1. PLANT MICROFOSSILS FROM THE JURASSIC MANGANESE ORE LAYERS OF ÚRKÚT, HUNGARY

M. KEDVES

Cell Biological and Evolutionary Micropaleontological Laboratory of the Department of Botany of the J. A. University, H–6701, P.O. Box 657, Szeged, Hungary

Abstract

This paper summarizes the new results on organic plant microfossils extracted from manganese ore layers in Úrkút. The scope of the new investigations is as follows.
1. First palynological data about the spore-pollen assemblages of the celadonite samples of Úrkút.
2. Cytological stain method was used to get information about the biopolymer organization and biochemistry of the plant microfossils.
3. Supplementary palynostratigraphic data about the Shaft III of Úrkút.

Key words: Palynology, fossil, Jurassic, manganese ore, Úrkút, Hungary.

Introduction

The necessity to investigate the plant microfossil content of the ore layers in Úrkút was emphasized first by GRASSELLY and KLIVÉNYI (1960). The first publications concerning this subject appeared in 1961 (SIMONCSICS and KEDVES). Several papers followed this pioneering information. A synthetic work about Palynology, and the results of all kinds of investigations of the manganese ore layers of Úrkút were published in a special volume of the Ore Geology Reviews – editor: E. I. ROBBINS – with a complete bibliography by KEDVES (1990).

The purposes of the new investigations are as follows.

1. To get first information about the plant microfossil assemblages from the celadonite samples, taking into consideration the pecularities of the diagenesis of this kind of manganese ore.

2. To use new concepts and methods of researches such as the stain methods of Cytology and Histology.

3. To check and/or complete the earlier established palynostratigraphic standards of the manganese ore layers in the region of Úrkút.

Material and Methods

Prof. Dr. GY. GRASSELLY, full member of the Hungarian Academy of Sciences gave me the following samples for my investigations:

1. Two samples of the celadonite: "A" — from the basis of Shaft III of Úrkút; "B" — average sample from the celadonite of Shaft III in Úrkút.
2. 21 samples from Shaft III of the carbonate manganese ore layers of Úrkút. This section was sampled from the deep gangway of this shaft.

50 g. from each sample was prepared in the following way. HCl aq. dil. to eliminite the carbonates. Washing with water. Adding cc. HF solving the remainder inorganic matter. Washing — for stain Malachit Green was used. Preparations were mounted in glycerine—jelly hydrated at 39.6%.

The plant microfossil assemblages of the celadonite samples

General establishments:

1. In both samples the plant microfossil remnants are well preserved, and the occurrences are on a high level.

2. The observed plant microfossil taxa are generally identical with the previously published ones, especially in the following papers: KEDVES and SIMONCSICS (1964a,b) SIMONCSICS and KEDVES (1961, 1969).

