertiary palaeoclimate. The values calculated by us for the Sarmatian deposits from the RBN 4 borehole using this method are the following: MAT 16.5–17.2°C, MAP 1300–1355 mm/yr, WMT 23.6–28.5°C, CMT 9.6–12.5°C.

Keywords: Moldavian Platform, palynomorphs, Sarmatian, palaeoclimate.

Introduction

The samples submitted to analysis are from the RBN 4 borehole (Neamţ County, Stanita-Vladnicele Village) and are located near the tectonic limit which separates the Moldavian Platform from the Bârlad Platform through the Fălciu–Plopana fault (fig. 1). The

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lithological column of the borehole has intercepted entirely Sarmatian deposits down to 970m. Between 970 and 975m, the lithology is represented mainly by anhydrite. According to the lithology, the limit between the Sarmatian and the Badenian is at approximately 970m in the studied area.

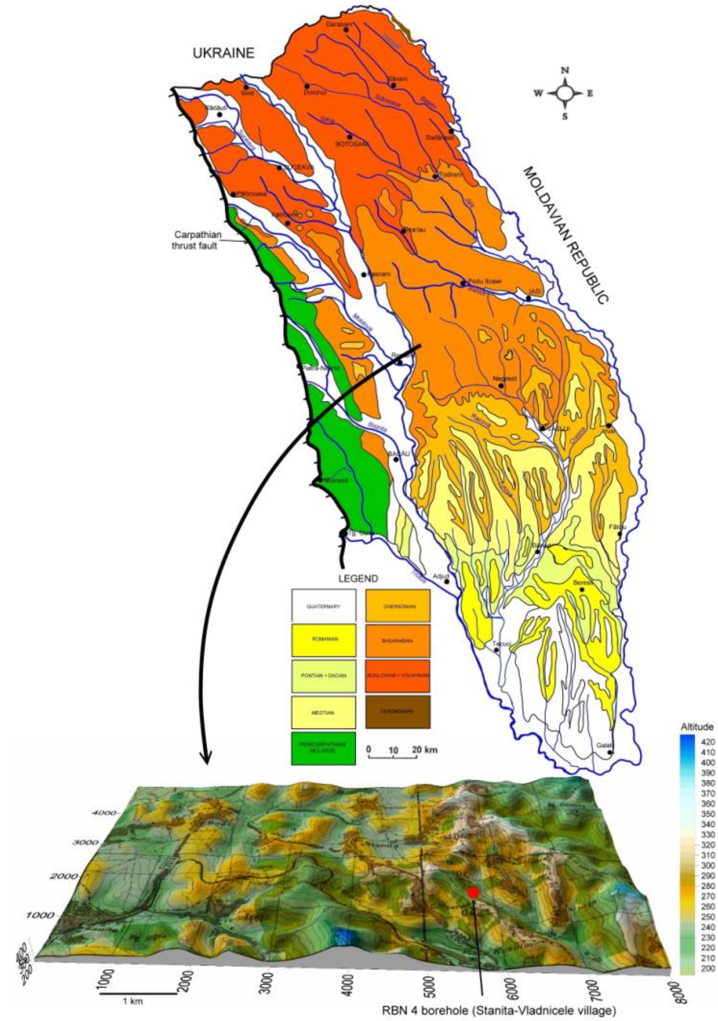

Fig. 1. Location of the Stăniţa-Vlădnicele borehole (Geological map of the Moldavian Platform according to Ionesi, 1994, Ionesi et al., 2005 with modifications. The 3D model was made using Digimap and Surfer 8.0 software)

Geological settings

The Moldavian Platform, which is the Romanian sector of the East European Platform, is considered the oldest platform unit of Romania (Ionesi, 1994). The western limit is at the contact of the peri-Carpathian area with the Miocene deposits of the platform on the Straja – Solca – Păltinoasa – Tg. Neamţ – Bacău route (Ionesi et al., 2005).

The Southern Moldavian Platform is separated from the Bârlad Platform by the Fălciu – Munteni – Plopana fault (Ionesi, 1994). The intra-Volhynian tectogenesis, and possibly the effects of the intra-Badenian as well, especially those taking place in the external areas of the Carpathians, strongly affected the evolution of the Paratethys basins. In the final part of the Badenian, the Moldavian Platform functioned as a continental area, the sedimentation process lasting until the Lower Sarmatian (Upper Buglovian) (Brânzilă and Ţabără, 2005).

Beginning with the Lower Sarmatian, in the Eastern Carpathian foreland, because of the advancement of the orogeny above the top of the Moldavian Platform, a series of characteristic depozones were outlined. Based on sedimentological criteria, from west to east, four depozones have been identified: wedge-top, foredeep depozone, forebulge and backbulge. The basinal waters have a much lower salinity as compared to that during the Badenian (Brânzilă, 1999; Grasu et al., 2002).

The southern part of the Moldavian Platform has developed under complex conditions, partially similar to those of the northern part, in a marine environment corresponding to the last stage of evolution of the foreland basin of the Eastern Carpathians, with an obvious tectonic control.

The lithological column of the well has intercepted entirely Sarmatian deposits, from the limit of the Badenian anhydrite to the *Cryptomactra* clays (Lower Bessarabian and the beginning of the Upper Bessarabian). The deposits of this interval belong to the first stage of evolution of the foreland basin, when the subsidence was polarized from east to west and inducted by the influence of the break-thrust (Grasu et al., 2002).

Method

The analysis of the pollen content of sediment samples is the main technique available for determining the response of vegetation to past terrestrial environmental change. The technique has been in use for nearly a century, initially as a method for investigating past climatic changes. More recently, the importance of processes such as human impact, successional change and other biotic and abiotic factors for vegetation change has been recognized. The palynological study was made using 10 samples collected from the Stăniţa – Vlădnicele borehole (RBN 4 borehole), from depths between 140 - 975m. The quantity of sediments submitted to analysis was of approximately 50 g for each sample. They have been treated with HCl (37%) to remove the carbonate and, afterwards, with HF (48%) to remove the silicate minerals. The separation of palynomorphs from the residue resulted from the chemical reaction described above was made with centrifugal action, using as heavy liquid $ZnCl_2$ with a density of 2.00g/cm^3. The organic fraction resulted was inserted into a mixture of glycerine and gelatine, 1-2 drops been mounted on the palynological shim. The visualisation of the palynomophs was accomplished with a Leica DM1000 microscope with transmitted light, using an amplification of x100, x400.

