PALAEOFLORISTIC STUDY OF THE VOLHYNIAN FROM RÂŞCA (MOLDAVIAN PLATFORM) – PALAEOCLIMATIC AND PALAEOENVIRONMENT IMPLICATIONS

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Abstract

The main objective of this study was to identify, describe and interpret and the paleofloristic taxa from the outcrop from Ţiganca River. For the area Fălticeni - Sasca – Răuceşti, Ţibuleac (1998) manage to split the interval between Volhynian and Basarabian in 4 lithological units. For our study we are interested by Fălticeni-Boroaia Formation. Lithological, this formation consist of marls, clays, sands, sandstones and rarely tuffs. Accordind with Ţibuleac (1998) the outcrop from Ţiganca River stratigraphicaly is situated under the A layer of coal. The outcrop is located on the Ţiganca River at 185 m from confluence with Moisea River. From this outcrop we have collected 6 palynological samples and over 100 samples of paleofloras impresions and we succeded to identify 11 taxa. From palynological analysis of the samples collected from Ţiganca Valley we have relive continental and aquatic palinomorphs with following percentage: Gymnospermatophyta 53%, Angiospermatophyta 33%, Pteridophyta 4%, Phytoplancton 10%. The paleofloristic taxa has been collected from lower part of the outcrop are well preserved. We been able to identify taxa as; *Laurophyllum, Typha, Phragmites*, *Magnolia* and *Salix*. The leaf assemblages normally attest autochthonous or very close location to the place of provenance, being more useful for local paleoflora reconstitution than the pollen record (microfossils), which generally represent a largescale vegetation distribution.

Geological setting

The Moldavian Platform wich is the romanian sector of the East European Platform is considerated the oldest platform unit from Romania (Ionesi 1994). Western limit is at the contact with pericarpatic area, with miocene deposits and sarmatians deposits of the platform on the line Straja - Solca - Păltinoasa – Tg. Neamț – Bacău (Ionesi et al, 2005). The south Moldavian Platform is limited from the Bârlad Platform by Fălciu – Munteni – Plopana fault. In the north the limit is Ukraine and in the east Republic of Moldova. Our area of study was on the Țiganca Valley, at 10 km south-west from Fălticeni town (Figure 1). The Țiganca river is right side affluent of the Moisea river and the Moisea river is right side affluent of the Râşca river. The age of the deposits from this area is Volhynian, established with taxa *Plicatiforma plicata plicata, Mactra* (*Podolimactra*) *eichwaldi, Potamides mitralis mitralis* etc (Țibuleac 1998). The sedimentary deposits was assigned to Fălticeni – Boroaia Formation.

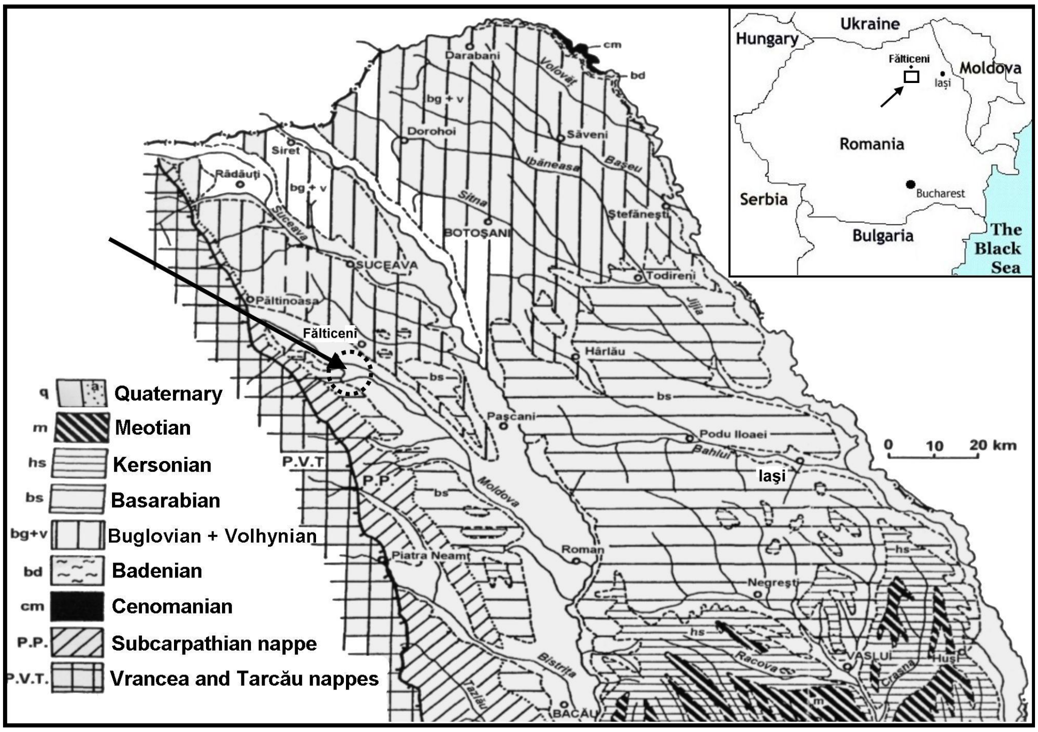

Figure 1. Geological map of the Moldavian Platform (Ionesi et al., 2005)

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Fălticeni – Boroaia Formation

Sarmatian deposits from Moldavian Platform was investigated by other autors: Barbu (1934), Macarovici (1955), Joja (1952 – fide Țibuleac 1998), Macarovici & Jeanrenaud (1958), Ionesi et. al. (1991), Ionesi L., Ionesi B. & Țibuleac (1993 – fide Țibuleac 1998), Ionesi L., Barbu, Ionesi B. (1994), Ionesi B. & Țibuleac (1995 – fide Țibuleac 1998), Țibuleac (1998), Guşă, Țibuleac, Olaru (1998), Grasu et al. (1999), Ionesi V. (2006), Ionesi et al. (2005).

For the Fălticeni - Sasca – Răuceşti area, Țibuleac (1998) manage to split the interval between Volhynian and Basarabian in 4 lithological units (Figure 2). For our study we are interested by Fălticeni-Boroaia Formation. Lithological, this formation consist of marls, clays, sands, sandstones and rarely tuffs. Accordind with Țibuleac (1998) the outcrop from Țiganca River stratigraphicaly is situated under the A layer of coal (Figure 2).