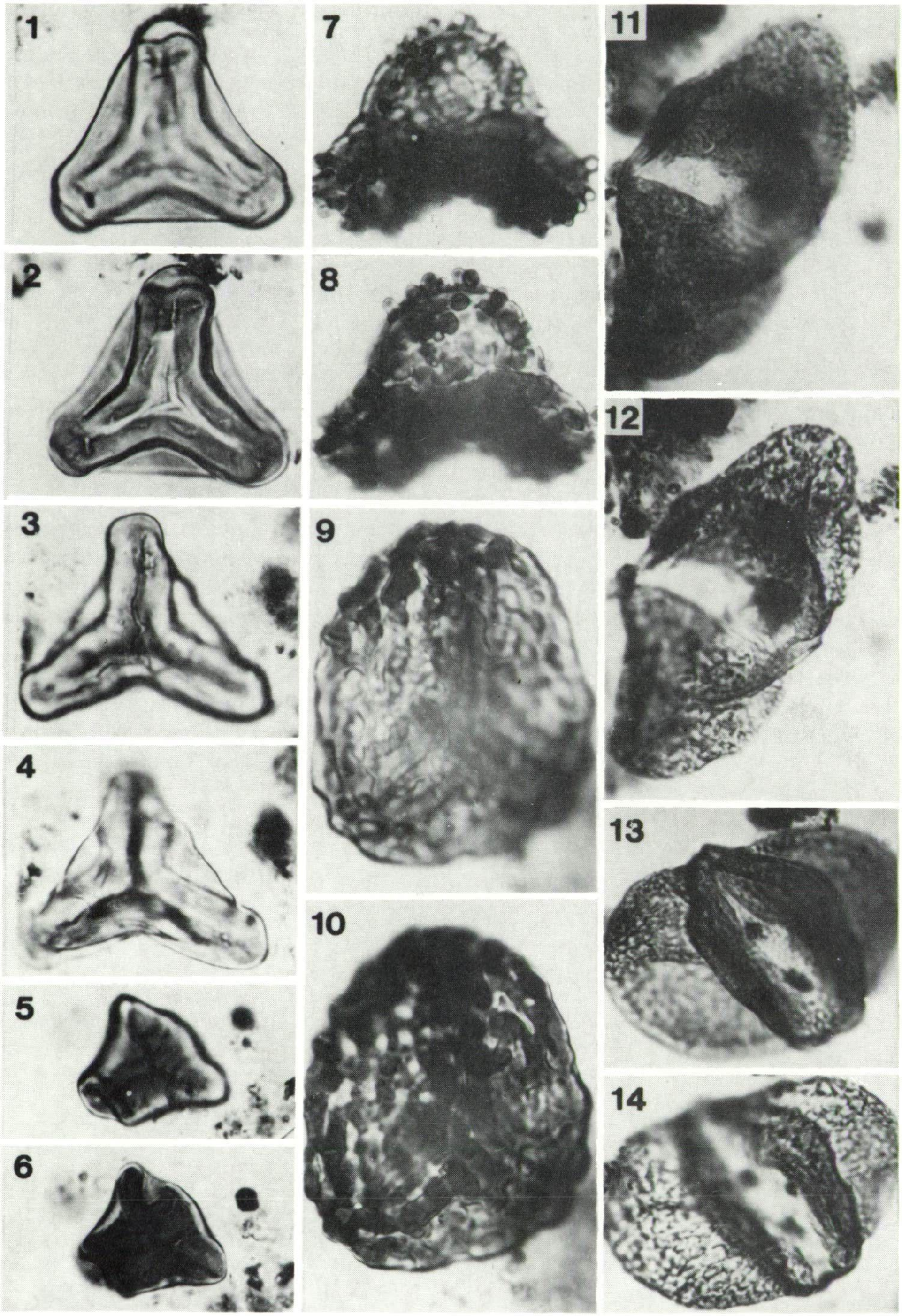
In Plate 1. 1. and 1. 2. the microphotographs of two kinds of microfossils are presented:

1. Some from the so-called classical taxa or types to demonstrate the extremely good preservation of the palynomorphs:

Dictyophyllidites toralis (LESCHIK 1955) (Plate 1. 1., fig. 1,2),
Dictyophyllidites mortoni DE JERSEY 1959 (Plate 1. 1., fig. 3,4),
Obtusisporis kara-murzae KEDVES and SIMONCSICS 1964a (Plate 1. 1., fig. 5,6),
Clavatisporites microcapitulus KEDVES and SIMONCSICS 1964a (Plate 1. 1., fig. 7,8),
Dictyotriletes (Klukisporites) variegatus COUPER 1958 (Plate 1. 1., fig. 9,10),
Vitreisporites pallidus (REISSINGER 1938) NILSSON 1958 (Plate 1. 2., fig. 1,2),
Classopollis classoides (PFLUG 1953) POCOCK and JANSONIUS 1961 (Plate 1. 2., figs. 3—6),
Classopollis minor POCOCK and JANSONIUS 1961 (Plate 1. 2., figs. 7—10),
Classopollis cf. *grandis* SIMONCSICS and KEDVES 1969 (Plate 1. 2., fig. 13, 14),