Results and discussions

The palynological assemblage present in the Stănita – Vlădnicele borehole (Table 1) is represented by Gymnospermatophytae (*Abiespollenites, Pityosporites, Cedripites, Inaperturopollenites, Podocarpidites, Zonalapollenites*), Angiospermatophytae (*Graminidites, Caryapollenites, Engelhardtioidites, Intratriporopollenites,* (*Quercopollenites*), Pteridophytae (*Laevigatosporites, Leiotriletes, Polypodiaceoisporites, Verrucatosporites*) and Phytoplancton (*Operculodinium, Spiniferites, Spirogyra, Tytthodiscus*). Gymnospermatophytae taxa (*Pityosporites*) and *Angiospermatophytae* taxa (*Caryapollenites* and *Tricolporopollenites*) are dominant. Phytoplancton species (*Operculodinium, Spiniferites, Spirogyra, Tytthodiscus)* are present in low quantities.

As we can see in table 1, samples P 301 (140m) and P 302 (340m) from the upper part of the borehole are characterized by a poor diversity of the palynomorphs. In these samples, species such as *Zonalapollenites minimus, Pityosporites* sp., *Zelkovaepollenites thiergarti, Tricolporopollenites* sp. and *Caryapollenites simplex* represent, as percentage, the main taxa. Sample P 303 (485m) is the richest in palynomophs. Apart from the continental taxa, a marine assemblage with *Operculodinium, Spiniferites* and *Tytthodiscus* is also present. According to Sluijs et al. (2005), *Spiniferites* and *Operculodinium* indicate a proximal self area (inner neritic – outer neritic) with lower water depth. In samples P 304 - P308 (550-895m), we have found mainly continental species. *Caryapollenites Tricolporopollenites* and *Pityosporites* are the dominant ones. In samples P 309 (950m) and P 310 (975m), palynomophs are present in low quantity. This can be explained by a less favorable depositional environment at the limit between the Sarmatian and the Badenian.

Dinoflagellate assemblage (marine domain). This assemblage is mainly composed of reworked species of Phytoplankton (*Operculodinium, Spiniferites, Spirogyra, Tytthodiscus)*. A higher percentage and diversity is present in sample 303, collected from a depth of 485m (tab. 1).

Continental assemblage

Based on the palynological assemblage, we have separated the following biocenosis for continental palynomophs: swamp assemblage, mixed mesophytic forest, terrestrial herbs and fern association.

Swamp assemblage. Aquatic plants like *Typha* indicate the presence of freshwater in the depositional environment. The swamp forest defines the lakeshore vegetation with moderate amounts of *Cupressaceae* and *Taxodiaceae*, and a high amount of the riparian genus *Salix*.

The mixed mesophytic forest is well represented by species of fossil pollen, such as *Carpinus, Quercus, Ulmus, Betula, Carya* and *Acer.* Pinaceae taxa (*Pityosporites alatus, Pityosporites labdacus, Pityosporites cedrisacciformis, Pityosporites insignis*) are abundant in the mesophytic forest. The ground-cover vegetation of mixed forests is made up of herbaceous plants and the presence of ferns indicates humidity (*Leiotriletes*, *Laevigatosporites*, *Polypodiaceoisporites* a. o.).

Terrestrial herbs. This association consists of seven taxa mainly constituted of ground-cover vegetation in the mesophytic forest. *Chenopodiaceae* are the dominant groups in this association.

The fern assemblage is represented by *Laevigatosporites, Leiotriletes*, *Polypodiaceoisporites* a. o.

Ivanov et al. (2002) showed that vegetation of the Middle and Upper Badenian of the Fore-Carpathian basin (central Paratethys, NW Bulgaria) was characterized by regular occurrence and abundance of thermophilous species, whereas, during the Sarmatian, subtropical elements like *Engelhardia, Reevesia, Itea, Castanopsis*, *Symplocaceae* and Arecaceae tend to decrease, while temperate elements such as *Alnus, Carpinus, Betula, Corylus* and *Fagus* display an increasing trend. A similar change in vegetation was observed in the Sarmatian deposits of the RBN 4 borehole. During the Sarmatian, favorable conditions existed in the Fore-Carpathian Basin for the development of mixed mesophytic forests, characterized by the predominance of warm-temperate and subtropical species, along with many palaeotropical elements.

Tab. 1 Palynological assemblage identified in the RBN 4 borehole

	P 301 140m	P302 340m	P303 485m	P304 550m	P305 665m	P306 790m	P307 850m	P308 895m	P309 950m	P310 975m
Phytoplancton										
Deflandrea phosphoritica EISENACK 1938			x							
Operculodinium sp.	x		x						x	
Spiniferites sp.			x					x		
Spirogyra sp.			x							
Tytthodiscus sp.			x					x		
Pteridophyta										
Cicatricosisporites sp.			x	x			x			
Echinatisporis sp.		x	x		x	x	x	x		
Echinatisporis wiesaënsis KRUTZSCH 1963	x		x	x			x			
Laevigatosporites gracilis WILSON – WEBSTER 1946						x	x	x		
Laevigatosporites haardti (POTONIE et VE N. 1934) Th. et PFLUG, 1953 subsp. *haardti* KRUTZSCH 1967			x	x		x	x			
Laevigatosporites sp.		x	x		x		x	x		
Leiotriletes sp.				x		x				x

Tab. 1 (continued 1)

