

STRATIGRAPHICAL DISTRIBUTION AND PALYNOLOGICAL CORRELATION BETWEEN DEVONIAN FORMATIONS FROM NORTH DOBROGEA AND EAST EUROPEAN PLATFORM

Alina LAZĂR¹

Abstract: In this paper we tried to achieve a correlation between the Devonian palynological assemblages from North Dobrogea Orogene and similar assemblages from East European Platform. The correlation was made based only on the palynological assemblages, which show the presence of Middle and Upper Devonian just in Tulcea Unit.

Attestation of Middle and Upper Devonian in North Dobrogea was established using palynological assemblages which include especially spores, and less acritarchs and chitinozoans.

Key words: Palynology; Correlation; Devonian; North Dobrogea; Romania.

Introduction

North Dobrogea represents an early Alpine orogene, its structural arrangement being polished during the neo-Cimmerian tectonic movements or eventually during the early Austrian ones, getting into the stable cratogene phase (Ionesi, 1994). This orogene lies between Bârlad Platform and Danube Delta Platform (Figure 1), separated by Sfântu Gheorghe-Oancea-Adjud Fault, and Central Dobrogea Massif, separated by Peceneaga-Camena Fault. Situated northward the main sector (Balkans-Taurides-Small Caucasus), the orogene is prolonging towards East under the Black Sea waters from Alpine (Southern) Crimea, where it extends to Large Caucasus (Ionesi, 1994).

On the Romanian territory, North Dobrogea Orogene includes Măcin Mountains, Tulcea Hills, Babadag Plateau and a sector situated northward Danube (between Prut and Siret), known as the "Buried North Dobrogea Promontory" (Ionesi, 1994). Between the above-mentioned limits, this orogene includes pre-Alpine formations (crystalline schists, Palaeozoical sedimentary deposits, magmatites) and Alpine formations (Triassic and Jurassic sedimentary deposits) included in unitary structures, realized during the neo-Cimmerian and Early Austrian orogenetic phases. The pre-Alpine formations also preserve the remains of the older fold processes (Hercinic, Caldonic and probably Assynthetic) (Ionesi, 1994).

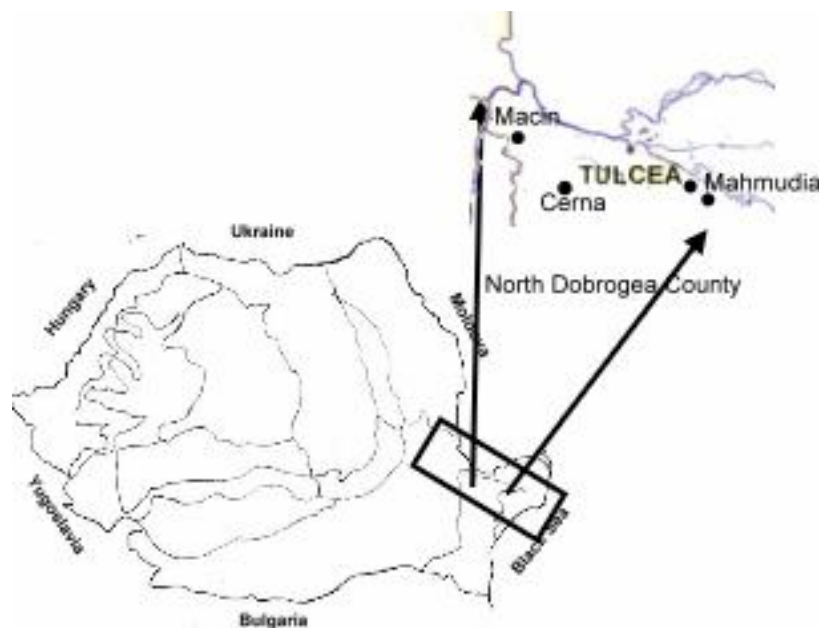


Figure 1. North Dobrogea Orogene

Correlation of Devonian assemblages from North Dobrogea with Devonian formations from East European Platform.