Plate 1. 1. ►

1,2. *Dictyophyllidites toralis* (LESCHIK 1955), slide: U-III-C-A-5, cross-table number: 21.3/143.5.
3,4. *Dictyophyllidites mortoni* DE JERSEY 1959, slide: U-III-C-A-1, cross-table number: 14.3/149.2.
5,6. *Obtusisporis kara-murzae* KEDVES and SIMONCSICS 1964a, slide: U-III-C-A-13, cross-table number: 10.6/145.9.
7,8. *Clavatisporites microcapitulus* KEDVES and SIMONCSICS 1964a, slide: U-III-C-A-2, cross-table number: 10.2/141.6.
9,10. *Dictyotriletes (Klukisporites) variegatus* COUPER 1958, slide: U-III-C-A-1, cross-table number 16.4/139.1.
11,12. *Pityosporites illustris* LESCHIK 1955, slide: U-III-C-B-6, cross-table number: 19.3/130.8.
13,14. *Alisporites toralis* (LESCHIK 1955) CLARKE 1965, slide: U-III-C-B-9, cross-table number: 21.2/143.7.
Magnification of all pictures: 1.000x.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2. Palynomorphs, which were not observed during the previous investigations of the manganese ore layers in Úrkút:

Pityosporites illustris LESCHIK 1955 (Plate 1. 1., fig. 11, 12),
Alisporites toralis (LESCHIK 1955) CLARKE 1965 (Plate 1. 1., fig. 13, 14),
Paracirculina tenebrosa SCHEURING 1970 (Plate 1. 2., fig. 11, 12),
Exesipollenites cf. *tumulus* BALME 1957 (Plate 1. 2., fig. 15, 16),
Exesipollenites scabrosus NORRIS 1969 (Plate 1. 2., fig. 17, 18, cf. 19, 20),
Tasmanites/Tytthodiscus sp. (Plate 1. 2., fig. 21, 22),
Micrhystridium rarispinosum SARJEANT 1960 (Plate 1. 2., fig. 23, 24).

Stain acceptance of the plant microfossils of the celadonite samples

To get information about the chemistry and the biopolymer structure of the plant microfossils, staining with Malachit Green was used. This stain well indicates the presence of the aromatic lignin derivates in the microscopic remnants. On the basis of stain acceptance the following groups were established:

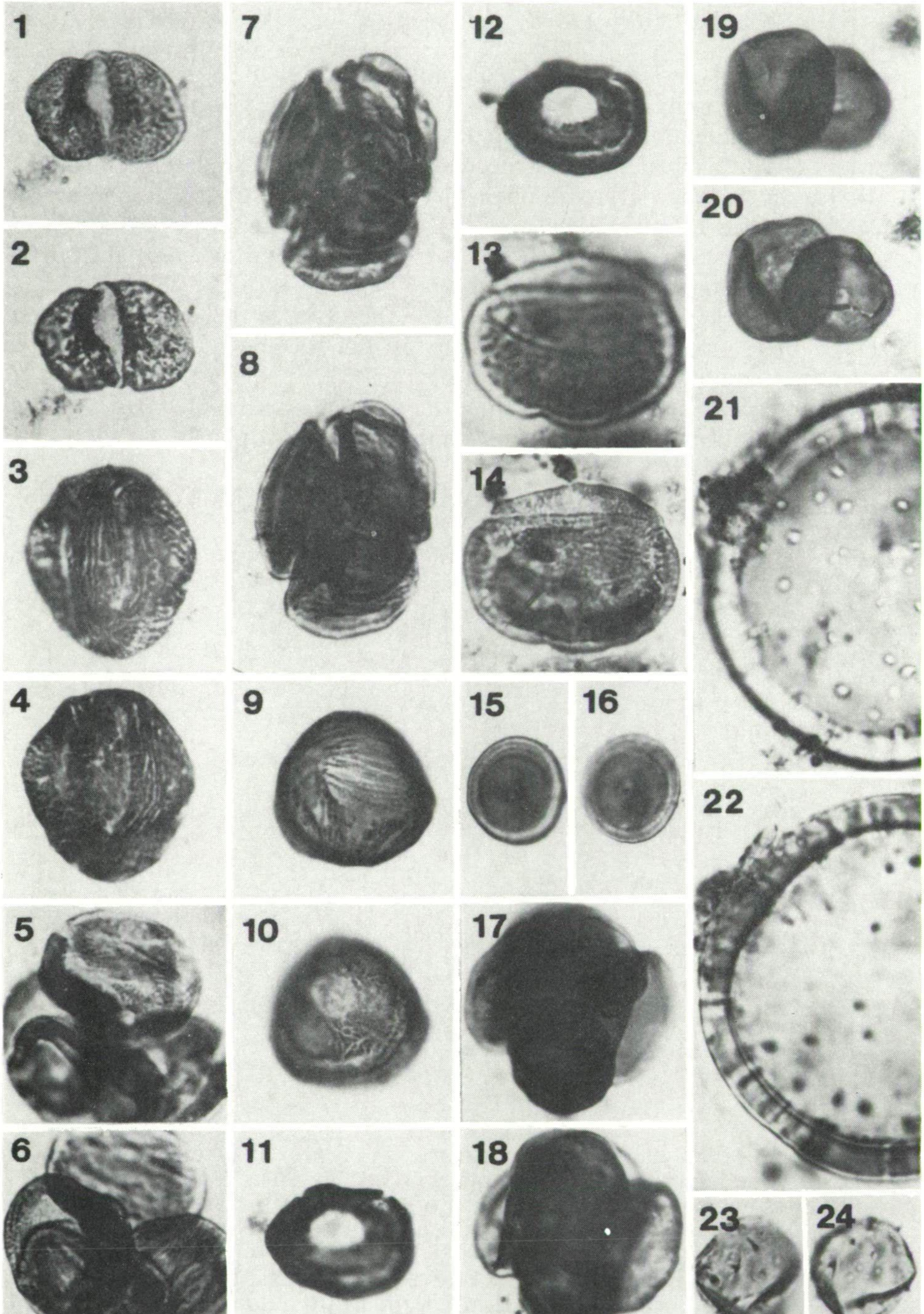
Brown coloured (B); in this case the plant cell wall adsorbed well the manganese ions and manganese oxides have been accumulated. In all probability the anionic character of the surface of the sporomorphs is important in this case. But it is necessary to point out as another factor the alterations of the electrostatic charge of the surface. It may be presumed that the surface has lost its electrostatic charge.

Brown-green coloured (BG); In all probability the surface has not lost its electrostatic charge, and in this way cations were adsorbed on the surface, mostly of Mn. But the exine layers, containing aromatic lignin derivates have accepted

Plate 1. 2. ▶

1,2. *Vitreisporites pallidus* (REISSINGER 1938) NILSSON 1958, slide: U-III-C-A-4, cross-table number: 12.6/132.8.
3,4. *Classopollis classoides* (PFLUG 1953) POCOCK and JANSONIUS 1961, slide: U-III-C-B-15, cross-table number: 23.2/142.3.
5,6. *Classopollis classoides* (PFLUG 1953) POCOCK and JANSONIUS 1961, slide: U-III-C-A-5, cross-table number: 11.8/141.8.
7,8. *Classopollis minor* POCOCK and JANSONIUS 1961, slide: U-III-C-A-7, cross-table number: 9.8/140.1.
9,10. *Classopollis minor* POCOCK and JANSONIUS 1961, slide: U-III-C-B-5, cross-table number: 21.3/145.7.
11,12. *Paracirculina tenebrosa* SCHEURING 1970, slide: U-III-C-B-15, cross-table number: 21.4/133.3.
13,14. *Classopollis* cf. *grandis* SIMONCSICS and KEDVES 1969, slide: U-III-C-A-6, cross-table number: 9.9/136.6.
15,16. *Exesipollenites* cf. *tumulus* BALME 1957, slide: U-III-C-A-4, cross-table number: 8.8/140.5.
17,18. *Exesipollenites scabrosus* NORRIS 1969, slide: U-III-C-B-17, cross-table number: 21.3/243.8.
19,20. *Exesipollenites* cf. *scabrosus* NORRIS 1969, slide: U-III-C-B-7, cross-table number: 8.4/145.6.
21,22. *Tasmanites/Tytthodiscus* sp., slide: U-III-C-B-17, cross-table number: 21.3/143.8.
23,24. *Micrhystridium rarispinosum* SARJEANT 1960, slide: U-III-C-B-21, cross-table number: 13.2/134.9.

