ACTA PALAEONTOLOGICA ROMANIAE V. 5 (2005), P. 351-366

# SOME PROBLEMS OF BIOSTRATIGRAPHY AND PALYNOLOGICAL CORRELATION OF UPPER FORMATION (Tg. 4) FROM TULGHEŞ GROUP, EAST CARPATHIANS (ROMANIA)

**Leonard OLARU**[1]

**Abstract.** For the biostratigraphical characterization of the metamorphic formations, beside the structure and tectonic particularities, the only biostratigraphical guide – marks are represented by the acritarchs and chitinozoans assemblages. For Upper Formation (Tg. 4) of Tulghes Group from Eastern Carpathians is an example difficult to study and biostratigraphical correlation due to its boundary position between Upper Cambrian and Lower Ordovician. Previous studies on chitinozoan and acritarch assemblages allowed some interesting palynological and biostratigraphical conclusions. The position of our country's territory in Perigondwanaland, at the intersection of warm and cold microfloristic element, from Upper Cambrian and Lower Ordovician, as well as the total lack of trilobite and graptolite fossil rests, for zonation and analogy, tectonization and the powerful metamorphism of the analyzed samples induced great difficulties in the biostratigraphical characterization of these formations. We consider that any biostratigraphical boundary between different geological formations represents a palaeobiological transitory zone, with an exchange and a gradual replacement of faunistic and floristic elements, with the turning up of palaeobiological assemblages with biostratigraphical provincialism characters. For a correct positioning we have considered that Tremadocian represent Arenigian or Early Ordovician stage, considering the interlaying of Tremadocian acritarch assemblage with Arenigian chitinozoan ones, both identified on the same analyzed samples from the Upper Formation (Tg. 4) of Tulghes Group.

**Keywords:** Palynology, Acritarchs, Chitinozoans, Arenigian, Biostratigraphy, Correlation, Tulgheş Group, Upper Formation (Tg. 4), East Carpathians, Romania.

## INTRODUCTION

Generally, the biostratigraphy of the metamorphic formations and, especially, of Upper Formation (Tg. 4) from Tulgheş Group represents a difficult research touchstone due to the evident proofs: the lack of some specific macrofossil rests; the lack or the extensive diminishing of the typical microfossil elements (acritarchs, chitinozoans); the mixture and the morphological modification of the microfossil rests of acritarchs and chitinozoans; the modification of all petrographic, lithological elements, as well as that of the integrated organic matter due to metamorphism and tectonic processes. Previous studies refer more to the lithology, metamorphism and tectonics of this formation. The previous palynological studies are in a smaller number, but with important contributions. Among these, we remind: Iliescu, Mureşan, 1975, 1976; Iliescu, Kräutner, 1975; Vodă *et al.*, 1976; Iliescu *et al.*, 1983; Olaru, Gunia, 1988; Olaru, Horaicu, 1989; Olaru, Apostoae, 1995; Olaru, 1991; Olaru, 2001. Two Ph.D. thesis also include references to the upper formations from Tulgheş Group (Horaicu, 1999; Vaida, 1999). Strict studies on the Bălan area of Upper Formation (Tg. 4) from Tulgheş Group were elaborated by Olaru, Apostoae, 2004; Olaru, Apostoae, Apostoae, (2003-2004) and Olaru, Lazăr, 2004 (in press). The purpose of this study is that of a synthesis of all known results, the clarifying of some biostratigraphical incertitudes, and the correlation with other classical formations from different regions on the globe.

## MATERIAL AND METHOD

There were analyzed the cross-sections from Upper Formation (Tg. 4) from Tulgheş Group, within Bălan Area, East Carpathians, coming from Bălan Formation and Sândominic Formation (Fig. 1). From Bălan Formation, the analyzed samples represent phyllitous chloritous-sericitous schists and graphitous schists of Arama Oltului Member (Fig. 1). From Sândominic Formation, the analyzed samples represent phyllitous chloritous-sericitous schists and black quartzites from Pârâul Crucii Member and Başca Member (Fig. 2). The laboratory preparation method was the classical one, utilized for the metamorphic rocks, meaning physical disintegration, chemical maceration, heavy liquid centrifugation, and the preparation of the microscopic slides in order to visualize, analyze, determine and interpretation.

## BIOSTRATIGRAPHY AND PALYNOLOGICAL CORRELATION OF UPPER FORMATION (TG. 4) FROM TULGHES GROUP

Upper Formation (Tg. 4) from Tulgheş Group stands within a boundary span, Cambrian-Ordovician, denominated by some authors as Tremadocian. Also, as result of the recent studies, in the modern chronostratigraphical scales, Tremadocian is considered as the lower part of Early Ordovician, and Arenigian, in the upper part of Later Ordovician. These conclusions represent the result of numerous studies and biozonations based on brachiopods, trilobites and conodontes from the main classical regions on the globe,

[1] *Department of Geology and Geochemistry, University „Al. I. Cuza" Iaşi, Romania; e-mail: lola@uaic.ro*