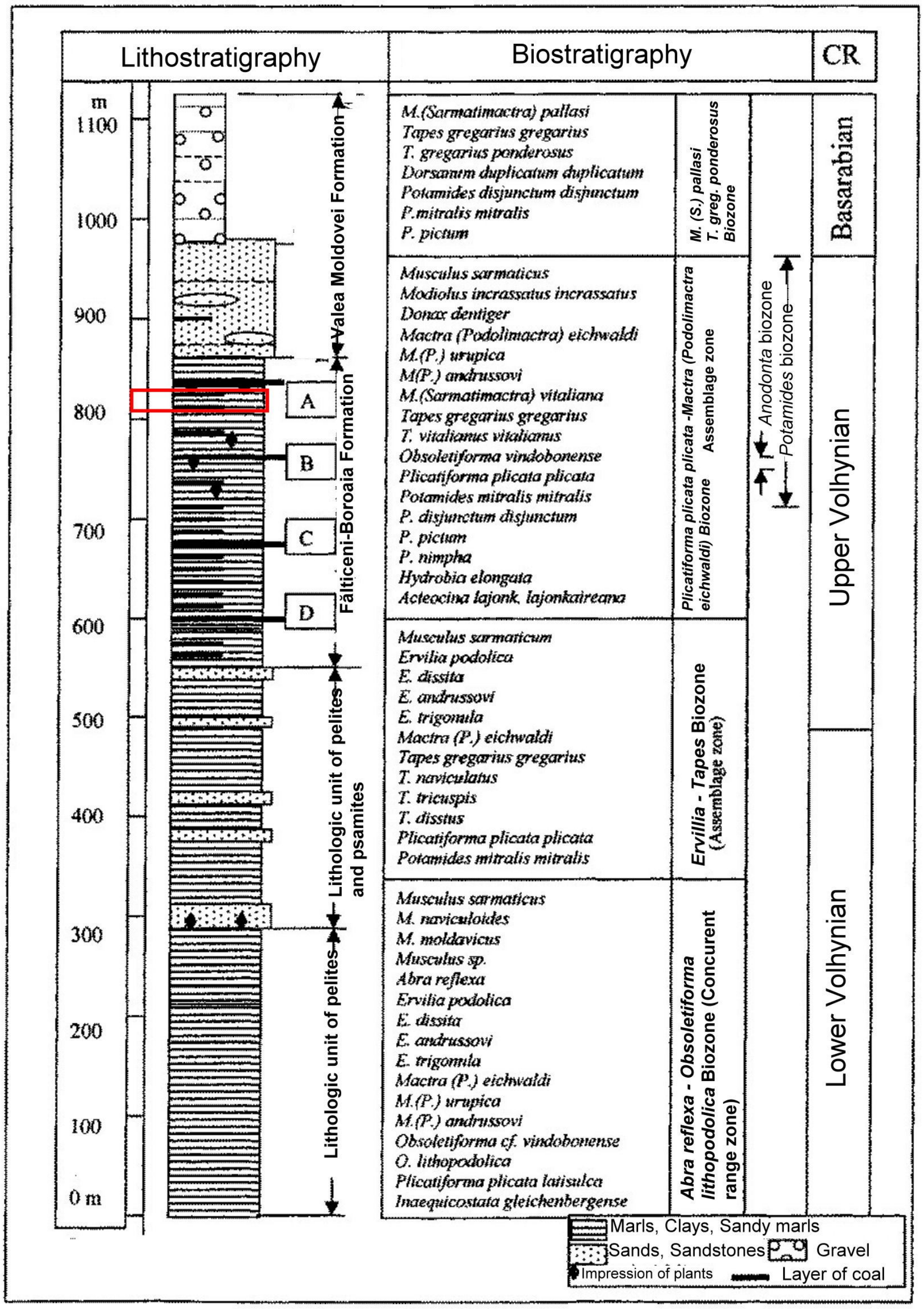

Figure 2. Lithological and biostratigraphic column of the Volhynian and Basarabian from Fălticeni-Sasca-Răuceşti area (Țibuleac, 1998).

Baciu and Ţibuleac (1996), has cited from Fălticeni – Boroaia Formation (Leucuşeşti area) for Upper Volhynian age 2 species of charophytae algae, *Nitelopsis* (*Tectochara*) *meriani* and *Lychnothamnus barbatus antiquus* collected from lacustrine deposits located under the B layer of coal. From the same deposits Ţibuleac (1998) has metionated next taxa: *Typha* sp., *Phragmites* sp., *Potamogeton martinianus* Sitar, *Potamogeton* sp., *Pinus* ex. gr. *binae* Beissner, *Pinus* sp. From coal layers located under was cited: *Glyptostrobus europaeus* (Brognt.) Ung., *Fagus* cf. *atenuata* Goepp., *Carpinus grandis* (Ung.) Heer, *Betula* sp.

From outcrops of Fălticeni – Boroaia Formation of the Moldova River (Râpa Băieşilor – Bogata), on Bogata River and Ţiganca River the layer of palaeoflora is situated under the A layer of coal is cited next taxa (Ţibuleac 1998, 2001): *Platanus leucophyla* Brogniart / Knobloch, *Cassiophyllum berenices* Unger / Krausel, *Sapindus* sp., *Monocotyla* (*Cyperites*) sp., *Corylus avellana* Linne, *Carya denticulata* (Weber) Iljinskaia, *Acer* cf. *palaeosaccharinum* Stur., *Acer tricuspidatum* Bronn., *Acer* sp., *Carpinus grandis* (Ung.) Heer, *Vitis strictum* (Goepp.) Kn.

This association of taxa (Upper Volhynian age) relieve the existence of few palaeobiotops. *Characaeae*, *Potamogeton martinianus, Potamogeton* sp. reliev a open lake area with lower water depth (under 2 m). At the proximity of the swamp area has been located taxa as *Phragmites* and *Typha.* In the dry area from around the swamp has been described taxa as *Pinus, Corylus, Carpinus, Fagus.* The autors succeeded to discover palaetropical taxa as (*Platanus leucophylla, Cassiophyllum berenices, Sapindus*) alongside with acrotertiary taxa (*Acer tricuspidatum, Carpinus grandis, Carya denticulata* etc.).