Magnification of all pictures: 1.000x.



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Malachit Green. This stain is peculiar for the lignin containing secondary xylem walls.

Green (G); at the near perfect coloration of the plant microfossil wall, two things may be pointed out:

i. The accumulation of the lignin derivates is on a high level, and there is no important alteration in the basic molecular structure of these derivates.

ii. The biopolymer structure of the surface is unable to accept cations. The surface has lost its electrostatic charge or original character.

On the basis of the new results on the biopolymer structure the surface pecularities are much more complicated than believed earlier.

Yellow (Y); in the first place there are the cysts of the *Algae* which have preserved their original colour. The high carotenoid and its polymer content seems not to be altered to an important degree.

The percentages of the most important plant microfossil types and their distribution following their colour are summarized as follows.

Sample U-III-C-A, basis of Shaft III, of Úrkút

	B	BG	G	Y	Total
Pteridophyta	24.0	3.0	0.5		27.5
Classopollis	9.0	50.1	2.0		61.1
Monosulcites		2.0			2.0
Vitreisporites		0.5			0.5
Eucommiidites		0.5	4.0		4.5
Spheripollenites		2.0	1.2		3.2
Algae (Pleurozonaria, etc.)				1.2	1.2
					100.0

Sample U-III-C-B, average sample from the celadonite of the Shaft III of Úrkút

	B	BG	G	Y	Total
Pteridophyta	1.0	1.0	0.6		2.6
Classopollis	7.0	13.2	1.5		21.7
Monosulcites	0.6	3.0			3.6
Vitreisporites		0.6			0.6
Eucommiidites		0.6	1.5		2.1
Spheripollenites	13.0	46.0	7.2		66.2
Algae (Pleurozonaria, etc.)				1.0	1.0
Hystrichosphaeridae	0.6	0.6	1.0		2.2
					100.0

The spore-pollen assemblage of sample "A" represents well the *Classopollis* zone, established earlier (KEDVES and SIMONCSICS 1964a, KEDVES 1990). It is worth mentioning that the pollen grains of *Cycadaceae* are relatively very few. But *Pteridophyta* is well represented with high quantity of well preserved different kinds of spores.

The average sample "B" may not represent one single previously established microstratigraphical level of Shaft III in Úrkút. But the dominant quantity of the form-genus *Spheripollenites* indicates that several samples come from the *Spheripollenites* zone, which represents the "Zone C". This is the upper part in the microstratigraphical zonation of Shaft III in Úrkút. The occurrence of *Hystrichosphaeride* is also important.

Palynological stratigraphy of the deep gangway of shaft III in Úrkút

(Text-fig. 1. 1.)

The spore-pollen taxa observed during the light-microscopical investigations are identical with the previously published ones. The percentages of the most important groups are illustrated in text-fig. 1. 1. On the basis of these quantitative data the following paleoecological, respectively microstratigraphical conclusions can be established.

OPEN SWAMP ZONE (*PTERIDOPHYTA* AND *SPHERIPOLLENITES*)

(Sample I. 318 m., green, grey and red flint containing limestone).