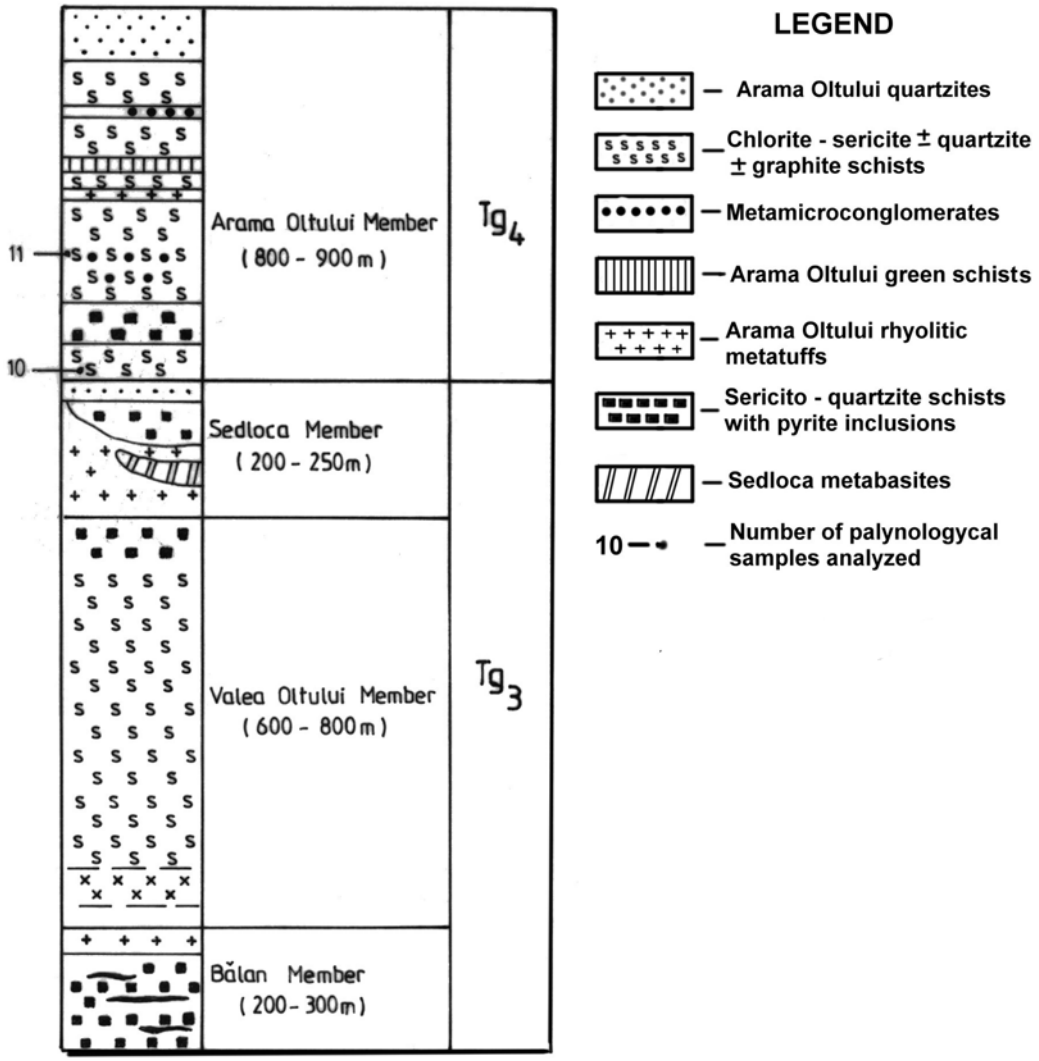



**Figure 1.** Geological column of the Upper Formation (Tg. 4) Tughes Group from the Balan Formation (after Kräutner & Bindea, 1995).

Baltic, Avalonia and Gondwanaland. All these biozones have correspondents in the acritarch and chitinozoan assemblages. In Upper Formation (Tg. 4) from Tulgheş Group, East Carpathians, there are no preserved marker species of conodontes, graptolites and trilobites, thus, in the biostratigraphical analysis and in the palynological correlation of this formation we exclusively used the acritarch and chitinozoan assemblages corresponding to the faunistic biozones. In Baltic region, acritarch assemblages from the Cambrian-Ordovician boundary span are delimited in the lower part by *Cordylodus proavis* Biozone, or by *Acerocare* Biozone, and the end of this span is marked by the last extension of the species from *Rhabdinipora flabelliformis* Group which is placed before the graptolite apparition from *Adelograptus tenellus* Biozone (Martin and Dean, 1981; Martin, 1993).

A similar situation we find in England – a classical region for this age. In a series of drillings and outcrops from Estonia and Moscow Syneclise, several author (Volkova and Mens, 1988, Volkova, 1989, 1990) come to the conclusion that the acritarch species of *Acanthodiacrodium angustum* is considered marker species for the base of Ordovician in the Baltic region and West of Russia, concomitantly with the apparition of *Cordylodus proavus* Biozone. On the other hand, the first apparition of acritarchs from *Veryhachium trispinosus* Group (Martin, 1982) is present above *Adelograptus tenellus* Biozone.

To be noticed within this interval, an acritarch influx from *Diacromorphitae and Herkomorphitae* Subgroups, among them *Acanthodiacrodium*, *Cymatiogalea*, *Cymatiosphaera*, and species of *Acanthomorphitae* and *Polygonomorphitae*, such as *Baltisphaeridium crinitum* and *Vulcanisphaera* cf. *africana*. Also, an acritarch influx is observed in other regions, such as East-European Platform and East Carpathians.

Thus, we conclude from these results that Tremadocian is considered as Early Ordovician, being defined by biozones of conodontes, graptolites, acritarchs, in association with chitinozoan species. In Avalonia, graptolite and conodonte species equivalent to those from Baltic region define the Cambrian-Ordovician boundary span (Martin, 1993).