Devonian from North Dobrogea orogene, certified by palynological assemblages, proves the presence of the three stages, Lower Devonian within Măcin and Tulcea Units, and Middle and Upper Devonian only within Tulcea Unit.

The Devonian attestation in North Dobrogea is based on palynological assemblages, which include especially spores, and less acritarchs and chitinozoans.

Lower Devonian from Măcin Unit, identified within Bujoarele Formation, was certified in the palynological assemblages from the yielded samples from Piatra Râioasă, Iglîța Promontory, Bujorul Bulgăresc Hill and Bujorul Românesc Hill, Cerna Hill.

Thus, within Lower Devonian (D₁), separated in Măcin Unit at Piatra Râioasă, in Iglîța Promontory, in Bujoarele Hill and southward of Cerna, there were outlined 3 distinct assemblages considering Beju (1971) as D_{1a}, D_{1b}, D_{1c}, corresponding to the stratigraphical intervals of Lochkovian (Gedinian), Pragian (Siegenian) and Emsian (Olaru, 1992-1993; Olaru, 1997; Olaru, Lazăr, 2002), including spores such as: *Acanthotriletes impolitus* Naum., *Acanthotriletes aceorsus* Naum., *Anapiculatisporites burtonensis* Streel, *Calamospora panucea* Rich., *Cyclogranisporites zumbosus* Cramer, *Dictyotriletes emsiensis* Allen, *Dictyotriletes minor* (Naum.) var. *negritelus* Nadler, *Emphanisporites minutus* Allen, *Leiotriletes confertus* McGregor, *Leiotriletes marginalis* McGregor, *Leiotriletes microrugosus* (lbr.) Naum., *Leiotriletes simplex* Naum., *Reticulosporites emsiensis* Allen, *Retusotriletes* cf. *semizonalis* McGregor, *Retusotriletes communis major* Schultz, *Verrucosisporites absurdus* Naum.; the identified acritarchs are few, *Baltisphaeridium ramusculosum* Defl., *Dyctotidium dictyotum*

(Eis.), *Tasmanites* cf. *balticus* Eis., *Veryhachium* cf. *thyrae* Cramer, *Veryhachium trispinosum* Eis., *Veryhachium* cf. *europaeum* Stock. & Will., while the chitinozoans, in a small number, developed in Lower Devonian, such as: *Ancyrochitina* cf. *tumida* Taug. & Jek., *Ancyrochitina echinata* Eis., *Linochitina erratica* Eis. The other taxa included in the assemblage do not have a stratigraphical interest due to their evolution until Middle Devonian or also during Upper Devonian.

Lower, Middle and Upper Devonian were identified and palynologically attested in Mahmudia Hills (Beștepe) from Tulcea Unit (Olaru, 1992-1993; Olaru, Lazăr, 2002). The lithological succession is better known as Beștepe Formation, and it was established in Mahmudia Hills (Murgoci, 1914); it was palaeontologically attested by an identified conodont fauna (O. and Elena Mirăuță, 1965), and palynologically – by the spores, acritarchs and chitinozoans assemblages (Olaru, 1992-1993; Olaru, Lazăr, 2002).

The spores species which evolved only during Lower Devonian are represented by: *Acanthotriletes impolitus* Naum., *Calamospora microrugosa* lbr., *Calamospora panucea* Rich., *Camarazonotriletes atavus* Naum., *Dictyotriletes emsiensis* Allen, *Dictyotriletes minor* (*Retusotriletes*) var. *negritelus* Nadler, *Emphanisporites mcgregorii* Cramer, *Leiotriletes pagius* Allen, *Reticulosporites emsiensis* Allen, *Retusotriletes* cf. *semizonalis* McGregor; from acritarchs, there are species such as: *Baltisphaeridium ramusculosum* Defl., *Tasmanites* cf. *balticus* Eis., *Veryhachium* cf. *europaeum* Stock. & Will., *Veryhachium* cf. *thyrae* Cramer; and the chitinozoans are represented by species of: *Angochitina echinata* Es., *Linochitina erratica* Eis., in a quite small amount. To be noticed the presence of some taxa with a continuous evolution from Silurian and taxa which continued their evolution up to Middle Devonian and even to the Upper one (Table 1).