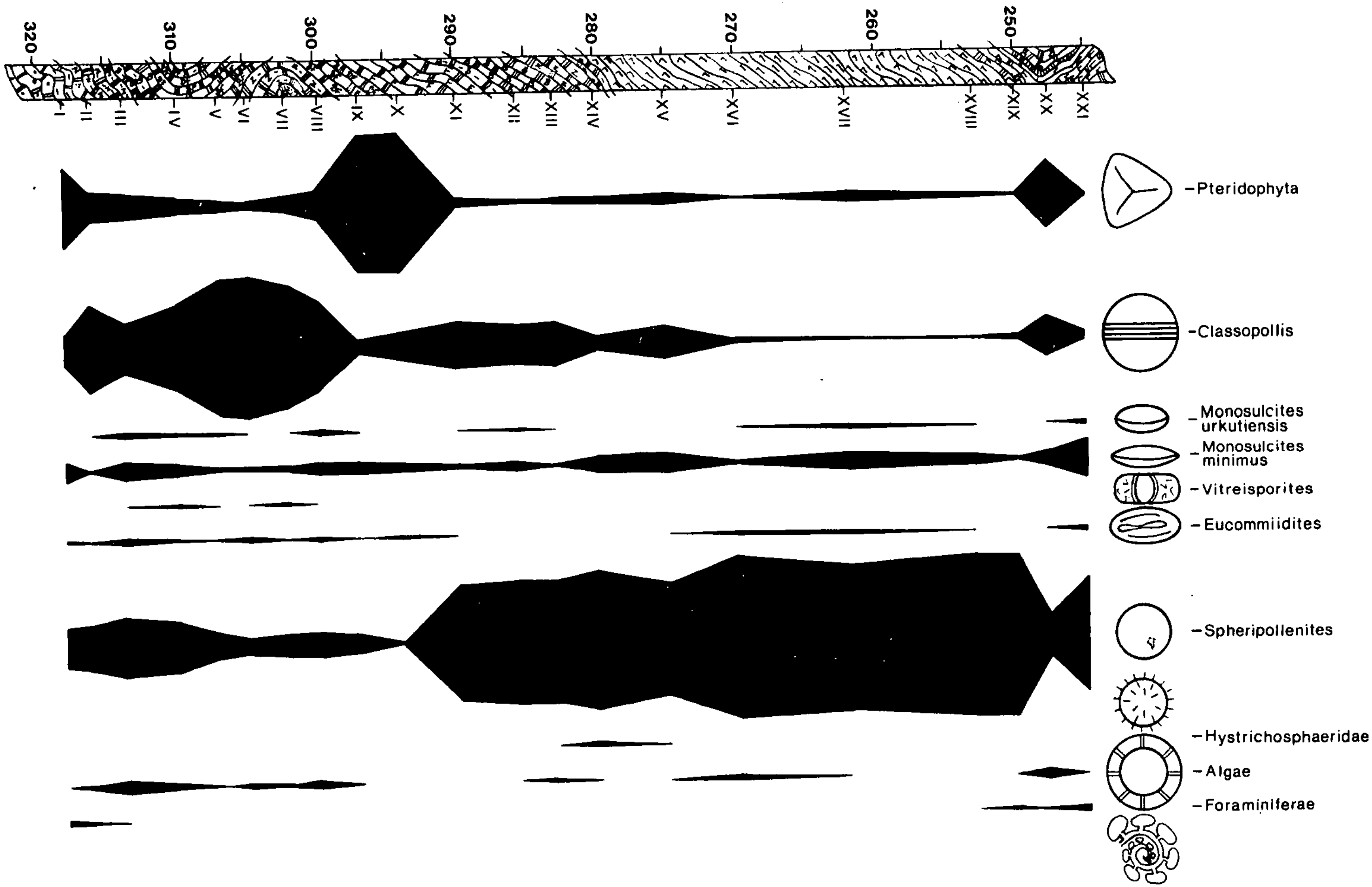
The quantity of the *Pteridophyta* spores is dominant (22.5%). The percentages of the pollen grains of the form-genus *Spheripollenites* are the highest among the gymnosperm types (11.0%). Worth of mentioning are the quantities of the pollen grains of the genus *Classopollis* and *Monosulcites minimus*. The presence in a low quantity is important of the chitionus shells of the *Foraminiferae,* indicating the salt water conditions.

CLASSOPOLLIS ZONE

(Samples II—VIII; II. 316 m., grey, green, finely streaked carbonaceous manganese ore, III. 314 m., IV. 310 m., and V. 307 m., brown, grey, finely streaked carbonaceous manganese ore, VI. 305 m., green — grey coarsely streaked carbonaceous manganese ore, VII. 302 m., green — grey carbonaceous ore, VIII. 300 m., brown, coarsely streaked carbonaceous ore).

The dominance of the pollen grains of the genus *Classopollis* is characteristic, exceptionally sample No III. As regards the details the following can be mentioned.