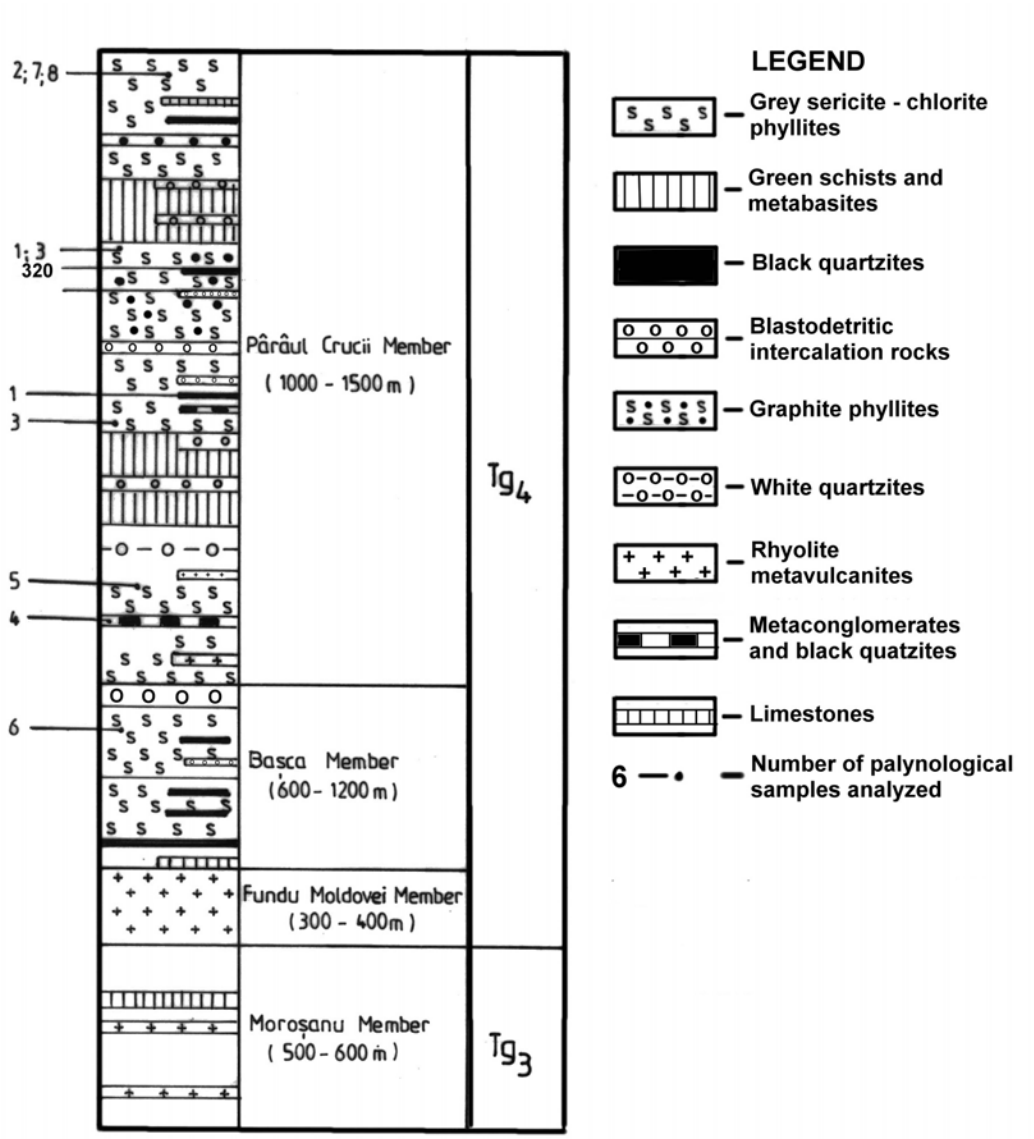



**Figure 2** Geological column of the Upper Formation (Tg. 4) Tulghes Group from the Sândominic Formation (after Kräutner & Bindea, 1995).

In Gondwanaland region (Morocco, Algerian Sahara), the acritarch assemblages come from the interval with *Rhabdinipora flabelliformis* (Elaouad-Debbaj, 1988) with "Grès d'El Gassi" at the lower part of Tremadocian. Within this interval, the apparition of *Acanthodiacrodium augustum* species, considered as Later Tremadocian, is associated with an influx of *Diacromorphitae* and *Herkomorphitae*, same as in Baltic region and Avalonia. The palaeoterritory of East Carpathians stands in the Perigondwanaland area, fact that is emphasized by the initial mixture of microflora, partially common with the above mentioned areas, Baltic, Avalonia, Gondwanaland. In this situation, only the species from the genera such as *Cordylodus* and *Rhabdinopora* were cosmopolites, being used in interregional correlations in contrast with trilobites, which often present a certain provincialism (Martin, 1993). From point of view of the microfloristic content, Upper Formation (Tg. 4) from Tulgheş Group represents an undifferentiated Arenigian (Lower Ordovician, upper part) unit, which includes, together, Upper Cambrian, Tremadocian and Arenigian elements, where stand out the acritarch species, corresponding to lower and upper biozones of Tremadocian, or from the lower part of Arenigian. Chitinozoans, which started their evolution in Lower Arenigian, come together with Upper Arenigian species. Conodontes, graptolites and trilobites, in order to compare and to realize their biozonation, are totally lacking. Therefore, the correlation and, partially, the biozonation could be realized through the separation from acritarch and chitinozoan assemblages of the markers, or of those which accompany these species in the classical regions, where the biozonation and the correlation were also made based on macrofauna.

## ACRITARCH ASSEMBLAGES AND BIOSTRATIGRAPHICAL CORRELATION

From the analyzed samples some acritarch assemblages came out, comparable and corresponding to the classical zones, pointed out by macrofauna biozones.

A first acritarch assemblage (Table 1), reworked from Upper Cambrian, corresponding to *Peltura scarabeoides* Zone, includes several typical species: *Acanthodiacrodium snookense*, *Veryhachium dumontii*, *Leiofusa stoumonensis*, *Pirea orbicularis*, *Cristallinium* cf. *randomense*. It is characteristic to RA5 and RA6 zones from Random Island, Newfoundland, Canada (Parsons and Anderson, 2000).

Another acritarch taxa assemblage is characteristic to the Upper Cambrian-Tremadocian (Lower Ordovician, lower part) boundary zone from the same region – Newfoundland, Canada, from RA7, RA8 and RA9 biozones, corresponding to the stratigraphical span delineated by *Acerocare* Zone at the lower part and *Rhabdinipora flabelliformis* Zone, at the upper part, from Moscow Syneclise, where also appears *Cordylodus andresi*, and at the basis of OT1 assemblage from Estonia. From this assemblage, we mention: *Poikilofusa squama*, *Ooidium rossicum*, *O.* cf. *clavigerum*, *Baltisphaeridium crinitum*, *Saharidia* cf. *fragillis*, *Vulcanisphaera tuberculata*, *Cristallinium cambriense*, *C. pillosum*, *Acanthodiacrodium golubii*, *A. lanatum*, *Cymatiogalea gorkae*, *C.* cf. *cuvillierii*, *C. velifera*, *Izhoria angulata*, *Arbusculidium* cf. *destombesii* (Table 1).

Characteristic for Tremadocian, it stands out an acritarch assemblage, among it we mention: *Acanthodiacrodium angustum*, *Baltisphaeridium aciculare*, *B. setaceum*, *Buedingiisphaeridium tremadocum*, *Dactylofusa squama*, *D. velifera*, *Elenia armilata*, *Lunulidia lunula*, *Polygonum sexradiatum*, *Stelliferidium* cf. *stelligerum*, *Vulcanisphaera* cf. *britannica*, *V.* cf. *capillata* (Plate 1 and 2).

This assemblage also appears between *Acerocare* Zone and *Rhabdinipora flabelliformis* Zone, as well as between *Cordylodus proavus* Zone and *C. intermedius* Zone from the same OT1 and OT2 assemblages from Estonia.

A few species, among them also appear elements from this acritarch assemblage, exceed the Tremadocian-Lower Arenigian boundary, continuing their evolution in Arenigian. Among them we mention: *Coryphidium bohemicum* (specific for Prague Basin), *Acanthodiacrodium angustum* (cosmopolite species), *A. lanatum*, *Dactylofusa squama*, *Baltisphaeridium aciculare*, *B. setaceum*, *Saharidia* cf. *fragillis*, *Vulcanisphaera britannica*, *Leiosphaeridia* sp. (Table 1). They are mentioned in the shore area of Baltic Sea (Estonia) within the acritarch OT1, OT2 and OT3 assemblages and within UC4B and UC4B-1 assemblages from Moscow Syneclise, beside other species.