	P 301 140m	P302 340m	P303 485m	P304 550m	P305 665m	P306 790m	P307 850m	P308 895m	P309 950m	P310 975m
Leiotriletes wolffi brevis KRUTZSCH 1962	x		x	x			x			
Leiotriletes wolffi wolffi KRUTZSCH 1962				x		x	x	x		
Polypodiaceoisporites saxonicus KRUTZSCH 1967							x			
Polypodiaceoisporites sp.		x	x			x				
Trilobosporites weylandi DÖRING 1965 (reworked)	x					x				
Triplanosporites sinuosus (PFLUG. 1952) TH. – PFLUG 1953			x	x			x	x		
Verrucatosporites cf. *favus* POTONIE 1931						x				
Gymnospermatophyta										
Abiespollenites absolutus THIERGART 1937				x		x	x	x		
Abiespollenites cedroides (THOMSON 1953) KRUTZSCH 1971		x			x	x				
Abiespollenites latisaccatus (TREVISAN 1967) KRUTZSCH 1971	x		x	x		x	x	x	x	
Abiespollenites maximus KRUTZSCH 1971		x		x		x				
Abiespollenites sp.			x		x					
Cedripites lusaticus KRUTZSCH 1971	x			x			x			
Cedripites miocaenicus KRUTZSCH 1971		x	x	x		x		x		
Cedripites sp.							x			
Cupressacites bockwitzensis KRUTZSCH 1971			x	x		x				
Cycadopites miocaenica NAGY 1969		x	x		x	x	x	x		
Ginkgo sp.	x				x	x				
Inaperturopollenites concedipites (WODEHOUSE 1933) KRUTZSCH 1971			x	x	x	x	x			
Inaperturopollenites hiatus (POTONIÉ 1931) THOMSON et PFLUG 1953	+	+	+	+	+	+	+	+	x	
Inaperturopollenites microforatus KRUTZSCH 1971	x		x	x						
Inaperturopollenites sp.		x	x	x			x	x		
Piceapollenites neogenicus NAGY 1969			x	x						
Piceapollis praemarianus KRUTZSCH 1971	x		x	x		x		x		
Piceapollis sp.			x	x			x			

Tab. 1 (continued 2)

	P 301 140m	P302 340m	P303 485m	P304 550m	P305 665m	P306 790m	P307 850m	P308 895m	P309 950m	P310 975m
Pinuspollenites longus NAGY 1985		x		x	x	x				
Pinuspollenites miocaenicus NAGY 1985	x		+	x			x	x		
Pityosporites alatus (POTONIÉ 1931) THOMSON et PFLUG 1953		+	+	x	x	+			x	x
Pityosporites cedrisacciformis KRUTZSCH 1971	x		x	x			x	x		
Pityosporites insignis (NAUMOVA ex BOLCHOVITINA 1953) KRUTZSCH 1971		+	x			x	x	x		
Pityosporites labdacus (POTONIÉ 1931) THOMSON et PFLUG 1953			+	x	x	x		x		x
Pityosporites microalatus (POTONIÉ 1931) THOMSON et PFLUG 1953			x	x				x		
Pityosporites minutus (ZAKLINSKAJA 1957) KRUTZSCH 1971			x	x		x		x		
Pityosporites sp.	+	+	+	+	+	+	+	+	x	x
Podocarpidites gigantea (ZAKL. 1957) NAGY 1985		x					x			
Podocarpidites nageiaformis (ZAKL. 1957) KRUTZSCH 1971			x	x	x	x				
Podocarpidites sp.		x				x	x			
Sciadopityspollenites serratus (POTONIE et VEN. 1934) THIERGART 1937					x	x		x		
Sciadopityspollenites sp.			x	x			x			
Sciadopityspollenites varius KRUTZSCH 1971	x		+		x	x				
Sequoiapollenites minor KRUTZSCH 1971				x			x	x		
Zonalapollenites minimus KRUTZSCH 1971		+	x		+	x				
Zonalapollenites rueterbergensis KRUTZSCH 1971	x		x	x			x	x		
Zonalapollenites sp.	x		x	x		x	x			
Zonalapollenites verrucatus KRUTZSCH 1971			+							
Angiospermatophyta. Monocotyledonatae										
Arecipites sp.			x			x		x		
Graminidites media (COOKSON 1947) POTONIÉ 1960				x	x		x			
Graminidites sp.	x	x	x	x				x		
Monocolpopollenites sp.				x	x		x		x	

Tab. 1 (continued 3)

	P 301 140m	P302 340m	P303 485m	P304 550m	P305 665m	P306 790m	P307 850m	P308 895m	P309 950m	P310 975m
Monocolpopollenites tranquillus (POTONIÉ 1934) THOMSON et PFLUG 1953	**x**		**x**	**x**		**x**		**x**		
Typha angustifolia LESCHIK 1956			**x**			**x**		**x**		
Angiospermatophyta. Dicotyledonatae										
Aceripollenites rotundus NAGY 1969				**x**						
Aceripollenites sp.		**x**	**x**	**x**	**x**		**x**			
Alnipollenites verus (POTONIÉ 1931) POTONIÉ 1934	**x**			**x**						
Betulaepollenites betuloides (PFLUG 1953) NAGY 1969		+	**x**		**x**			**x**		
Carpinipites carpinoides (PFLUG 1953) NAGY 1985	**x**			**x**				**x**		
Caryapollenites simplex (POTONIÉ 1931) KRUTZSCH 1960	+	+	+	+	+	+	+	+		**x**
Caryapollenites sp.	+	+	+	+	+	+	+	+		
Chenopodipollis multiplex (WEYLAND et PFLUG 1957) KRUTZSCH 1966			+	+	**x**	**x**	**x**			
Cyrillaceaepollenites exactus (POTONIÉ 1931) POTONIÉ 1960				**x**		**x**	**x**			
Cyrillaceaepollenites megaexactus (POTONIÉ 1931) POTONIÉ 1960			**x**				**x**			
Engelhardtioidites microcoryphaeus (POTONIÉ 1931) THOMSON et THIERGART ex POTONIÉ 1960	+	+	+	+	+	+	**x**	**x**	**x**	
Ericipites ericius (POTONIÉ 1931) POTONIÉ 1960		**x**		**x**		**x**				
Eucommiapollis eucommi (PLANDEROVA 1990) PETRESCU 1999	**x**	**x**	**x**	**x**		**x**	**x**	**x**		
Faguspollenites minor NAGY 1969				**x**						
Faguspollenites sp.	**x**		**x**				**x**	**x**		
Ilexpollenites margaritatus (POTONIÉ 1931) POTONIÉ 1960			**x**		**x**		**x**			
Intratriporopollenites instructus (POTONIÉ 1931) THOMSON et PFLUG 1953		**x**		**x**		**x**		**x**		
Juglanspollenites maculosus (POTONIÉ 1931) NAGY 1985			**x**	**x**						
Juglanspollenites sp.	**x**			**x**		**x**	**x**	**x**		
Liquidambarpollenites sp.			**x**		**x**					
Magnolipollis sp.			**x**		**x**	**x**				