Palynological data has been collected and analysed from Fălticeni-Boroaia Formation by Guşă et al. (1998). The palynological association is represented by 35 taxa and 16 are temperate taxa,12 tropicals, 6 subtropical and 1 is mediteraneean taxa. The ratio from the main botanic groupe is follow: ferns (18,6 %), angiosperms (41,7 %) and gimnosperms (38,4 %). The palynological assemblage described by autors is following: *Monoleiotriletes gracilis*, *Echinatisporis miocenicus*, *Polypodiisporites favus*, *Triatriopollenites rurensis*, *Inaperturopollenites hiatus*, *Laevigatosporites haardti*, *Intratriporopollenites instructus*, *Pityosporites alatus*, *Pityosporites labdacus*, *Tricolporopollenites edmundi*, *Polyvestibulopollenites* sp. s.a.

As conclusion the opinion of autors is that in Volhynian from Fălticeni area is a progresiv transfer from thermophile to acrotertiary floras caused by a cooling of the climate.

The outcrop from Ţiganca River

The Ţiganca River is right side affluent of the Moisea River. The outcrop is located on the Ţiganca River at 185 m from confluence with Moisea River. The length of the outcrop is 50 m and the height is 9.5 -10 m (Figure 4a, b). The altitude at the base of the outcrop is 385 m and the geographical coordinate are: N 47º 20' 35,6"; E 26º 13' 34,4".

The geological succession is following: from the base of the outcrop we been able to identify a succesion of marls, sandy marls interbedded with thin layers of sands. In the top of the outcrop we have seen loess and soil. The samples for palynological examination has been collected from depth 385 m (P 100), 385,6 m (P 101), 386 m (P 102), 386,7 m (P 103), 388 m (P 104), 389 m (P 105) (Figure 3). The samples for palaeofloristic analysis (over 100 samples) has been collected from the base of the outcrop (Figure 3).

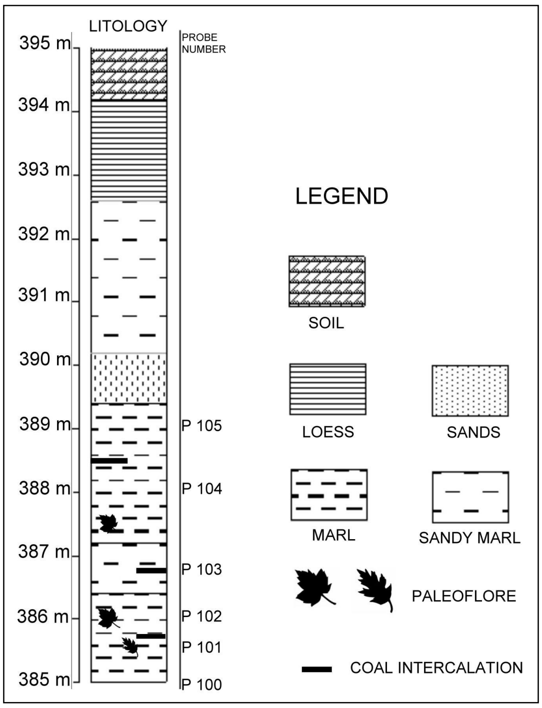

Figure 3. Lithological colomn of the outcrop from Ţiganca Valley.

Figure 4a. The outcrop from Țiganca River

Figure 4b. Same outcrop (reverse angle).

Palaeofloristic data

From the outcrop from Ţiganca Valley we have collected 6 palynological samples and over 100 samples of palaeofloras impresions and we succeded to identify 11 taxa (Table 1). A list of taxa and the frequency for each palynological sample from the outcrop from Ţiganca Valley is presented in Table 2.

Salix varians Goepp.
Laurophyllum sp.
Typha latissima A. Br.
Ilex irregularis Giv.
Phragmites oeningensis Al. Br.
Cassiophyllum berenices (Ung.) Krausel
Fraxinus ungeri (Gaud.) Kn. et Kv.
Juglans sp.
Magnolia cuneiforma Baik.
Querqus pontica Koch.
Vitis strictum (Goepp.) Kn.

Table 1. Palaeofloristic taxa from outcrop of Ţiganca Valley.

From palynological analysis of the samples collected from Ţiganca Valley we have relive continental and aquatic palynomorphs with following percentual distribution: Gymnospermatophyta 53%, Angiospermatophyta 33%, Pteridophyta 4%, Phytoplancton 10% (figure 5).

In figure 6 we manage to divide the palynological taxa from Ţiganca Valley as following;

- **Mixed mesophytic forest** with *Abies, Cedrus, Podocarpus, Tsuga, Querqus, Castanea* etc;
- **Swamp forest** with *Taxodium, Myrica* and *Cyrilla*;
- **Herbs** with *Chenopodiaceae, Ephedra*;
- **Ferns** with *Baculatisporites, Echinatisporis, Laevigatosporites* etc;
- **Phytoplancton** with *Polysphaeridium, Lingulodinium, Operculodinium*, *Botryococcus* etc;