They correspond to *Rhabdinipora flabelliformis*, *Cordylodus lindstroemi* and *Cordylodus rotundatus – Cordylodus angulatus* Zones, as well as to *Clonograptus – Didimograptus* graptolite Zone.

**Table 1.** Range chart showing of stratigraphic distribution of acritarch assemblage in the Upper Formation (Tg.4) of the Tulgheş Group, Balan Zone (East Carpathians).

| TAXONOMIC UNITS | ANALYSED SAMPLES | | | | | | | | CHRONOSTRATIGRAPHIE | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 3 | 4 | 5 | 6 | 9 | 10 | 11 | Cb.3 | Trem. | Aren. |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| *Acantodiacrodium angustum* (Dow.) Comb. | • | • | • | • | • | • | • | | | | |
| *Leiosphaeridia* sp. A. | • | • | • | • | • | • | • | • | | | |
| *Baltisphaeridium crinitum* Martin | | | | | | • | | | | | |
| *Acantodiacrodium snookense* Parsons & Anderson | • | • | | | | • | | | | | |
| *Acantodiacrodium golubii* Fensome et al. | • | • | | | | • | • | | | | |
| *Leiosphaeridia* sp. B. | • | • | • | • | • | • | • | • | | | |
| *Veryhachium dumontii* Vang. | | • | • | • | | • | • | • | | | |
| *Baltisphaeridium aciculare* (Tim.) | • | | | | | | | | | | |
| *Lunulidia lunula* (Eis.) Eis. | • | • | | | • | | • | | | | |
| *Leiofusa stoumonensis* Vang. | | | • | | • | | • | • | | | |
| *Acanthodiacrodium lanatum* (Tim.) Martin | • | | • | | | | | | | | |
| *Orthosphaeridium extensum* Parsons & Anderson | | | • | | | | | | | | |
| *Saharidia* cf. *fragilis* (Dow.) Combaz. | | | • | • | • | | | | | | |
| *Polygonum minimum* (Tim.) Volkova | | | • | | | | | | | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Impulviculus bibulbulus* Parsons & Anderson | | | | • | | | | | — | — | |
| *Tasmanites* sp. | | | | • | | | • | • | — | — | |
| *Elenia armilata* (Vanderflit) Volkova | | | | • | | • | | | — | — | |
| *Polygonum sexradiatum* (Tim.) Volkova | | | | • | | | | | — | | |
| *Vulcanisphaera tuberculata* (Downie) Eis. | | | | • | | | | | — | — | |
| *Cristallinium cambriense* (Slavikova) Vanguestaine | | | | • | • | | | | — | — | |
| *Buedingisphaeridium tremadocum* Rasul | | | | • | | | | • | — | — | |
| *Izhoria angulata* Golub et Volkova | | | | | • | | | | — | — | |
| *Cymatiogalea gorkae* Rauscher | | | | | • | | | | — | — | |
| *Acanthodiacrodium* sp. | | | | | • | • | | | — | — | — |
| *Pirea orbicularis* Volkova | | | | | • | | • | • | — | | |
| *Dactylofusa squama* (Deunff) Martin | • | | | | | • | | | | — | |
| *Baltisphaeridium setaceum* (Tim.) | • | | | | | | | | | — | |
| *Arbusculidium ornatum* (Deunff) Martin | • | | | | | | | | | — | |
| *Cristallinium pilosum* Golub. et Volkova | | | | | | | • | | — | | |
| *Vulcanisphaera capillata* Jardiné | | | • | | | | | | — | — | |
| *Dactylofusa velifera* Cocchio | • | | | • | | | • | | | — | |
| *Poikilofusa squama* (Deunff) Martin | • | | | | | | • | • | | — | |
| *Stelliferidium* cf. *stelligerum* (Gorka) Deunff et al. | | | • | | | | • | | | — | |
| *Timofeevia estonica* Volkova | | | | | | • | • | | — | | |
| *Cristallinium* cf. *randomense* Martin Fensom et al., Ribb. & Vang. | | | | | | | • | | — | - - - - | |
| *Ooidium* cf. *rossicum* Timofeev | | | | | | | • | | — | | |
| *Ooidium timofeevii* Loeblich | | | | | | | • | | — | | |
| *Leiofusa* sp. | • | | • | | | | • | • | — | — | |
| *Trachydiacrodium coarctatum* Tim. | | | | | | | | • | — | | |
| *Ooidium* cf. *clavigerum* Parsons & Anderson | | | • | | | | | • | — | | |
| *Trichosphaeridium annovaelense* Tim. | | | | | | | | • | — | | |
| *Lophodiacrodium valdaicum*(Tim.) Defl. et Defl.-Rigaud. | | | | | | | | • | — | | |

## CHITINOZOAN ASSEMBLAGE AND BIOSTRATIGRAPHICAL CORRELATION

Marine chitinozoan organisms more recent than acritarchs start their evolution in Lower Arenigian. They coexist with older acritarchs in the same samples due to the sedimentation process, and to the microflora mixture as result of the metamorphism and of the successive tectonic phases, subsequent to the sedimentation. They are benthic organisms and were affected by metamorphism and tectonic processes the same as acritarchs.

The chitinozoan assemblage is represented by characteristic species, but with a large extension on the globe: Laurentian Shield, Baltic Shield, East-European Platform, Bohemia, SW Europe, Gondwanaland (Sahara and Australia), Siberian Platform. Within the chitinozoan assemblage

some species are marker elements for different biozones:

- *Conochitina symmetrica* Taug. and De Jekh. defines the Arenigian lower limit (Tremadocian-Arenigian), found in Klabava Formation (Prague Basin, Bohemia) (Paris and Mergl, 1987) together with *Clonograptus* and *Tetragraptus appoximatus* (Kraft and Mergl, 1979). Also, from the same formation was separated the acritarch marker species of *Coryphidium bohemicum* Vavrdova. This chitinozoan species was separated in SW of Europe, in Baltic Shield, together with *Lagenochitina esthonica* (Eis.) in Estonia (Eisenack, 1955); in Russian Platform (Umnova, 1986; Grahn, 1980, 1981, 1984); in Laurentian Shield (Achab, 1980, 1981, 1985, 1986, 1989, 1991); in Sahara (Morocco) (Elaouad-Debbaj, 1987, 1988; Paris, 1990, 1996) and Australia (Achab and Millepied, 1980); East Carpathians, Romania (Olaru, Apostoae, 2004; Olaru, Apostoae, Apostoae, 2003-2004).