Tab. 1 (continued 3)

	P 301 140m	P302 340m	P303 485m	P304 550m	P305 665m	P306 790m	P307 850m	P308 895m	P309 950m	P310 975m
Momipites punctatus (POTONIÉ 1931) NAGY 1969				**x**				**x**		
Myricipites bituitus (POTONIE 1931) NAGY 1969	+		+	+	+	+	+	+		
Platycaryapollenites sp.	**x**	**x**	**x**		**x**		**x**			
Porocolpopollenites vestibulum (POTONIÉ 1931) THOMSON et PFLUG 1953			**x**					**x**		
Pterocaryapollenites stellatus (POTONIÉ 1931) THIERGART 1937	+	+	**x**	+	+	+	+	+	**x**	
Quercopollenites granulatus NAGY 1969		**x**	**x**							
Quercopollenites petrea NAGY 1969	**x**	**x**		**x**		**x**	**x**			
Quercopollenites robur NAGY 1969	**x**		**x**				**x**	**x**		
Quercopollenites sp.		**x**		**x**	**x**					
Salixipollenites helveticus NAGY 1969			**x**	**x**		**x**	**x**			
Tricolpopollenites liblarensis (THOMSON 1950) THOMSON et PFLUG 1953 subsp. *Liblarensis*	**x**		**x**	**x**		**x**		**x**		
Tricolporopollenites cingulum (POTONIE 1931) THOMSON et PFLUG 1953 subsp. *pusillus* (POTONIE 1934) THOMSON et PFLUG 1953		**x**		**x**	**x**		**x**	**x**		
Tricolporopollenites henrici (POTONIÉ 1931) KRUTZSCH 1960			**x**	**x**	**x**	**x**	**x**	**x**		
Tricolporopollenites marcodurensis PFLUG et THOMSON 1953			**x**	**x**		**x**	**x**	**x**		
Tricolporopollenites microhenrici (POTONIÉ 1930) KRUTZSCH 1960			**x**	**x**		**x**		**x**	**x**	
Tricolporopollenites sp.	+	+	+	+	+	+	+	+	**x**	**x**
Ulmipollenites undulosus WOLFF 1934	**x**		**x**	**x**		**x**	**x**			
Zelkovaepollenites potoniéi NAGY 1969		+			+	**x**		**x**		
Zelkovaepollenites sp.	**x**	+	**x**	+	+	**x**	**x**	+		
Zelkovaepollenites thiergarti NAGY 1969	+	+	+	+	+	+	+	+		
Gombaspora (Hyphomycetes)				**x**						

Legend: **x** very rare (1-2 grains); + rare (3-9 grains)

Palaeoclimatical interpretation based on palynological assemblage

The method used for palaeoclimatic estimations is the “Coexistence Approach” (CA), described by Mosbrugger and Utescher (1997). This method was frequently used for the reconstruction of the European tertiary palaeoclimate. The "Coexistence Approach" method is based on determination of the coexistence approach for all taxa, establishing for the fossil flora their relative life conditions (NLR - Nearest Living Relative) and climate of tolerance (maximum and minim values), respecting variations of the palaeoclimatic parameters (MAT, MAP, CMT, WMT). It is supposed that the intervals of coexistence describe the palaeoclimate assumed on the fossil flora.

Four palaeoclimatic parameters have been calculated in the present study: Mean annual temperature (MAT), Mean annual precipitation (MAP), Warmest month temperature (WMT) and Coldest month temperature (CMT).

The values calculated by us using the "Coexistence Approach" method are the following (fig. 2): MAT 16.5–17.2°C, MAP 1300–1355mm/yr, WMT 23.6–28.5°C, CMT 9.6–12.5°C. The data obtained by us is similar to those presented by Chirilă and Ţabără (2008) for the Volhynian deposits from Râşca Valley (MAP 16.5–17.2°C, MAP 1300–1355mm/yr); Chirilă (2008), for samples analyzed from the Moisea watercourse, of Volhynian age (MAT, 15.3–17.2°C and MAP, 1300–1520mm/yr), and the Baia borehole (MAT, 16.5–16.6°C and MAP 1300–1355mm/yr); Ţabără et al. (2009), for the Bessarabian deposits from Stan's Hill – Bozieni (MAT, 15.3–16.6°C and MAP between 1300–1520mm/yr). Relatively close values of MAT 14–15°C and lower values of MAP 800–1000mm/yr have been proposed for the Upper Badenian (Kossovian) – Lower Sarmatian from Mereşti - Harghita (Petrescu et al., 1988). Palaeoclimatic estimations in the Republic of Moldova for the Volhynian were a MAT of 15°C, WMT of 25°C, CMT of 3–6°C and MAP of 1000mm/yr (Ştefârţă, 1997). For the Bessarabian deposits from the same area, Ştefârţă (1997), established the following climatic parameters: MAT 11°C, WMT 23°C, CMT 5–8°C and MAP 700mm/yr.

The climatic parameters established for the Volhynian and the Bessarabian from Bulgaria have shown the following values (Ivanov et al., 2002): MAT between 15.6–17.2°C, CMT 5–7°C and WMT 24.6–27.8°C. For the Chersonian, a lower MAT, of 2°C, has been calculated, regardless of the Bessarabian and Volhynian values.