Sample No II. The quantity of the *Pteridophyta* spores, and of the pollen grains of the genus *Spheripollenites* is relatively high. *Foraminiferal* shells also occur together with algal cysts. In the microfossil assemblage of sample No III. the pollen grains of the genus *Classopollis,* and *Spheripollenites* are predominant. The quantity of the algal cysts, and the *Pteridophyta* spores is relatively high. In the following sample (No IV.), the pollen genus of *Classopollis* is predominant, but the quantities of the algal cysts and the *Pteridophyta* spores, and the pollen grains of *Monosulcites minimus* and *Spheripollenites* are also common. High dominance of the pollen grains of genus *Classopollis* is characteristic for the spore-pollen assemblage of the samples No V., VI., and VII. The presence of the algal cysts and the further previously mentioned plant microfossils is also worth of mentioning.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Classopollis
Monosulcites urkutiensis
Monosulcites minimus
Vitreisporites
Eucommiidites
Spheripollenites
Hystrichosphaeridae
Algae
Foraminiferae

◄ Text-fig. 1. 1.

Drawing of the profil investigated with the diagram of organic microfossil remains.

PTERIDOPHYTA OXIDIZING ZONE

(Samples IX., 297 m. and X., 294 m., black finely streaked carbonaceous manganese ore).

The preservation of the organic remains is extremely bad. The predominant percentages of the spores are in all probability the consequence of selective fossilization. After all, the position of this layer is peculiar, because this represents the bordering between the *Classopollis* and the *Spheripollenites* zone.

SPHERIPOLLENITES ZONE

(Samples XI–XXI; XII. 286 m., brown (green) coarsely streaked carbonaceous ore, XIV. 280 m., grey coarsely streaked carbonaceous ore).
Clayey marl with *Radiolaria:* Sample XVI., 270 m., XVII. 262 m., XVIII. 253 m.
Sample XIX. 250 m., grey green coarsely streaked carbonaceous ore (Shaft II.).
Sample XX. 248 m., calcareous marl with *Ammonites.*
Sample XXI. 245 m., quartzose bench.

Taking into consideration the lithology of the above mentioned samples it is necessary to point out the following.

Here we have samples from the clayey marl with *Radiolaria,* the top-layer of the manganese ore layers of Shaft III. One sample represents the manganese ore from Shaft II., and its top-layer with *Ammonites.* The quartzose bench is important in connection with the occurrence of celadonite in the manganese ore layers of Úrkút. In this way it is the best to take into consideration the above mentioned lithological data in the fine differences of the spore-pollen assemblages.

The upper part of the carbonaceous manganese ore layers – except the uppermost sample (No XIV.) – contains a remarkable quantity of *Classopollis,* together with the dominant pollen grains of *Spheripollenites.* In the clay marl, with *Radiolaria,* except its lowermost sample the high dominance of the pollen grains of *Spheripollenites* is characteristic. The same spore-pollen composition was found in the manganese ore sample of Shaft II.

In the calcareous marl with *Ammonites,* the *Pteridophyta* spores are dominant with high quantity of *Classopollis* pollen grains. The relatively high amount of the cysts of the *Algae* indicates open swamp conditions.

The spore-pollen composition of the quartzose bench can be characterized by the dominance of *Spheripollenites* with *Monosulcites minimus.* The occurrence of the chitinous shells of *Foraminifera* is worth of mentioning.

Discussion and Conclusions

Concerning our new results it is necessary to emphasize the palynological data of the celadonite samples. Following the monograph of KOCH et al. (1967) celadonite is similar to glauconite. The first occurrence of celadonite is in basalt or in general volcanic rocks. The origin of the celadonite layers of the manganese ore layers is in all probability volcanic nearly submarine hydrothermic (rift). The excellent preservation of the sporomorphs in these samples can be emphasized. The stain acceptance was in this case a first attempt to demonstrate this new opportunity to get more information about the alterations of the organic material during the deposition of the minerai manganese.

The new palynostratigraphic data complete our earlier knowledge concerning this subject. The few data from Shaft II., and calcareous marl with *Ammonites* and the quartzose bench are new remarkable additions. But it seems that in the further detailed investigation of the upper and underlying can yield more interesting data for the elucidation of this interesting problem.

Acknowledgements

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