Table 1. Palynomorph frequency from the Devonian palynological assemblages of Mahmudia Hills, North Dobrogea

Palynomorphs	Frequency			
	Silurian	Lower Devonian	Middle Devonian	Upper Devonian
<i>Acanthotriletes impolitus</i> Naum.		++		
<i>Acanthotriletes acerorus</i> Naum.		++		
<i>Acanthotriletes cuspidatus</i> Nadler				++
<i>Acanthotriletes rugatus rugatus</i> Naum.				++
<i>Acanthotriletes uncatatus</i> Naum.			++	

STRATIGRAPHICAL DISTRIBUTION AND PALYNOLOGICAL CORRELATION BETWEEN
DEVONIAN FORMATIONS FROM NORTH DOBROGEOA AND EAST EUROPEAN PLATFORM

Ambitisporites dilutus (Hoff) Rich & Lister		+	++	
Anapiculatisporites burtonensis Streele		++		
Ancyrochitina cf. tumida Taug. & Jek.		++		
Ancyrospora longispinosa Rich.			++	
Angochitina cf. devonica Eis		++		
Apiculatisporites spicula Rich. & Lister	++			
Apiculiretusispora sinorea Rich. & Lister	++			
Apiculiretusispora sp.	++			
Apiculiretusispora (Retusotriletes) concina Naum.			++	
Archaeotriletes (Retusotriletes) chlus (Cramer) Rich.&Lister		+	+	
Archaeotriletes cf. fillosus Tchibr.			++	
Archaeotriletes crenatus Naum.				++
Archaeotriletes devonicus Naum.		++		
Archaeozonotriletes compactus minor Naum.			++	
Archaeozonotriletes famennensis Naum.				++
Archaeozonotriletes hereomerus Nadler				++
Archaeozonotriletes micromanifestus Naum.		++	++	
Archaeozonotriletes timanicus Naum.				++
Calyptosporites proteus (Naum.) Allen			++	
Camarozonotriletes atavus Naum.		++		
Conochitina cf. decipiens Taug. & Jek.		+		
Cyclogranisporites plicatus Allen		+		
Cyclogranisporites zumbosus Cramer		+		
Cymatiosphaera nebulosa Deunff		+	++	
Desmochitina densa Eis.		+		
Dibolisporites (Retusotriletes) devonicus Naum.				++
Dibolisporites minor Naum.				++
Dictyotidium dictyotum (Eis.)		+		
Dictyotriletes devonicus Naum.		+		
Dictyotriletes emsiensis Allen		+		
Dictyotriletes famennensis Naum.				++
Dictyotriletes minor (Naum.) var. negritellus Nadler		+		
Dictyotriletes nigratus Naum.		++		
Emphanisporites micromnatus Rich. & Lister	++			
Emphanisporites minutus Allen		+		
Emphanisporites robustus McGregor		+	++	
Emphanisporites annulatus McGregor		+	++	
Geminospora svalbardiae (Vigran) Allen				+
Hymenozonotriletes hyalinus Naum.				++
Hymenozonotriletes imperfectus Naum.				++
Hymenozonotriletes multiangularis Naum.				++
Hymenozonotriletes sp.		++		
Hystricosporites cf. obscurus Mortimer & Chaloner			++	+
Leiotriletes acutangulus Naum.				++
Leiotriletes confertus McGregor		++		
Leiotriletes devonicus Naum.		++		
Leiotriletes dicksonialis Naum.				++
Leiotriletes levis Naum.		+	++	