Based on palynoflora presented by Guşă-Popescu (2006), Ţabără et al. (2008) have calculated the following values: for the Ivăncăuţi area (Botoşani county) MAT 15.7–16.6°C, MAP 1300–1355mm/yr., CMT 7–9.6°C, WMT 24.7–27.8°C, while for the Truşeşti area (Botoşani county) MAT 15.7–16.6°C, MAP 1300–1355mm/yr., CMT 9.6–13.3°C, WMT 27.3–28.1°C.

From the Upper Badenian microflora of north-western Bulgaria, Ivanov et al. (2002) have calculated values of MAT ranging between 16.5–17.5°C.

Syabryaj et al. (2007) estimate for the Upper Badenian from the Ukrainian Plaine (Korobki region) a MAT of 15.6°C and a MAP between 1304–1356mm/yr.

As noted above, the palaeoclimatic parameters calculated in this paper are similar to data presented by other authors from Romania, the Republic of Moldova, Bulgaria and Ukraine, which may suggest similar or relatively close paleoecological conditions during the Sarmatian and the Badenian. Small differences in MAT, MAP, CMT, WMT values are due to conditions specific to each region during the Sarmatian and the Badenian.

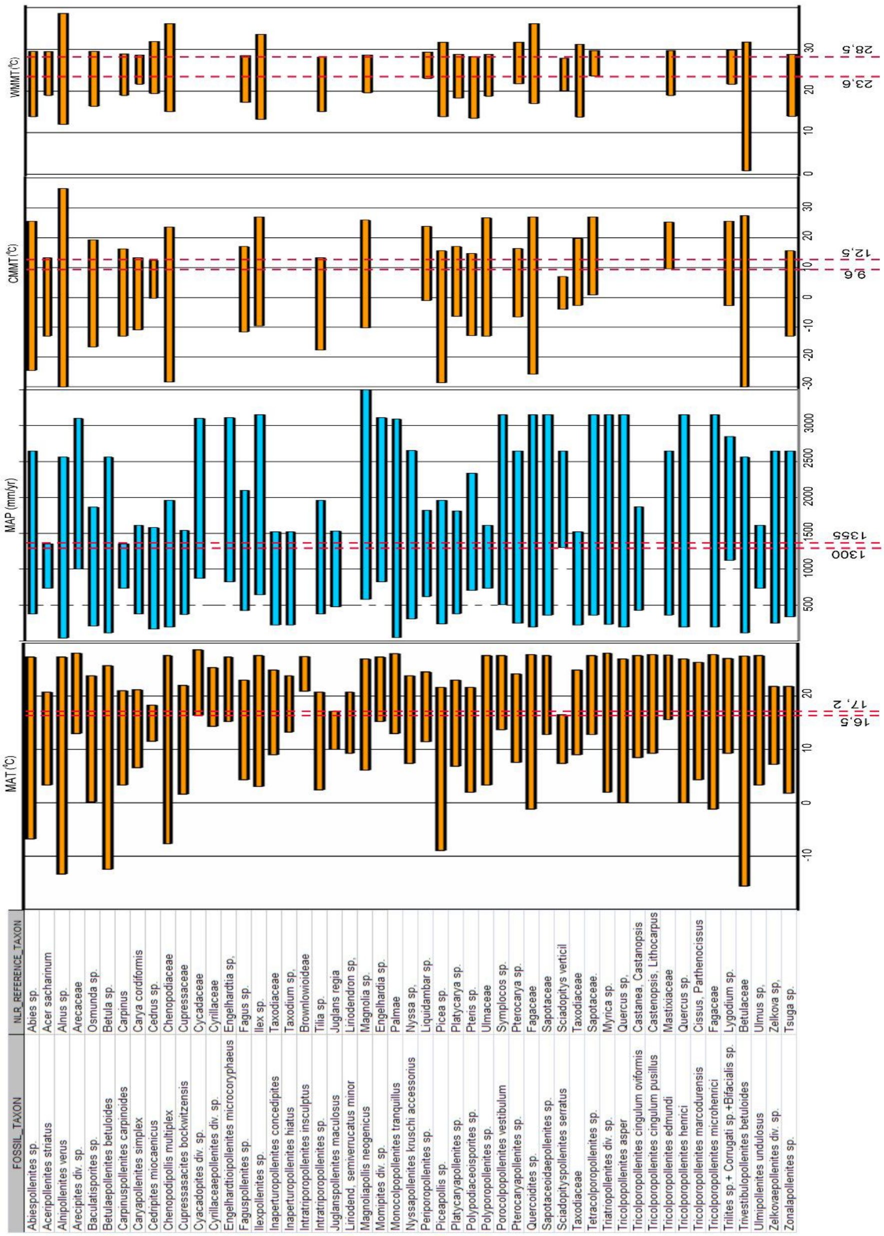

Fig. 2 Estimation of the MAT, MAP, CMT, WMT values using Coexistence approach method.

Conclusions

Based on the palynological assemblage, we have separated the following biocenosis for continental palynomophs: swamp assemblage, mixed mesophytic forest, terrestrial herbs and fern association. Phytoplankton is present with a low frequency and is represented by *Spiniferites*, *Operculodinium* and a few reworked species such as *Deflandrea* a.o.

The palaeoclimatic values calculated by us for the Sarmatian deposits from the RBN 4 borehole using the coexistence approach method are the following (fig. 2): MAT 16.5–17.2°C, MAP 1300–1355mm/yr, WMT 23.6–28.5°C, CMT 9.6–12.5°C. The samples contained very few tropical elements, like *Podocarpus*, and more subtropical species, such as *Liquidambar*, *Zelkova* and *Cedrus*, but they were dominated by temperate plants, such as *Ericaceae*, *Tilia*, *Ulmus*, *Carpinus*, *Castanea*, *Betula*, *Alnus*, *Quercus*, *Fagus*, *Pterocarya*, and *Carya*, and *Conifers*, including *Pinus*, *Picea*, *Abies*, and *Tsuga*.