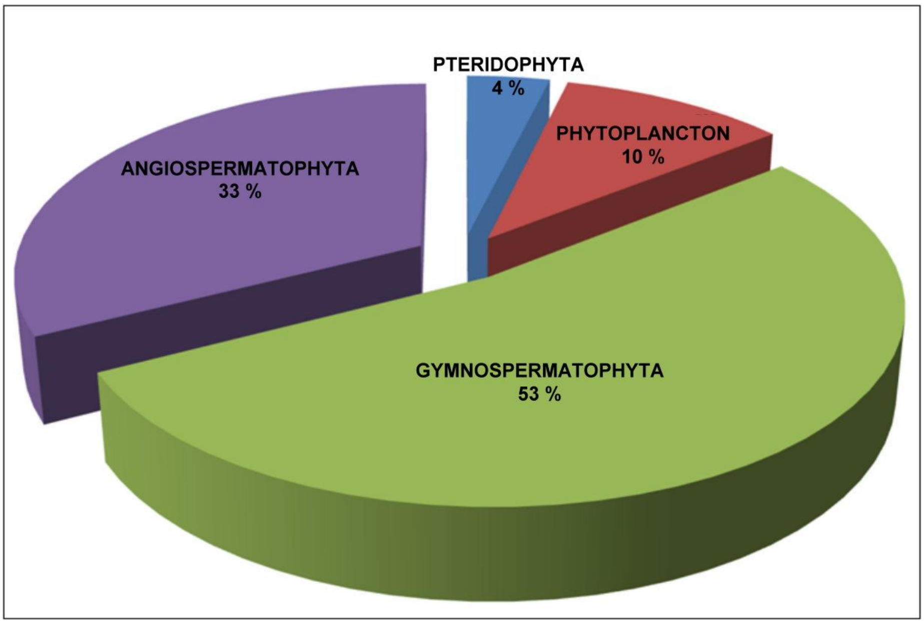

Figure 5. Percentual distribution of the major groups of palynomorphs from outcrop of Ţiganca Valley.

		TAXA	ELEVATION (m) / SAMPLE 385,0/ P100	385,6/ P101	386,0/ P102	386,7/ P103	388,0/ P104	389,0/ P105
PHYTOPLANCTON	Reworked dinoflagellates	*Wetzeliella articulata* EISENACK 1938						X
		Achomosphaera sp						x
		Oligosphaeridium sp.						x
		Deflandrea sp.					x	
		Sumatradinium druggi LENTIN et al. 1994			x			
		Cordosphaeridium sp.						x
	Autochthonous dinoflagellates	*Spiniferites bentorii* (ROSSIGNOL1964) WALL et DALE 1970						x
		Botryococcus braunii KUTZING 1849			x			x
		Lingulodinium machaerophorum (DEFLANDRE et COOKSON 1955) WALL 1967				x		
		Polysphaeridium zoharyi (ROSSIGNOL1962) BUJAK et al., 1980						x
		Operculodinium centrocarpum (DEFLANDRE et COOKSON 1955) WALL 1967						x
PTERIDOPHYTA		*Baculatisporites nanus* (WOLFF1934) KRUTZSCH 1959	x					
		Echinatisporis cycloides KRUTZSCH 1963	x					
		Laevigatosporites gracilis WILSON - WEBSTER 1946						x
		Laevigatosporites pseudodiscordatus KRUTZSCH 1959						x
		Neogenisporis neogenicus KRUTZSCH 1962						x
		Leiotriletes wolffi brevis KRUTZSCH 1962					x	
		Stereisporites pseudopsilatus KRUTZSCH 1959		x				
GYMNOSPERMATOPHYTA		*Abiespollenites sibriciformis* (ZAKLINSKAJA 1957) KRUTZSCH 1971					x	
		Abiespollenites absolutus THIERGART 1937						x
		Abiespollenites latisaccatus (TREVISAN 1967) KRUTZSCH 1971		x	x			x
		Abiespollenites sp.					x	x
		Cedripites miocaenicus KRUTZSCH 1971	x			x		x
		Pinuspollenites verruculatus (TREVISAN 1967) NAGY 1985					x	
		Pinuspollenites miocaenicus NAGY 1985			x			
		Ginkgo sp.						x
		Cycadopites sp.		x				
		Ephedripites sg. Ephedripites wolkenbergensis KRUTZSCH 1961		x				
		Inaperturopollenites hiatus (POTONIÉ 1931) THOMSON et PFLUG 1953		x	x	x	x	x
		Pityosporites microalatus (POTONIÉ 1931) THOMSON et PFLUG 1953			x	x	+	+
		Pityosporites alatus (POTONIÉ 1931) THOMSON et PFLUG 1953		x	x	x	x	+
		Pityosporites cedrisacciformis KRUTZSCH 1971						x
		Pityosporites labdacus (POTONIÉ 1931) THOMSON et PFLUG 1953	+	x		x	+	+
		Pityosporites macroinsignis KRUTZSCH 1971						x
		Pityosporites insignis (NAUMOVA ex BOLCHOVITINA 1953) KRUTZSCH			x		x	+
		Pityosporites minutus (ZAKLINSKAJA 1957) KRUTZSCH 1971		x	x	x	x	+
		Pityosporites pacltovae KRUTZSCH 1971		x	x	x		x
		Pityosporites pristinipollinius (TRAV. 1955) KRUTZSCH						

	1971						
	Pityosporites scopulipites (WODEHOUSE 1933) KRUTZSCH 1971			x	x		x
	Pityosporites sp.	+	+	+	+	+	+
	Podocarpidites sp.					x	
	Podocarpidites libellus (POTONIÉ 1931) KRUTZSCH 1971					x	x
	Podocarpidites piniverrucatus KRUTZSCH 1971						+
	Pinuspollenites miocaenicus NAGY 1985			x			
	Sciadopityspollenites sp.						x
	Zonalapollenites sp.					x	
	Psophosphaera pseudotsugoides KRUTZSCH 1971						x
	Monocolpopollenites sp		x				
AGIOSPERMATOPHYTA	*Betulaepollenites betuloides* (PFLUG 1953) NAGY 1969				x		
	Chenopodipollis multiplex (WEYLAND et PFLUG 1957) KRUTZSCH 1966	x	+			x	x
	Cyrillaceaepollenites megaexactus (POTONIÉ 1931) POTONIÉ 1960			x			
	Engelhardtioidites microcoryphaeus (POTONIÉ 1931) THOMSON et THIERGART ex POTONIÉ 1960		x	x	x	+	x
	Intratriporopollenites instructus (POTONIÉ 1931) THOMSON et PFLUG 1953		x		x		x
	Myricipites bituitus (POTONIE 1931) NAGY 1969				x		
	Myricipites rurensis (PFLUG et THOMSON 1953) NAGY 1969		x				
	Momipites punctatus (POTONIÉ 1931) NAGY 1969						x
	Nymphaeaepollenites panonicus NAGY 1969		x				
	Pterocaryapollenites stellatus (POTONIÉ 1931) THIERGART 1937				x		
	Quercopollenites granulatus NAGY 1969						x
	Quercopollenites sp.					x	
	Ilexpollenites margaritatus (POTONIÉ 1931) POTONIÉ 1960			+			
	Magnolipollis neogenicus KRUTZSCH 1970				x		x
	Tricolporopollenites cingulum (POTONIE 1931) THOMSON et PFLUG 1953 subsp. *oviformis* (POTONIE 1931) THOMSON et PFLUG 1953				x	x	x
	Tricolporopollenites henrici (POTONIÉ 1931) KRUTZSCH 1960						x
	Tricolporopollenites minimus NAGY 1969	x	x				
	Tricolporopollenites sp.	+	x	x	x		+
	Tricolporopollenites microreticulatus (PFLUG et THOMSON) THOMSON et PFLUG 1953				x		
	Porocolpopollenites sp.		X			x	
	Platycaryapollenites miocaenicus NAGY 1969					+	
	Reeversiapollis sp.				x		
	Normapoles sp. (reworked)			x	x		
Fung	*Gombaspora (Hyphomycetes)*		x				
LEGEND: **X** – Very rare (1 - 2 grains), **+** - Rare (3 - 9 grains)							