<i>Leiotriletes marginalis</i> McGregor		++		
<i>Leiotriletes minutissimus</i> Naum.				+
<i>Leiotriletes perpusillus</i> Naum.		++		
<i>Leiotriletes rotundus</i> Naum.			++	
<i>Lophotriletes communis</i> Naum.				++
<i>Lophotriletes megalothelis</i> Naum.				++
<i>Lophotriletes minor</i> Naum.				++
<i>Lophotriletes salebrosus famennensis</i> Naum.				++
<i>Lophotriletes trivialis</i> Naum.				+
<i>Punctatisporites</i> sp.			++	
<i>Reticulosporites emsiensis</i> Allen		+		
<i>Retusotriles cf. semizonalis</i> Naum		+		
<i>Retusotriletes cf. greggsii</i> McGregor			+	
<i>Retusotriletes clandestinus</i> Avkh.		++		
<i>Retusotriletes cf. semizonalis</i> McGregor		++		
<i>Retusotriletes cf. warringtonii</i> Rich.& Lister		+	+	
<i>Retusotriletes famennensis</i> Naum.				++
<i>Retusotriletes parvimammathus famennensis</i> Naum.				++
<i>Samarisporites cf. usitata</i> Allen				+
<i>Spinozonotriletes maximus</i> Lanninger				++
<i>Stenozonotriletes extensus</i> Naum.				++
<i>Stenozonotriletes extensus minor</i> Naum.				++
<i>Scolecodote</i>	-	+		
<i>Triletes langi</i> Rich.			++	
<i>Verrucosisporites absurdus</i> Naum.			+	
<i>Verrucosisporites cf. absurdus</i> Tchibr.		++		
<i>Verrucosisporites</i> sp.		++		
<i>Veryhachium trispinosum</i> Eis.		++		
<i>Veryhachium trisulcum</i> Deunff		++		
<i>Veryhachium triangulina alargada</i> Cramer		++		

Legend: x – rare (1-10); + – moderate (10-20); ++ – frequent (> 20).

Middle and Upper Devonian are identified in palynological assemblages by spores and acritarchs species only in the outcrops from Tulcea Unit, Beştepe Formation. Therefore, this identified assemblage which proves Middle Devonian includes spores such as: *Acanthotriletes cuspidatus* Nadler, *Acanthotriletes pullus* Naum., *Archaeotriletes crenatus* Naum., *Azonomoletes rarus* Naum., *Geminospora svalbardiae* (Vigran) Allen, *Hymenozonotriles imperfectus* Naum., *Leiotriletes acutangulus* Naum., *Leiotriletes minutissimus* Naum., *Lophotriletes minor* Naum., *Lophotriletes trivialis* Naum., *Stenozonotriletes extensus minor* Naum., *Stenozonotriletes extensus* Naum.; the acritarchs lack from the analyzed area.

Upper Devonian is represented by a spores assemblage with: *Acanthotriletes pullus* Naum., *Archaeotriletes crenatus* Naum.,

Archaeozonotriletes famennensis Naum., *Dibolisporites minor* Naum., *Dictyotriletes famennensis* Naum., *Hymenozonotriletes hyalinus* Naum., *Hymenozonotriletes multiangularis* Naum., *Lophotriletes salebrosus famennensis* Naum., *Retusotriletes famennensis* Naum., *Spinozonotriletes maximus* Lanninger, *Stenozonotriletes extensus minor* Naum..

Upper Devonian from Tulcea Unit is represented by Frasnian-Famennian assemblages, which include species such as: *Azonomotriletes rarus* Naum., *Acanthotriletes rugatus* Naum., *Archaeotriletes devonicus* Naum., *Samarisporites triangulatus* Allen, *Geminospora svalbardiae* (Vigran) Allen, *Stenozonotriletes famennensis* Naum., *Hymenozonotriletes hyalinus* Naum., *Retusotriletes famennensis* Naum., *Retusotriletes parvimammathus* Naum., which

STRATIGRAPHICAL DISTRIBUTION AND PALYNOLOGICAL CORRELATION BETWEEN
DEVONIAN FORMATIONS FROM NORTH DOBROGEA AND EAST EUROPEAN PLATFORM

could be correlated with the OK and SD zones for Lower Frasnian, the OG zone for Middle Frasnian, DE for Upper Frasnian from East Europe (Avkhimovitch *et al.*, 1993); Famennian corresponds to the VV, CZ and Im zones (Lower Famennian), the CVa zone (Middle Famennian) and the VF zone (Upper Famennian) from East Europe (Avkhimovitch *et al.*, 1993).