- *Desmochitina bulla* Taug. and De Jekh. is a marker species for the Arenigian-Llandvirnian (Upper Arenigian) limit, separated in Bohemia (Paris and Mergl, 1984) and corresponding to *Didimograptus artus* Zone. This marker species also was found in Baltic Sea region, Russian Platform, Sahara, Morocco, and in Laurentian Shield. Beside these two characteristic limit species, within the chitinozoan assemblage are also present other specific Arenigian species: *Lagenochitina esthonica*, *Conochitina raymondii*, *Fustichitina grandicula*, *Rhabdochitina magna*, *Clathrochitina oblonga*, *Lagenochitina* cf. *combazi*, *Conochitina brevis*, *Euconochitina parvicola* etc. (Olaru, Apostoae, 2004) (Plate 3 and 4).

## CONCLUSIONS

- The biostratigraphy problems and palynological correlation of Upper Formation (Tg. 4) from Tulgheş Group are difficult due to some natural causes and phenomena which stood at the basis of the evolution of this lithological unit. Among these, we remind:

- The limit stratigraphical position of this formation.

- The lack of any macrofauna fossil rests.

- The microflora mixture (acritarchs and chitinozoans) from the sedimentation phase in the marine basin.

- The subsequent influence of the metamorphism and of the successive tectonic phases on the petrographical and palynological formation, by disintegration of the organic matter, erosion and resedimentation of petrographic and organic elements, lithology reorganization of this formation.

- In spite of these difficult factors for a study of biostratigraphy and palynological correlation, we could obtain important results in order to clarify the biostratigraphy of this formation, its correlation with other regions and to define its stratigraphic position.

- This study was realized based on acritarch and chitinozoan assemblages.

- The palynological correlation took place by comparing and equivalencing the assemblages from the studied area with similar assemblages, corresponding to the already established biozones on macrofauna criteria (conodontes, graptolites, trilobites) from the classical regions on the globe: Laurentian Shiled, Baltic Shield, East-European Platform, Bohemia, Gondwanaland (Sahara, Morocco, Australia).

- As result of this synthesis study, we conclude that Upper Formation (Tg. 4) from Tulgheş Group is Arenigian (Lower Ordovician, upper part).

- Tremadocian (Lower Ordovician, lower part) is represented by numerous species of acritarchs common in the same samples with the Arenigian ones, which prove us its boundary and microflora transitory position between Cambrian and Ordovician, established in the analyzed samples.

- The correlation with Lower Ordovician formations from Baltic region and Finno-Scandinavian Shield also could be established by the presence of the intercalations of metaconglomerates, limestones and rhyolithic tuffs, all found as sedimentary formations distinct in the above mentioned regions. Also, the graphitous schists could be considered as metamorphosed rocks, similar to Ordovician Kukers schists from Baltic region (Estonia).

## REFERENCES


Achab, A. 1980, Chitinozoaires de l'Arenig inférieur de la Formation de Lévis. Quebec, Canada. *Revue Paleobotanical and Palynological,* 31: 219 – 239.

Achab, A. 1982, Chitinozoaires de l'Arenig supérieur (zone D) de la Formation de Lévis. Quebec, Canada. *Canadian Journal of Earth Scientes*, 19: 1295 – 1307.

Achab, A. 1986, Assemblages de Chitinozoaires dans l'Ordovician inférieur de l'est du Canada. *Canadian Journal of Earth Scientes*, 23: 682 – 695.

Achab, A. 1989, Ordovician chitinozoan zonation of Quebec and western Newfoundland. *Journal Paleontological*, 63: 14 - 24.

Achab, A. 1991, Biogeography of Ordovician Chitinozoa – In: Barnes, C. R. & Williams, S. H. (Eds.): Advances in Ordovician geology: 135 – 142, *Papers Geological Survey*, Canada , 90 – 9; Ottawa.

Achab, A., Millepied, P. 1980, Conochitina symmetrica. Tougourdeau et de Jekhowsky a guide fossil to the Lower Ordovician. *Fifth International Palynological Conference*, Cambridge, England, Abstract: 3.

Albani, R. 1989, Ordovician (Arenigian) acritarchs from the Solanas Sandstone Formation Central Sardinia, Italy. *Bolletino della Soc. Paleont. Ital.,* 28(1), 3-37.

Balintoni, I. 1997, Geotectonica terenurilor metamorfice din România. *Editura Carpatica*, 176 p., Cluj-Napoca.

Benoit, A., Taugourdeau 1961, Sur quelques chitinozoaires de l'Ordovicien du Sahara. *Revue de l'Institute Francese du Petrol*, 16 : 1403 – 1421.

Bockelie, T. G. 1980, Early Ordovician chitinozoa from Spitsbergen. *Palynology*, 4: 1 – 14.

Combaz, A., Péniguel, G. 1972, Étude palynostratigraphique de l'Ordovicien dans quelques sondages du bassin de Canning (Australie Occidentale). *Bulletain du Centre de Recherches de Pau*, SNPA, 6, 121 – 167.

Dean, W. T., Martin, F. 1978, Lower Ordovician acritarchs and trilobites from Bell Island, Eastern Newfoundland. *Geol. Surv.,* Canada, 284, 35 p.

Di Milia, A., Tongiorgi, M. 1993, Tremadocian acritarch assemblages from Solanas Sandstone, Formation Zone of Central Sardinia. *Geol. Soc. of Ital. Mem.,* 49, 193-204.

Eisenack, A. 1958, Mikrofossilien aus dem Ordovizium des Balticums. 1. Markasitschicht, Dictyonema – Schifer, glaukonitsand, glaukonitkalk. *Senckenbergiana Lethaea*, 39: 389 – 405.

Eisenack, A. 1962, Mikrofossilien aus dem Ordovizium des Baltikums. 2. Vaginatenkalk bis Lyckholmer Stufe. *Senckenbergiana Lethaea*, 43: 349 – 366.

Elaouad – Debbaj, Z. 1984, Acritarches et chitinozoaires de l'Arenig. Llanvirn de l'Anti-Atlas, Maroc. *Review Paleobotany and Palynology*, 43 : 67 – 88.

Elaouad – Debbaj, Z. 1987, Acritarches et chitinozoaires de l'Ordovicien du Maroc. Systématique, biostratigraphie, corrélations. *Doctoral dissertation,* 310 p., University of Rennes.

Elaouad – Debbaj, Z. 1988, Acritarches et chitinozoaires du Tremadoc de l'Anti-Atlas Central (Maroc). *Review Micropaleontology*, 31 : 85 – 128.

Grahn, Y. 1980, Early Ordovician Chitinozoa from Öland. *Sverige Geologiska Undersök*, C, 775: 1 – 41.