Table 2. Taxonomical list a palynomorphs from the studied material.

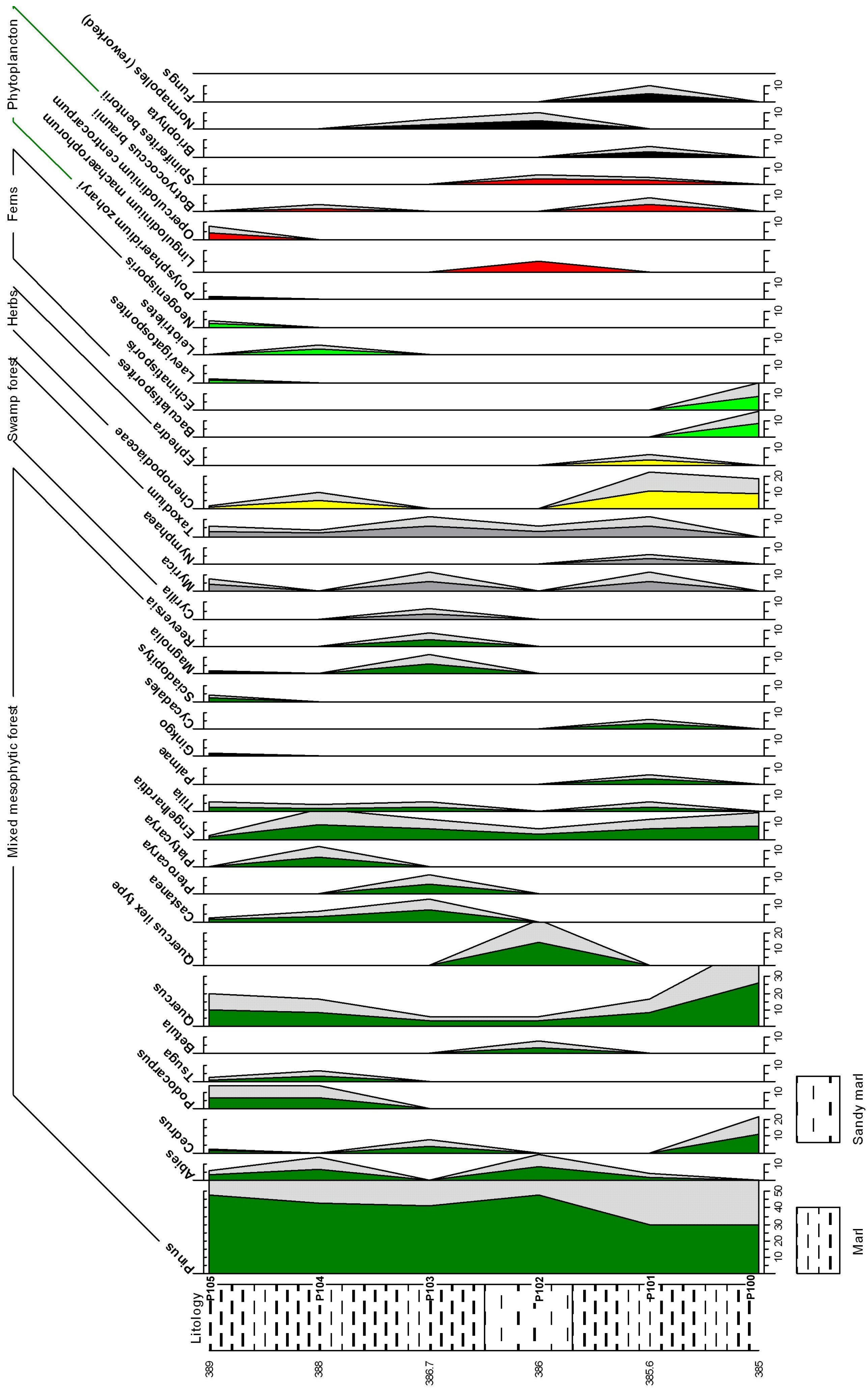

Figure 6. Percentage diagram of palynological taxa from the studied material.

Discutions

After the analysis of the samples from Ţiganca Valley, we are able to see that the *Pinaceae* is the main group of plants from the palynological samples (30 – 50 %) (Figure 6). This abundance of the *Pinaceae* maybe explain by the ability of the the plants to generate a large amount of pollen.

Among the angiosperms, higher percentage is represented by arborescent plants as *Quercus* div sp., *Engelhardtia, Castanea* and *Tilia*, follow by herbs (*Chenopodiaceae, Ephedra*). From thermophil species we been able to found palms pollen (*Monocolpopollenites* sp.) and *Magnolia*, but the percentage of those is lower. The swamp vegetation (*Cyrilla, Myrica, Engelhardtia*) is present in all analysed samples.

The ferns spores (*Baculatisporites*, *Echinatisporis*) are more abundants in the lower part of the outcrop (P 100 – from 385 m).