In Upper Devonian, ascertained in Mahmudia Hills, the palynological attestation was realized based on an assemblage including mainly spores (100%), the acritarchs and the chitinozoans lacking from these samples, therefore the stratigraphical stages of Upper Devonian could be separated only based on the spores assemblages specific for Frasnian and for Famennian.

The identified assemblages from Mahmudia Hills contributed to the biozonation

of the Devonian formations from Măcin Unit. The identified palynozones proved Lower and Middle Devonian. The established biozones from Măcin Unit and from Tulcea Unit could be correlated with other Devonian biozones from Romania and Europe (Table 2).

In North Dobrogea, Emsian is proved based on the presence of species such as *Angochitina echinata* Eis., *Veryhachium trispinosum* Eis., *Ambitisporites dillutus* (Hoff.) Rich. & Lister, *Archaeozonotriletes (Retusotriletes) chlus* (Cramer) Rich. & Lister, *Hystrichosporites* sp., *Leiotriletes levis* Naum., *Perotriletes mutabilis* Lele & Strel, *Retusotriletes cf. warringtonii* Rich. & Lister. The correlation of Emsian from North Dobrogea was realized based on the assemblages, which correspond to the Upper Emsian RC and DI zones from East European Platform (Avkhimovitch *et al.*, 1993).

Table 2. Devonian biozonation from North Dobrogea and correlation of the zone assemblages established after Avkhimovich *et al.* (1993).

Age	Zone assemblages	Zone	Assemblages from MAHMUDIA
EARLY FAMENNIAN	Dictyotriletes versabilis - Geminospora famenensis	VF	<i>Dictyotriletes famennensis</i> Naum., <i>Archaeotriletes famennensis</i> Naum., <i>Lophotriletes salebrosus famennensis</i> Naum., <i>Lophotriletes grumosus famennensis</i> Naum., <i>Lophotriletes megathelis</i> Naum., <i>Stenozonotriletes famennensis</i> Naum., <i>Hymenozonotriletes hyalinus</i> Naum., <i>Hymenozonotriletes multiangularis</i> Naum., <i>Retusotriletes famenensis</i> Naum., <i>Retusotriletes parvimammathus</i> Naum.
MIDDLE FAMENNIAN	Cornisporites varicornata	CVa	
EARLY FAMENNIAN	Lagenosporites immensus	Im	
	Cyrtospora cristifer – Diaphanospora zadonica	CZ	
EARLY FAMENNIAN	Corbulispora viminensis - Geminospora vasjamica	VV	
	LATE FRASNIAN	Cristatisporites deliquescens Verrucosporites evlanensis	DE
MIDDLE FRASNIAN	Archaeoperisaccus ovalis Verrucosporites grumosus	OG	
EARLY FRASNIAN	Geminospora semilucensa Perotriletes donensis	SD	<i>Dictyotriletes devonicus</i> Naum., <i>Leiotriletes minutissimus</i> Naum., <i>Leiotriletes microrugosus</i> (Ibr.) Naum., <i>Lophotriletes scalebrosus famennensis</i> Naum., <i>Acanthotriletes pullus</i> Naum..
	Contagisporites optivus Spaeotriletes krestovnikovi	OK	
MIDDLE	Geminospora extensa	EX	<i>Camaronotriletes atavus</i> Naum.,