Grahn, Y. 1984, Ordovician Chitinozoa from Tallinn, northern Estonia. *Review Paleobotany and Palynology*, 43 : 5 – 31.

Horaicu, C. 1999, Studiul geologic, petrografic şi metalogenetic al bazinului inferior al Vaserului. Corelări şi datări pe baza asociațiilor palinologice în formațiunile metamorfice din masivul cristalin al Maramureşului. *Teză de doctorat*, Uni. ,,Al. I. Cuza'' Iaşi.

Iliescu, V., Kräutner, H. G. 1975, Contribution à la connaissance du contenu en microflore et de l'age des formation métamorphiques des Monts Rodnei et des Monts Bistriței., *Dări de Seamă ale Şedințelor Institutului de Geologie şi Geofizică a României*, LXI, 11 – 25, Bucureşti.

Iliescu, V., Kräutner, H. G., Kräutner, F., Hann, H. 1983, New palynological proofs on the Cambrian age of the Tulgheş Group (East Carpathians). *Anuarul Institutului de Geologie şi Geofizică a României*, 59, 7 – 17, Bucureşti.

Kräutner, H. G., Bindea, G. 1995, The Ditrău alkaline intrusive complex and its geological environment. *Romanian Journal*, Petrology, Bucureşti, 77, 3, 1-44.

Männil, R. 1971, Distribution of selected Ordovician chitinozoan assemblages and species in nothern Europe, and their stratigraphic evolution. *Mémoire du Bureau des Recherches Géologiques et Miniére*, 73: 309 – 311.

Männil, R. 1990, The Ordovician of Estonia, In: Kaljo, D. & Nestor, H. (ed.) Field meeting Estonia 1990. An Excursion Guidebook, *Estonian Academy Sciences Institut Geology*, 11 – 20.

Marhoumi, M. R., Rauscher, R., Vanguestaine, M. 1982, Les microfossiles (Chitinozoaires et Acritarches) des schistes du Tazekka au Maroc oriental. *Sciences Geologiques Bulletin*, 35 (3) : 137 – 145.

Martin, F. 1973, Les Acritarches de l'Ordovicien inférieur de la Montagne Noire (Hérault, France). *Bull. Inst. Royal des Sci. Nat. de Belgique*, 48(10), 61 p.

Martin, F. 1975, Sur quelques Chitinozoaires ordoviciens du Québéc et de Ontario, Canada. *Canadian Journal of Earth Scientes*, 12 (6): 1006 – 1018.

Martin, F. 1977, Acritarches du Cambro-Ordovicien du Massif du Brabant, Belgique. *Bull. Inst. Royal des Sci. Nat. de Belgique*, 51(1), 33 p.

Martin, F. 1978, Lower Paleozoic Chitinozoa and Acritarcha from Newfoundland. *Curr. Res. B. Geological Survey of Canada*, 78 1 B: 73 – 81.

Martin, F. 1982, Some aspects of the late Cambrian and early Ordovician acritarchs. *In: Basset G. M., Dean W. T; The Cambrian – Ordovician boundary*: sections fossil distributions, and correlation, National Museum of Wales, Geological series 3, Cardiff, 29-40.

Martin, F. 1993, Acritarchs. *A review Biol. Rev. 68,* Great Britain, 475-538.

Martin, F., Dean W. T. 1981, Middle and Upper Cambrian and Lower Ordovician acritarchs from Random Island, Eastern Newfoundland. *Geological Survey of Canada*, Bulletin 343, 43 p.

Nõlvak, J., Grahn, Y. 1993, Ordovician chitinozoan zones from Baltoscandia. *Review Paleobotany and Palynology*, 79 : 245 – 269.

Obut, A. M. 1973, On the geographical distribution, comparative morphology, ecology, phylogeny and systematic position of Chitinozoa, In: Betekhtina O. A., Zhuravleva I. T. (ed.). Environment and life in the geological past. Akademia Nauk, SSSR, Sibirskoi Otdelenie, *Trudy Instituta Gheologhii i Gheofiziki*, 169: 72 – 84, 148 – 152, 166 – 174.

Olaru, L. 1991, Stratigraphical evolution of the palynological assemblages from the crystalline formations of the Romanian East Carpathians and the correlation with other areas from Europe. *Evolution and Adaptation*, 4, 77 – 87, Cluj-Napoca.

Olaru, L. 2001, Using acritarch assemblages to correlate Upper Proterozoic and Lower Paleozoic metamorphic sequences in Romania. *Proceedings of IX$^{th}$ I.P.C.*, Houston, Texas, A.A.S.P. Foundation, Dallas, Texas, USA, 115 – 127.

Olaru, L., Gunia T. 1988, Palynological correlations between the Cambrian formation of the Sudetic Mountains (Poland) and the East Carpathians (Romania). *Analele Ştiințifice ale Universității ,,A. I. Cuza'' Iaşi*, II b, Geologie-Geografie, XXXIV, 23 – 31, Iaşi.

Olaru, L., Horaicu, C. 1989, Considerations on the biostratigraphy of the Tulghes Group of the Romanian East Carpathians, by palynological data. *XIV$^{th}$ Congress C.B.G.A.*, Sofia.

Olaru, L., Apostoae, L. 1995, La presence de quelques acritarches dans le group de Tulghes (Tg. 3 – La zone Balan, Carpates Orientales). *Analele Ştiințifice ale Universității ,,Al. I. Cuza'' Iaşi*, geologie, XL – XLI, Iaşi.

Olaru, L., Apostoae, L., Apostoae, Liliana 2003 – 2004, Contributions à l'étude palynologique de la formation superieure (Tg. 4) de la region de Balan (Carpates Orientale, Roumanie). *Anal. Şt. Univ. „Al. I. Cuza" Iaşi,* Geol., XLIX – L, 133 – 160, Iaşi.

Paris, F. 1981, Les Chitinozoaires dans le Paléozoique du sud – ouest de l'Europe (Cadre géologique – Etude systématique – Biostratigraphie). *Mémoire de la Societé Geologique et Miniere de Bretagne*, 26, 1 – 496.

Paris, F. 1990, The Ordovician chitinozoan biozones of the Northem Gondwana Domain. *Review Paleobotany and Palynology*, 66, 181 – 209.

Paris, F. 1992, Application of chitinozoan in long-distance Ordovician correlations. In: Webby, B. D., Laurie, J. R. (ed.), *Global perspectives on Ordovician Geology*, Balkema, 23 – 33, Rotterdam.

Paris, F. 1996, Chitinozoan biostratigraphy and palaeoecology. In: Jansonius, J., Mc Gregor, D. C. (ed.) Palynology: principles and applications. *A.A.S.P. Foundation*, 2, 531 – 552.