The aquatic vegetation (phytoplancton) it is more abundant (10%) (Figure 5) than the ferns and the frecvecy is higher on the samples 102 and 105. This phytoplancton is divided in autochthonous phytoplancton (*Polysphaeridium zoharyi, Lingulodinium machaerophorum, Operculodinium centrocarpum, Botryococcus brauni* and *Spiniferites bentorii*) and allochthonous phytoplancton (*Wetzeliella articulata, Deflandrea, Cordosphaeridium*) reworked from older deposits. As reworked paleofloristic taxa we been able to relieve also pollen of *Normapolles.*

The paleofloristic taxa has been collected from lower part of the outcrop (Figure 3) are well preserved. We been able to identify taxa as; *Laurophyllum, Typha, Phragmites*, *Magnolia* and *Salix*.

The leaf assemblages normally attest autochthonous or very close location to the place of provenance, being more useful for local palaeoflora reconstitution than the pollen record (microfossils), which generally represent a largescale vegetation distribution. Palaeofloras compounded by remains of leaf denote quasi–instantaneous or minimally transported accumulations, making them more suitable for comparison between paleocommunities and for analogy with modern biomes than palynological assemblage.

Palaeoclimatic and palaeoenvironment implication

Using coexistence approach method (Mosbrugger & Utescher (1997) we been able to aproximate Mean Annual Temperature (MAT) and Mean Annual Precipitation (MAP) (Figure 7) for palaeofloras of the outcrop from Ţiganca Valley. The coexistence approach is an efficient and reliable method for quantitative terrestrial palaeoclimate reconstructions in the Tertiary (Mosbrugger & Utescher, 1997). It is based on the assumption that Tertiary plant taxa have similar climatic requirements as their nearest living relatives. The aim of the coexistence approach is to find for a given fossil flora and a selected variable the climatic interval, in which all nearest living relatives of the fossil flora can coexist.

Palaeoclimatic reconstruction is based on analysis of 30 taxa and their Nearest Living Relatives - NLR (27 taxa of palynomorphs and 3 macrofloras taxa) (Figure 7). Estimation of coexistence interval is presented as following:

-MAT (Mean Annual Temperature) between $15{,}3^0$ – $16{,}6^0$C (the minimum reading is for *Engelhardtia* sp. and the maximum reading is for *Sciadopityspollenites serratus*).

- MAP (Mean Annual Precipitation): 1300 mm/year - 1355 mm/year (this interval is coresponding to *Sciadopityspollenites serratus* – *Carpinuspollenites carpinoides*).

The reading for MAT decided using coexistence approach method for the outcrop from Ţiganca Valley is in accord with others autors:

- MAT = 14^0 - 15^0C and MAP 800 – 1000 mm for the Upper Badenian (Kossovian) – Lower Sarmatian from Mereşti - Harghita (Petrescu et al., 1988).
- MAT = 15^0C and MAP 1000 mm in Volhynian age from Moldavian Republic (Ştefârţă, 1997).

Palaeoenvironmental we been able to conclude base on palaeofloristic taxa, two zones:

1. *Self zone*;
2. *Continental zone*;

1. The *self zone* (Figure 8) is the source area for dinoflagellates wich is having a higher percentage in samples 102 from 386 m and 105 from 389 m. As we can see is a proximal self area (inner neritic – outer neritic) with lower water depth where we have *Spiniferites* and *Operculodinium* (Figure 8).

The sedimentation environment is near to the coast fact accentuated by a higher percentage of the spores and pollen (terrestrial's organisms) and predomination of the terigen organic matter (coal fragments, vegetal tissues, cuticles).

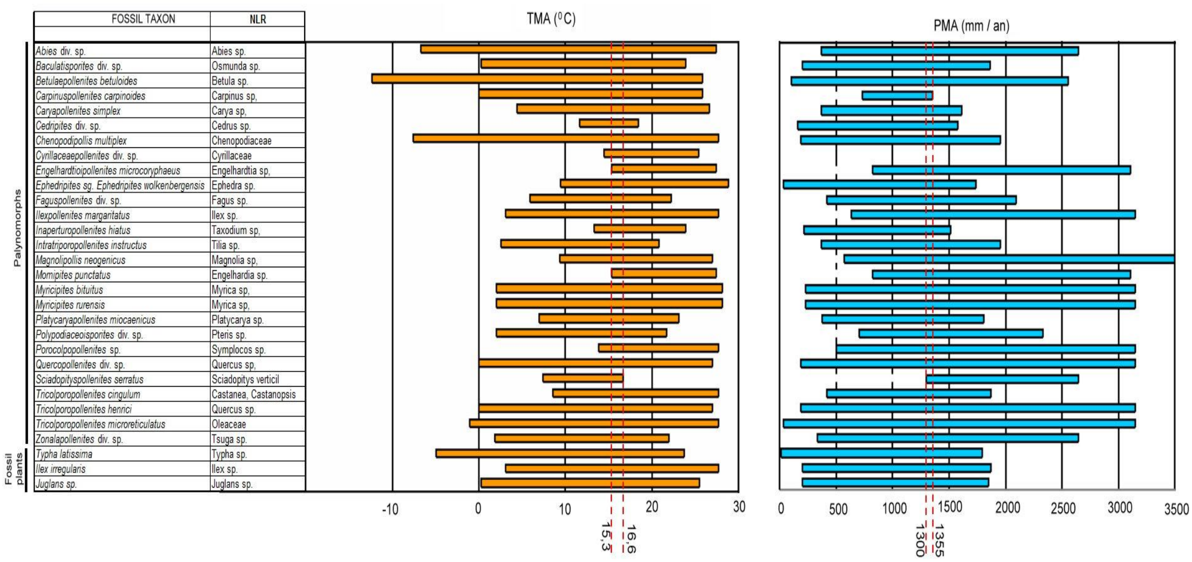

Figure 7. Estimation of MAT (Mean Annual Temperature) and MAP (Mean Annual Precipitation) using the coexistence approach method for palaeofloras of the outcrop from Țiganca Valley.

1.1. Paleoecological interpretation based on dinocysts association:

- *Lingulodinium machaerophorum* (topical species) can be considered to be a temperate to tropical, coastal euryhaline species present in regions with summer sea-surface temperature (SST) exceedind 12^0 C (Marret & Zonneveld, 2003). It is distributed within a very broad salinity range and has been recorded from brackish to fully marine environments, with salinity ranging between 16,9 – 36,7 $^0/_{00}$.