DEVONIAN (GIVETIAN)			<i>Calyptosporites proteus</i> (Naum.) Allen, <i>Archaeozonotriletes chlus</i> (Cramer) Rich. & Lister, <i>Retusotriletes</i> cf. <i>greggsii</i> McGregor, <i>Retusotriletes</i> cf. <i>warringtonii</i> Rich. & Lister,
LATE EMSIAN	<i>D. inassueta</i>	DI	<i>Angochitina echinata</i> Eis., <i>Calamospora panucea</i> Rich., <i>Calamospora</i> cf. <i>microrugosa</i> (Ibr.), <i>Calamospora nigrata</i> (Naum.) Allen, <i>Camarozonotriletes atavus</i> Naum., <i>Cyclogranisporites zumbosus</i> Cramer, <i>Dictyotriletes devonicus</i> Naum., <i>Dictyotriletes emsiensis</i> Allen, <i>Dictyotriletes minor</i> (Naum.) <i>negritellus</i> Nadler, <i>Dictyotriletes minor</i> (Naum.), <i>Leiotriletes confertus</i> McGregor, <i>Leiotriletes marginalis</i> McGregor, <i>Leiotriletes microrugosus</i> (Ibr.) Naum., <i>Lophotriletes rugosus</i> Naum. <i>Reticulatisporites emsiensis</i> Allen, <i>Retusotriletes semizonalis</i> McGregor
	<i>Retusotriletes clandestinus</i>	RC	

Middle Devonian identified within Măcin and Tulcea Units starts with Givetian. Eifelian is missing from these lithological successions, but it is represented by the assemblages which correspond to the PT zone (Lower Eifelian) and the RL zone (Upper Eifelian), separated by Avkhimovich *et al.* (1993) in East European Platform. The limit between Middle Devonian and Upper Devonian could not be outlined due to the mixture of the assemblages from the analyzed lithological column.

In North Dobrogea, the presence of Givetian represented by the assemblage which includes *Camarozonotriletes atavus* Naum., *Calyptosporites proteus* (Naum.) Allen, *Archaeozonotriletes chlus* (Cramer) Rich. & Lister, *Retusotriletes* cf. *greggsii* McGregor, *Retusotriletes* cf. *warringtonii* Rich. & Lister, could lead to the correlation between the FX zone – the Givetian zone with *Geminospora extensa*, where the assemblage is characterized by *Geminospora extensa*, *Geminospora tuberculata*, *Geminospora decora*, *Geminospora vulgata*, and *Geminospora micromanifesta*, *Geminospora rugosa*, *Geminospora notata* are much numerous.

Upper Devonian from Tulcea Unit is represented by Frasnian-Famennian assemblages which include species such as: *Azonomotriletes rarus* Naum., *Acanthotriletes*

rugatus Naum., *Archaeotriletes devonicus* Naum., *Samarisporites triangulatus* Allen, *Geminospora svalbardiae* (Vigran) Allen, *Stenozonotriletes famennensis* Naum., *Hymenozonotriletes hyalinus* Naum., *Retusotriletes famenensis* Naum., *Retusotriletes parvimammathus* Naum., which could be correlated with the OK and SD zones for Lower Frasnian, the OG zone for Middle Frasnian, the DE zone for Upper Frasnian from East Europe (Avkhimovitch *et al.*, 1993). The assemblage which attests Famennian corresponds to the VV, CZ and Im zones (Lower Famennian), to CVa zone (Middle Famennian) and the VF zone (Upper Famennian) from East Europe (Avkhimovitch *et al.*, 1993).

The correlation of the assemblages from Mahmudia with those identified in East European Platform could be done based on the palynomorphs identified in the analyzed samples, and not considering the zone palynomorphs identified by Avkhimovitch *et al.* (1983) in East European Platform.

The palynological assemblages which includes especially spores, and less acritarchs and chitinozoans, could offer taxa to attest the age of the researched formations, even if there were no identified zone taxa specific for the Devonian formations from East European Platform.