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References

Brânzilă, M., Ţabără, D., 2005. The palynological content of Lower Basarabian (The clays with Cryptomactra) on the Moldavian Platform. Anal. Şt. Univ. „Al. I. Cuza" Iaşi, Geol., **XLIX-L**, 277-291.

Brânzilă, M., 1999. The geology of the southern part of Moldavian Plaine. Ed. Corson, Iaşi. 221p. (In Romanian).

Chirilă, G., 2008. Palaefloristic study of the Sarmatian from Râşca Valley basin. PhD. Thesis, "Al. I. Cuza" Univ., Iaşi. (In Romanian).

Chirilă, G., Ţabără, D., 2008. Palaeofloristic study of the Volhynian from Râşca (Moldavian Platform) - Palaeoclimatic and palaeoenvironment implications. Acta Palaeontologica Romaniae, **VI**, 29-42.

Grasu, C., Brânzilă, M., Miclăuş, C., Boboş, I., 2002. The Sarmatian of foreland basins from Eastearn Carpathians. Ed. Tehnică, Bucureşti, 407p. (In Romanian).

Guşă–Popescu, C. T., 2006. Palynological and microfaunistical study of the Badenian from Moldavian Platform and Southern Dobrogea. PhD. Thesis, Univ. „Al. I. Cuza" Iaşi, 253p. (In Romanian).

Ionesi, L., 1994. The geology of platform units and North-Dobrogea orogeny. Ed. Tehnică, Bucureşti, 279p. (In Romanian)

Ionesi, L., Ionesi, B., Lungu, A., Roşca, V., Ionesi, V., 2005. Upper and Middle Sarmatian from Moldavian Platform. Ed. Academiei Române, 558p. (In Romanian)

Ivanov, D., Ashraf, A. R., Mosbrugger, V., Palamarev, E., 2002. Palynological evidence for Miocene climate change in the Forecarpathian Basin (central Paratethys, NW Bulgaria). Palaeogeogr. Palaeoclim. Palaeoecol., **178**, 19-37.

Mosbrugger, V., Utescher, T., 1997. The coexistence approach - a method for quantitative reconstructions of Tertiary terrestrial palaeoclimate data using plant fossils. Palaeogeogr. Palaeoclim. Palaeoecol., **134**, 61-86.

Petrescu, I., Meszaros, N., Filipescu, S., Buda, A., 1988. Contributions to the stratigraphic knowledge of the neogen deposits in borehole 12 – Mereşti (SE Transylvanian Basin). Studia Univ. „Babeş-Bolyai", Geologia-Geografia, **XXXIII/2**, 15-24.

Syabryaj, S., Molchanoff, S., Utescher, T., Bruch, A.A., 2007. Vegetation and palaeoclimate in the Miocene of Ukraine. Palaeogeogr. Palaeoclim. Palaeoecol., **253**, 153-168.

Sluijs, A., Pross, J., Brinkhuis, H., 2005. From greenhouse to icehouse; organic-walled dinoflagellate cysts as paleoenvironmental indicators in the Paleogene. Earth-Science Reviews, **68**, 281-315.

Ştefârţă, A., 1997. Miocene flora from Nistru-Prut area. Review for habilitation degree in biological science based on published papers. Chişinău, 48p. (In Romanian)

Ţabără, D., 2008. The palynoloy of the Middle and Upper Sarmatian from Moldavian Platform. Ed. Univ. „Al. I. Cuza" Iaşi, 319p. (In Romanian).

Ţabără, D., Chirilă, G., Paraschiv, V., 2008. Palaeoclimatic estimation of the MAT (Mean anual temperature) and MAP (mean annual precipitation) from the Miocene from Romania based on palynological study. National Symposium „Grigore Cobâlcescu", Iaşi, 25-26 October 2008. (In Romanian)

Ţabără, D., Chirilă, G., Paraschiv, V., 2009. The Sarmatian macro- and microflora from Stan's Hill – Bozieni (Moldavian Platform). Anal. Şt. Univ. „Al. I. Cuza" Iaşi, Geol., **LV/2**, 2009, 19-37.