- *Operculodinium centrocarpum* is generally reported as a cosmopolitan species that might have low relative abundances in the tropics and high relative abundances in regions with cold/temperate waters such as the North Atlantic (Wall et al. 1977; Marret & Zonneveld, 2003). This species is distributed within a very broad range: temperature(-2,1^0 C and 29,6^0 C) and salinity (16,1 – 36,8 $^0/_{00}$).

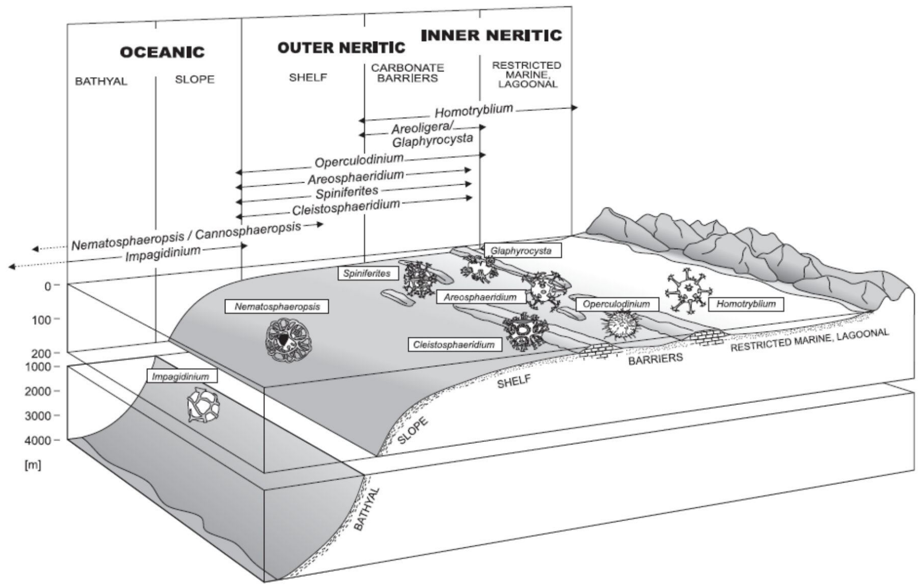

Figure 8. Schematic model for the distribution of dinocyst associations along a proximal –distal transaction of the sedimentary basin. (after Brinkhuis, 1994; modified by Sluijs, Pross & Brinkhuis, 2005).

- *Polysphaeridium zoharyi* (typical species) – high relative abundances occur in areas with summer SST around 28^0 C and with a few exceptions has not been recorded from regions where winter SST is below 14,5^0 C (Marret & Zonneveld, 2003). This taxon is distributed within a broad salinity range between 16,2 – 36,6 $^0/_{00.}$

2. *Continental zone* (Figure 9): based on the organic matter furnish we been able to conclude next's paleobiocenosis:

- Swamp forest very close to the coast where we could find species as *Taxodium, Cyrilla, Myrica*;
- Lacustrine vegetation with low water depth with species as *Typha*, *Phragmites* and *Botryococcus*;
- Mixed mesophytic forest is well represented in palynological samples and in palaeofloristic species: *Tilia, Castanea, Betula, Pinaceae* (*Pinus, Abies, Tsuga*).
- The presence of the *Chenopodiaceae* in a fair percentage in the samples from the lower part of the outcrop (samples 100, 101) may indicate a period with low amount of precipitation and a lower temperature. This assumption is confimed by the reading for MAP using coexistence approach method (figure 7) where the level of precipitation is between 530 - 870 mm/year.

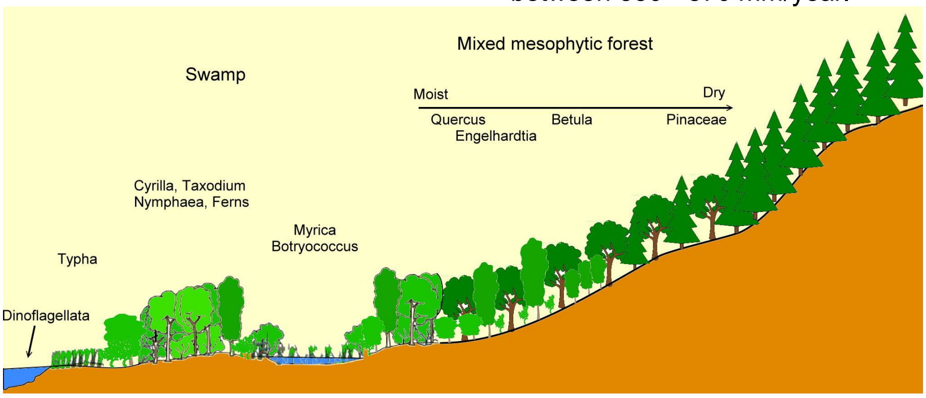

Figure 9. Reconstruction of the continental vegetation using the palaeofloristic species found in the outcrop from Ţiganca Valley.

Correlation with other area from Paratethys

Based on analysis on samples colected from the outcrop from Ţiganca Valley we been able to identify a few species anterior citated from Central Paratethys by Jiménez-Moreno et al. (2005, 2006)). This autors mention for Lower Sarmatian species as *Cleistosphaeridium placacanthum* (assemblage biozone Cpl), *Lingulodinium machaerophorum, Operculodinium centrocarpum-israelianum, Polysphaeridium zoharyi, Spiniferites* ssp. This species (with exception of biozone taxa) was identify in our association citated from the outcrop of Ţiganca Valley.

In Middle and Upper Miocene deposits from the Croatian part of the Pannonian Basin was recognized seven characteristic palynozones (Bakrač, 2007). For Sarmatian was determined *Polysphaeridium zoharyi – Lingulodinium machaerophorum* Zone, characterized by relatively rich marine community, but the most forms are euryhaline like *Polysphaeridium zoharyi* and *Lingulodinium machaerophorum*.

Conclusion

Palaeofloristic analysis of the Upper Volhynian from Ţiganca Valley allowed us to recreate the vegetation, palaeoecology and climate during Lower Sarmatian in the Fălticeni area. With the help of the coexistence approach we obtained a Mean Annual Temperature and Mean Annual Precipitation for the stratigraphic sequence analysed.