STRATIGRAPHICAL DISTRIBUTION AND PALYNOLOGICAL CORRELATION BETWEEN
DEVONIAN FORMATIONS FROM NORTH DOBROGEA AND EAST EUROPEAN PLATFORM

Bibliography

- Avkhimovici, V.I., Tchibrikova, E.V., Obukhovskaya, T.G., Nazarenko, A.M., Chumova, V.T., Raskatova, I.G, Mantsurova, V.N., Loboziak, S., Strel, M. 1993, *Middle and Upper Devonian miospora zonation of Eastern Europe*. Bulletin des Centres de Recherches Exploration - Production elf aquitaine, 17, 1, 1-301; France (Boussens);
- Beju, D. 1971, *Contribuții la studiul palinoprotistologic al Paleozoicului din Platforma Moesică*. Teza de doctorat, Univ. „Al.I.Cuza” Iași;
- Ionesi, L. 1994, *Geologia unităților de platformă și a Orogenului Nord Dobrogean*. Editura Tehnică, București;
- Mirăuță, O., Mirăuță, Elena 1963-1964, *Prezența Devonianului mediu în zona Colinelor Mahmudiei (Dobrogea de Nord)*. Dări de Seamă ale Ședințelor, LII/1-Stratigrafie;
- Mirăuță, O., Mirăuță, Elena 1964, *Prezența Devonianului mediu în zona colinelor Mahmudiei (Dobrogea de Nord)*, Dări de Seamă ale Comitetului Geologic, LI/1, București;
- Mutihac, V. 1990, *Structura geologică a teritoriului României*. Editura Tehnică, București;
- Olaru, L. 1992-1993, *Iglița Promontory palynological aspects on the Lower Devonian Formation from the North Dobrogea County*. Analele Științifice ale Universității „Al. I. Cuza” Iași, tom XXXVIII - XXXIX;
- Olaru, L. 1992 – 1993, *Palynological aspects on the Lower Devonian formations from the Iglița Promontory, North Dobrogea County*. Analele Științifice ale Universității „Al. I. Cuza” Iași, tom XXXVIII - XXXIX, IIb;
- Olaru, L. 1992 – 1993, *Palynostratigraphy of the Devonian's formations from Mahmudia Hills, North Dobrogea (Romania)*. Analele Științifice ale Universității „Al. I. Cuza” Iași, tom XXXVIII - XXXIX, IIb;
- Olaru, L. 1996, *Palynology and stratigraphy in the Paleozoic formations of the North Dobrogea (Romania)*. Studia Universitates ” Babeș - Bolyai ”, Geologia, 1-2, Cluj-Napoca;
- Olaru, L., Sliusari, B. 1996, *New palynostratigraphical data about the geological formation that outcrops near the Orlovca Village (Ukraine)*. Anal. Șt. Univ. „Al.I.Cuza”, Iași, s. II, XXXII-XXXIII, Iași;
- Olaru, L. 1997, *About the palynological correlation of Devonian formations of Northern Dobrogea*. Acta paleontologica Romaniae, The First Romanian National Symposium on Palaeontology, Bucharest;
- Olaru, L., Lazar, Alina 2002, *La Palynologie et la cyclicité des événements géologiques dans le Paléozoïque de la Dobrogea du Nord (Roumanie)*. Acta Palaeontologica Romaniae, vol III, Iași.

EXPLANATIONS OF THE BOARDS

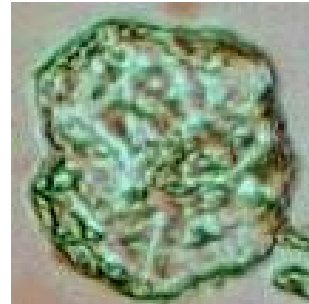
Plate 1

1. Calamospora cf. microrugosa Ibr.
2. Emphanisporites robustus McGregor
3. Geminospora svalbardiae (Vigran) Allen
4. Leiotriletes pagius Allen
5. Retusotriletes parvimammatus Naumova
6. Verrucosisporites grumosus (Naum.) Obukhuvskaia

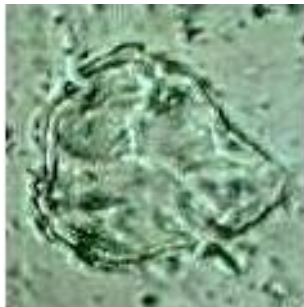
All the images are increased X 800.



1



2



3



4



5



6