Paris, F., Mergl, M. 1984, Arenigian chitinozoans from Klabava Formation, Bohemia. *Review Paleobotany and Palynology*, 43 : 33 – 65.

Parsons, G. M., Anderson, M. M. 2000, Acritarch microfloral succesion from the Late Cambrian and Ordovician (Early Tremadoc) of Random Island, Eastern Newfoundland, and its comparison to coeval microfloras, particularly those of the East European Platform. *A.A.S.P. Contributions Series,* no. 38, Dallas, Texas, 129 p.

Playford, G., Martin, F. 1984, Ordovician acritarchs from the Canning Basin, Western Australia. *Alcheringa*, 8(3), 187-223.

Rauscher, R. 1968, Chitinozoaires de l'Arenig de la Montagne Noire (France). *Revue de Micropaleontologie*, 11, 1, 51 – 60.

Ribecai, C., Bruton, D. L., Tongiorgi, M. 1999, Acritarchs from the Ordovician of the Oslo Region, Norway. *Norsk. Geologisk Tidssekrift,* Oslo, 251-258.

Samuelsson, J., Vernier, J. 2000, Ordovician chitinozoan biozonation of the Brabant Massif, Belgium. *Review Paleobotany and Palynology*, 111 : 105 – 129.

Samuelsson, J., Servais, Th. 2001, Chitinozoa biostratigraphy of subsurface Ordovician sediments from the Lohme 2/70 well, Island of Rügen (NE Germany), *N. Jb. Geol. Paläon. Abh.*, 222 (1/2): 73 – 90, Stuttgart.

Samuelsson, J. **,** Vecoli, M., Bednarczyk, W.S., Verniers, J . 2002. Timing of the Avalonia-Baltica plate convergence as inferred from palaeogeographic and stratigraphic data of chitinozoan assemblages in West Pomerania, northern Poland . In: Winchester , J.A., Pharaoh T.C. & Verniers, J. (Editors) Palaeozoic Amalgamation of Central Europe . *Geological Society, London , Special Publications* 201 , 95-113.

Soufiane, A., Achab, A. 1993, Quelques assemblages de chitinozoaires de l'Ordovicien de Maroc, Bassin de Tadla. *GEOBIOS*, 26, 5 : 535 – 553.

Taugourdeau, Ph. 1965, Chitinozoaires de l'Ordovicien des U.S.A. Comparaison avec les faunes de l'ancien monde. *Revue du Institute Française du Petrol et Annuaire du Combustible liquide* , 20, 3, 463 – 485, Paris.

Tongiorgi, M., Bruton, D. L., Di Milia, A. 2003, Taxonomic composition and palaebiogeographic significance of the acritarch assemblages from Tremadoc-Arenig (Hunneberg, Billingen, and lower Volkov Stages) of the Oslo Region. *Bollettino della Soc. Paleont. Ital.* 42 (3), Modena, 205 – 224.

Umnova, N. I. 1969, Distribution of chitinozoa in the Ordovician of the Russian Platform. *Paleontol. J.*, 3: 45 – 62.

Vaida, M. 1999, Datarea şi corelarea pe baza asociaţiilor palinologice a formaţiunilor cristalofiliene şi mineralizaţiilor asociate din partea sudică a masivului cristalin al Carpaţilor Orientali şi partea estică a Carpaţilor Meridionali. *Teză de doctorat*. Universitatea ,,Al. I. Cuza'' Iaşi.

Vanguestaine, M. 1986, Progrès récents de la stratigraphie par Acritarches du Cambro-Ordovicien d'Ardenne, d'Irelande, d'Angleterre, du Pays de Galles et de Terre-Neuve orientale. *Soc. Géol. du Nord*, Annales, 105, 65-76.

Vanguestaine, M. 1992, Biostratigraphie par acritarches du Cambro-Ordovicien de Belgique et des regions limitrophes> synthese et perspectives d'avenir. *Annales de la Soc. Géol. de Belgique*, 115(1), 1-18.

Vavrdova, M. 1965, Ordovician acritarchs from Central Bohemia. *Vestnik Ustredniho Ustavu Geologickeho,* 40, 351-357.

Vodă, A. 1986, Central East Carpathians Formations in the Broşteni-Borca Region. *Dări de Seamă ale Şedinţelor Institutului de Geologie şi Geofizică a României*, 70 – 71/5, 269 – 275.

Vodă, A. 2000, Sinteza zonei cristalino-mezozoice a Carpaţilor Orientali. Date regionale. Geologie şi metalogeneză regională. Tema V/15 – 1997, *S.C. ,,Prospecţiuni'' S.A.,* 171 p., Bucureşti.

Vodă, A., Balintoni, I. 1996, Corelări litostratigrafice în cristalinul Carpaţilor Orientali. *Studia Universitatis ,,Babeş-Bolyai''*, Geologie, XXXIX/ 1 – 2, 61 – 66, Cluj-Napoca.

Volkova, N. A. 1988, Novâe vidî akritarch iz Nijnego Tremadoka Estonii. *Palinologhia v SSSR, Izd. „Nauka"*, Novosibirsk, 79-82.

Volkova, N. A. 1989, Akritarhi pogranicinâh otlojenii Kembria i Ordovika Severa Estonii. *Izv. Akad. Nauk. SSSR*, 7, Moskva, 59-67.

Volkova, N. A. 1990, Middle and Upper Cambrian acritarchs in the East-European Platform. *Trudy Geologicheskii Institut Academija Nauk SSSR*, 454, 116 p.

Volkova, N. A., Mens, K. 1988, Distribution of acritarchs in the Cambrian-Ordovician boundary beds of the Suhkrumägi section (North-Estonia). *Proceed. Of the Acad. of Sci. of the Estonian SSR*, Geology, 37, 97-102.