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PLATE CAPTIONS

Plate I

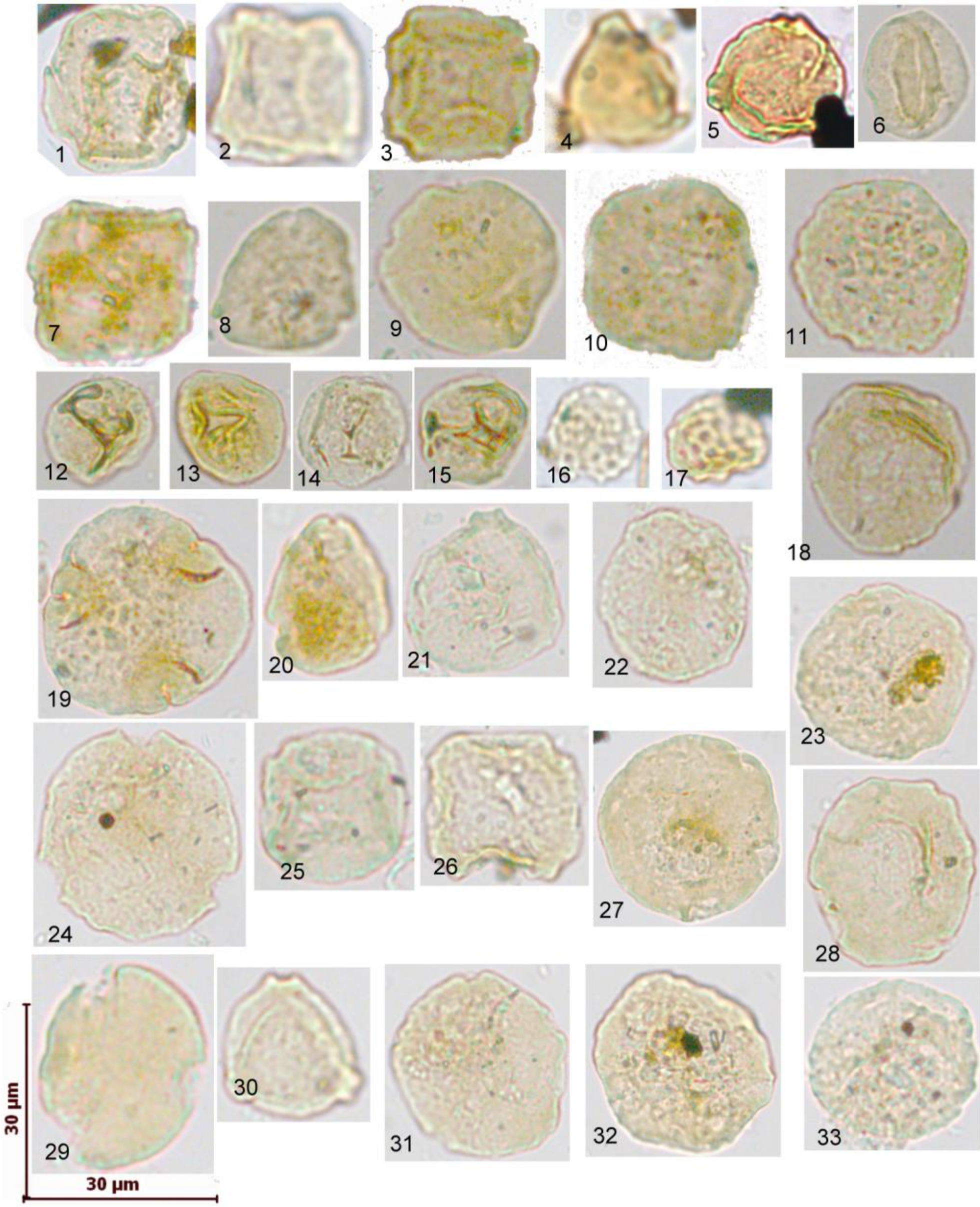
1, 25. *Zelkovaepollenites* sp.
2, 3, 7, 27. *Zelkovaepollenites thiergarti* NAGY 1969
4, 5, 21, 30. *Myricipites bituitus* (POTONIE 1931) NAGY 1969
6. *Tricolporopollenites* sp.
8, 20. *Engelhardtioidites microcoryphaeus* (POTONIÉ 1931) THOMSON et THIERGART ex POTONIÉ 1960
9, 10, 11, 18, 22, 23, 27, 32, 33. *Caryapollenites simplex* (POTONIÉ 1931) KRUTZSCH 1960
12-15. *Hydrosporis levis* KRUTZSCH 1962
16, 17. *Chenopodipollis multiplex* (WEYLAND et PFLUG 1957) KRUTZSCH 1966
19, 24. *Intratriporopollenites instructus* (POTONIÉ 1931) THOMSON et PFLUG 1953
28, 31. *Pterocaryapollenites stellatus* (POTONIÉ 1931) THIERGART 1937
29. *Aceripollenites* sp.

Plate II

1-7. *Inaperturopollenites concedipites* (WODEHOUSE 1933) KRUTZSCH 1971
8, 15. *Pityosporites labdacus* (POTONIÉ 1931) THOMSON et PFLUG 1953
9, 16. *Magnolipollis neogenicus* KRUTZSCH 1970
10, 11, 12. *Pityosporites alatus* (POTONIÉ 1931) THOMSON et PFLUG 1953
13. *Podocarpidites* sp.
14. *Podocarpidites podocarpoides* (THIERGART 1958) KRUTZSCH 1971
17. *Pityosporites minutus* (ZAKLINSKAJA 1957) KRUTZSCH 1971
18. *Inaperturopollenites hiatus* (POTONIÉ 1931) THOMSON et PFLUG 1953