The Volhynian vegetation are mous favourable conditions existed for the development of mixed mesophytic forests, characterised by a predominance of warm-temperate and subtropical elements. The palaeoclimatic parameters are: MAT between 15.3^0 – 16.6^{0}C and MAP 1300 – 1355 mm/year.

The present data on pollen suggest a forest organized in altitudinal belts.

The dinocyst assemblage is characterized by a low diversity and reflects as salinities mostly exceeding 16 $^0/_{00.}$

Acknowledgements

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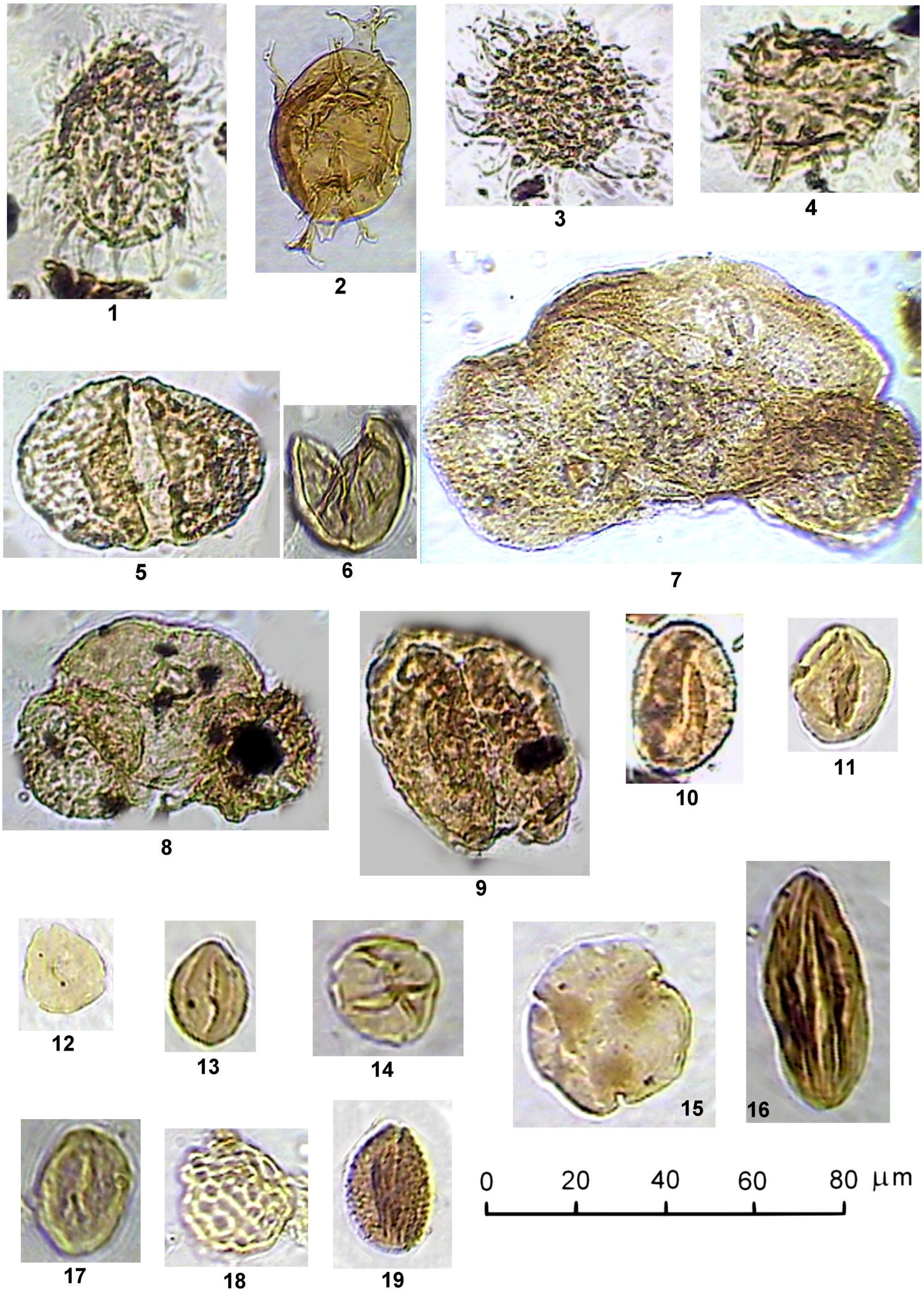
Plate I

1. *Operculodinium centrocarpum* (DEFLANDRE et COOKSON 1955) WALL 1967
2. *Spiniferites bentorii* (ROSSIGNOL1964) WALL et DALE 1970
3. *Lingulodinium machaerophorum* (DEFLANDRE et COOKSON 1955) WALL 1967
4. *Polysphaeridium zoharyi* (ROSSIGNOL1962) BUJAK et al., 1980
5. *Pityosporites microalatus* (POTONIÉ 1931) THOMSON et PFLUG 1953
6. *Inaperturopollenites hiatus* (POTONIÉ 1931) THOMSON et PFLUG 1953
7. *Abiespollenites latisaccatus* (TREVISAN 1967) KRUTZSCH 1971
8. *Pityosporites labdacus* (POTONIÉ 1931) THOMSON et PFLUG 1953
9. *Pityosporites pacltovae* KRUTZSCH 1971
10. *Quercopollenites granulatus* NAGY 1969
11. *Cyrillaceaepollenites megaexactus* (POTONIÉ 1931) POTONIÉ 1960
12. *Engelhardtioidites microcoryphaeus* (POTONIÉ 1931) THOMSON et THIERGART ex POTONIÉ 1960
13. *Tricolporopollenites minimus* NAGY 1969
14. *Platycaryapollenites miocaenicus* NAGY 1969
15. *Intratriporopollenites instructus* (POTONIÉ 1931) THOMSON et PFLUG 1953
16. *Ephedripites sg. Ephedripites wolkenbergensis* KRUTZSCH 1961
17. *Tricolporopollenites cingulum* (POTONIE 1931) THOMSON et PFLUG 1953 subsp. *oviformis* (POTONIE 1931) THOMSON et PFLUG 1953
18. *Chenopodipollis multiplex* (WEYLAND et PFLUG 1957) KRUTZSCH 1966
19. *Ilexpollenites margaritatus* (POTONIÉ 1931) POTONIÉ 1960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