Plate III

1. *Pinuspollenites miocaenicus* NAGY 1985
2. *Pityosporites microalatus* (POTONIÉ 1931) THOMSON et PFLUG 1953
3. *Pityosporites minutus* (ZAKLINSKAJA 1957) KRUTZSCH 1971
4. *Zonalapollenites maximus* (RAATZ 1937) KRUTZSCH 1971
5. *Abiespollenites maximus* KRUTZSCH 1971
6. *Monocolpopollenites* sp.
7. *Pityosporites insignis* (NAUMOVA ex BOLCHOVITINA 1953) KRUTZSCH 1971
8-9. *Podocarpidites nageiaformis* (ZAKLINSKAJA 1957) KRUTZSCH 1971
10. *Abiespollenites* sp.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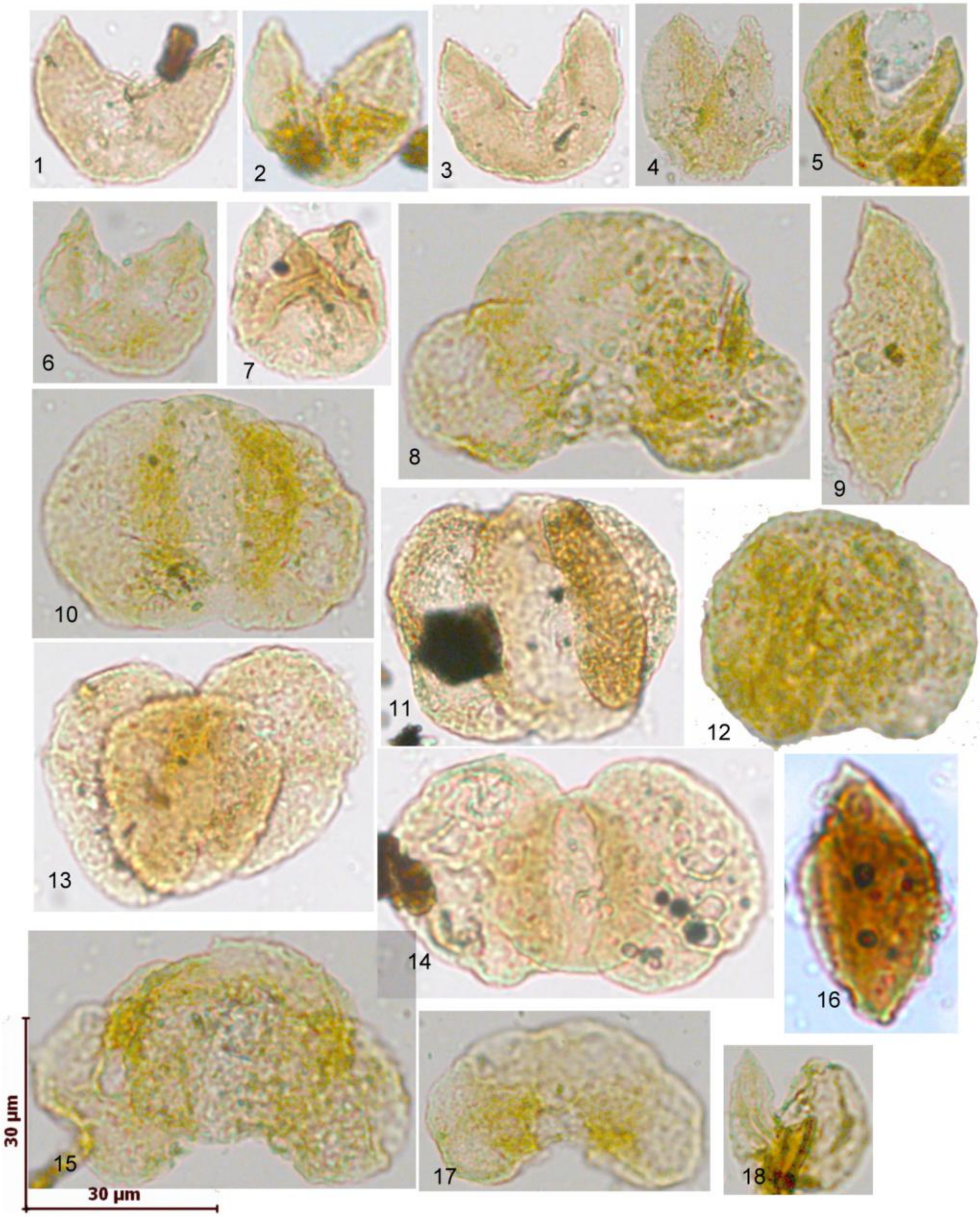
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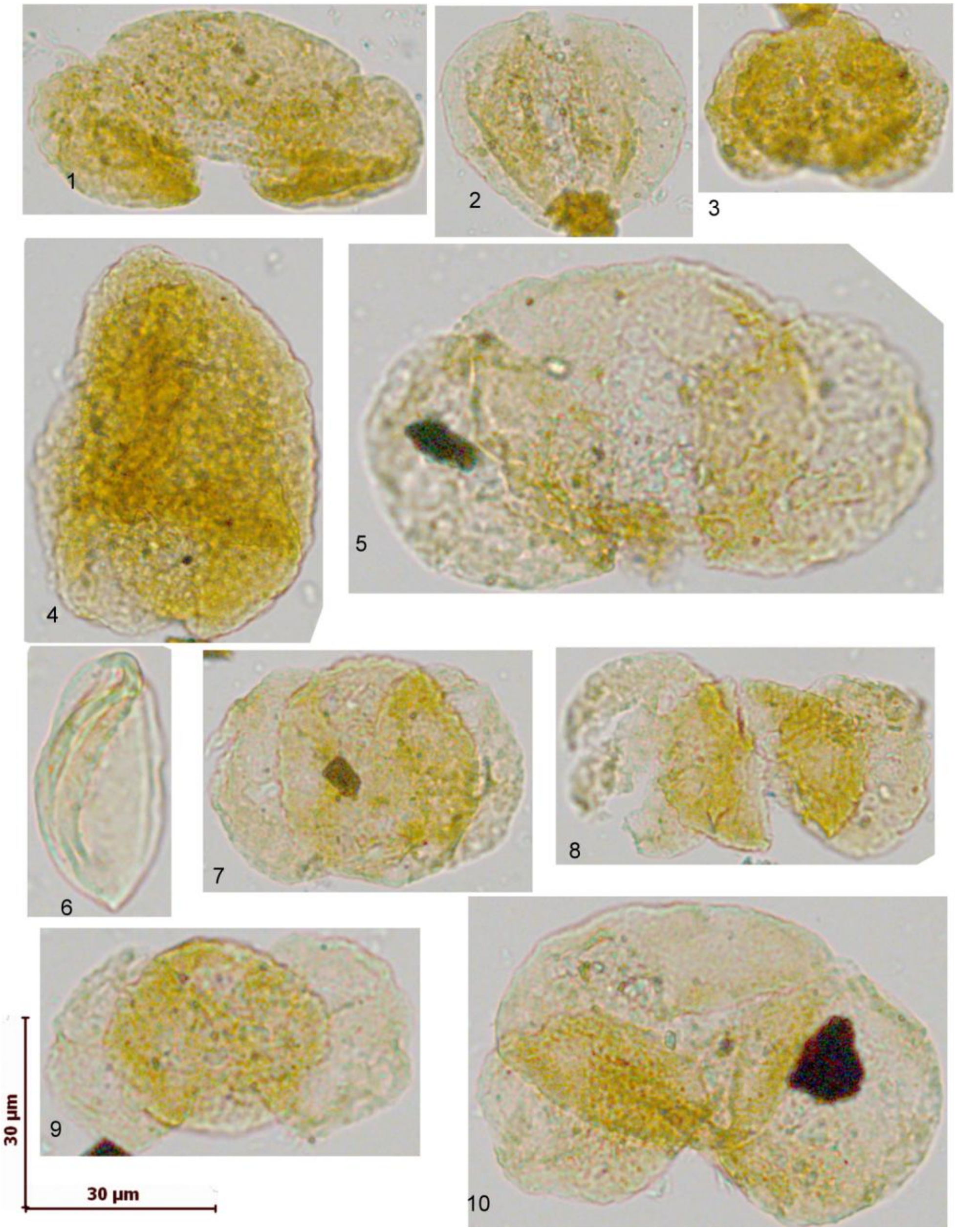
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