## EXPLANATION OF PLATES

### PLATE I

1. *Leiosphaeridia* sp. A (2 specimens)
2. *Acanthodiacrodium angustum* (Downie) Combaz
3. *Acanthodiacrodium angustum* (Downie) Combaz
4. *Arbusculidium* cf. *destombesii* Deunff
5. *Dactylofusa squama* (Deunff) Martin
6. *Dactylofusa velifera* Cocchio
7. *Lunulidia lunula* Eisenack
8. *Dactylofusa squama* (Deunff) Martin
9. *Lunulidia lunula* Eisenack
10. *Cymatiogalea* cf. *cuvillieri* (Deunff) Martin
11. *Baltisphaeridium setaceum* (Timofeev) Martin
12. *Baltisphaeridium aciculare* (Timofeev) Martin
13. *Acanthodiacrodium lanatum* (Timofeev) Martin
14. *Pirea orbicularis* Volkova
15. *Pirea cf. orbicularis* Volkova
16. *Pirea* sp.
17. *Dactylofusa* cf. *squama* (Deunff) Martin
18. *Poikilofusa squama* (Deunff) Martin
19. *Dactylofusa squama* (Deunff) Martin

All figures increased by 1000 X

### PLATE II

1. *Orthosphaeridium extensum* Parsons & Anderson
2. *Leiofusa stoumonensis* Vanguestaine
3. *Veryhachium* cf. *dumontii* Vanguestaine
4. *Acanthodiacrodium angustum* (Downie) Combaz
5. *Leiosphaeridia* sp. A
6. *Cymatiosphaera deunffi* Jardiné et al.
7. *Ooidium* cf. *clavigerum* Parsons & Anderson
8. *Saharidia* cf. *fragilis* (Downie) Combaz
9. *Dactylofusa velifera* Cocchio
10. *Leiosphaeridia* sp. A
11. *Veryhachium dumontii* Vanguestaine
12. *Leiospharidia* sp. B (3 specimens)
13. *Cristallinium* cf. *cambriense* Slaviková
14. *Acanthodiacrodium golubii* Fensome et al.
15. *Vulcanisphaera* cf. *britannica* Rasul
16. *Coryphidium* aff. *bohemicum* Vavrdová
17. *Veryhachium dumontii* Vanguestaine
18. *Baltisphaeridium crinitum* Martin
19. *Buedingiisphaeridium tremadocum* Rasul
20. *Acanthosphaeridium angustum* (Downie) Combaz
21. *Lunulidia lunula* (Eisenack) Eisenack

All figures increased by 1000 X

### PLATE III

1. *Lagenochitina esthonica* Eisenack (39 x 23 µm); sample no. 1, black quartzites, Şindrila de Sus Brook, Pârâul Crucii Member, Sândominic Formation.
2. *Lagenochitina esthonica* Eisenack (39 x 26 µm); sample no. 3, grey phyllites, Fagul Înalt Brook, Pârâul Crucii Member, Sândominic Formation.
3. *Lagenochitina esthonica* Eisenack (36 x 23 µm); sample no. 3, grey phyllites, Fagul Înalt Brook, Pârâul Crucii Member, Sândominic Formation.
4. *Lagenochitina esthonica* Eisenack (38 x 26 µm); sample no. 3, grey phyllites, Fagul Înalt Brook, Pârâul Crucii Member, Sândominic Formation.

5. *Lagenochitina esthonica* Eisenack (43 x 23 μm); sample no. 5, grey phyllites, Pârâul Scurt Brook, Pârâul Crucii Member, Sândominic Formation.
6. *Lagenochitina esthonica* Eisenack (38 x 24 μm); sample no. 3, grey phyllites, Fagul Înalt Brook, Pârâul Crucii Member, Sândominic Formation.
7. *Lagenochitina esthonica* Eisenack (37 x 24 μm); sample no. 4, black quartzites, Babaşa Brook, Pârâul Crucii Member, Sândominic Formation.
8. *Lagenochitina esthonica* Eisenack (38 x 27 μm); sample no. 4, black quartzites, Babaşa Brook, Pârâul Crucii Member, Sândominic Formation.
9. *Lagenochitina esthonica* Eisenack (40 x 28 μm); sample no. 4, black quartzites, Babaşa Brook, Pârâul Crucii Member, Sândominic Formation.
10. *Lagenochitina esthonica* Eisenack (38 x 23 μm); sample no. 9, black graphitous phyllites with intercalations of black quartzites, Pârâul Crucii Member, Sândominic Formation.
11. *Lagenochitina esthonica* Eisenack (39 x 24 μm); sample no. 5, grey phyllites, Pârâul Scurt Brook, Pârâul Crucii Member, Sândominic Formation.
12. *Lagenochitina esthonica* Eisenack (43 x 27 μm); sample no. 5, grey phyllites, Pârâul Scurt Brook, Pârâul Crucii Member, Sândominic Formation.
13. *Lagenochitina esthonica* Eisenack (35 x 21 μm); sample no. 9, black graphitous phyllites with intercalations of black quartzites, Pârâul Crucii Member, Sândominic Formation.
14. *Lagenochitina esthonica* Eisenack (47 x 28 μm); sample no. 4, black quartzites, Babaşa Brook, Pârâul Crucii Member, Sândominic Formation.
15. *Desmochitina bulla* Taug. & Jekh. (20 x 15 μm); sample no. 1, black quartzites, Şindrila de Sus Brook, Pârâul Crucii Member, Sândominic Formation.
16. *Desmochitina bulla* Taug. & Jekh. (22 x 18 μm); sample no. 3, grey phyllites, Fagul Înalt Brook, Pârâul Crucii Member, Sândominic Formation.
17. *Desmochitina bulla* Taug. & Jekh. (17 x 12 μm); sample no. 3, grey phyllites, Fagul Înalt Brook, Pârâul Crucii Member, Sândominic Formation.
18. *Desmochitina bulla* Taug. & Jekh. (17 x 13 μm); sample no. 6, grey sericitous-graphitous phyllites, Şipoş Valley, Başca Member, Sândomonic Formation.
19. *Desmochitina bulla* Taug. & Jekh. (15 x 10 μm); sample no. 9, black graphitous phyllites with intercalations of black quartzites, Pârâul Crucii Member, Sândominic Formation.
20. *Conochitina symmetrica* Taug. & Jekh. (46 x 31 μm); sample no. 3, grey phyllites, Fagul Înalt Brook, Pârâul Crucii Member, Sândominic Formation.
21. *Conochitina symmetrica* Taug. & Jekh. (47 x 32 μm); sample no. 3, grey phyllites, Fagul Înalt Brook, Pârâul Crucii Member, Sândominic Formation.
22. *Conochitina symmetrica* Taug. & Jekh. (45 x 30 μm); sample no. 4, black quartzites, Babaşa Brook, Pârâul Crucii Member, Sândominic Formation.
23. *Conochitina symmetrica* Taug. & Jekh. (47 x 33 μm); sample no. 5, grey phyllites, Pârâul Scurt Brook, Pârâul Crucii Member, Sândominic Formation.
24. *Conochitina symmetrica* Taug. & Jekh. (52 x 35 μm); sample no. 6, grey sericitous-graphitous phyllites, Şipoş Valley, Başca Member, Sândomonic Formation.

Without dimensions scale

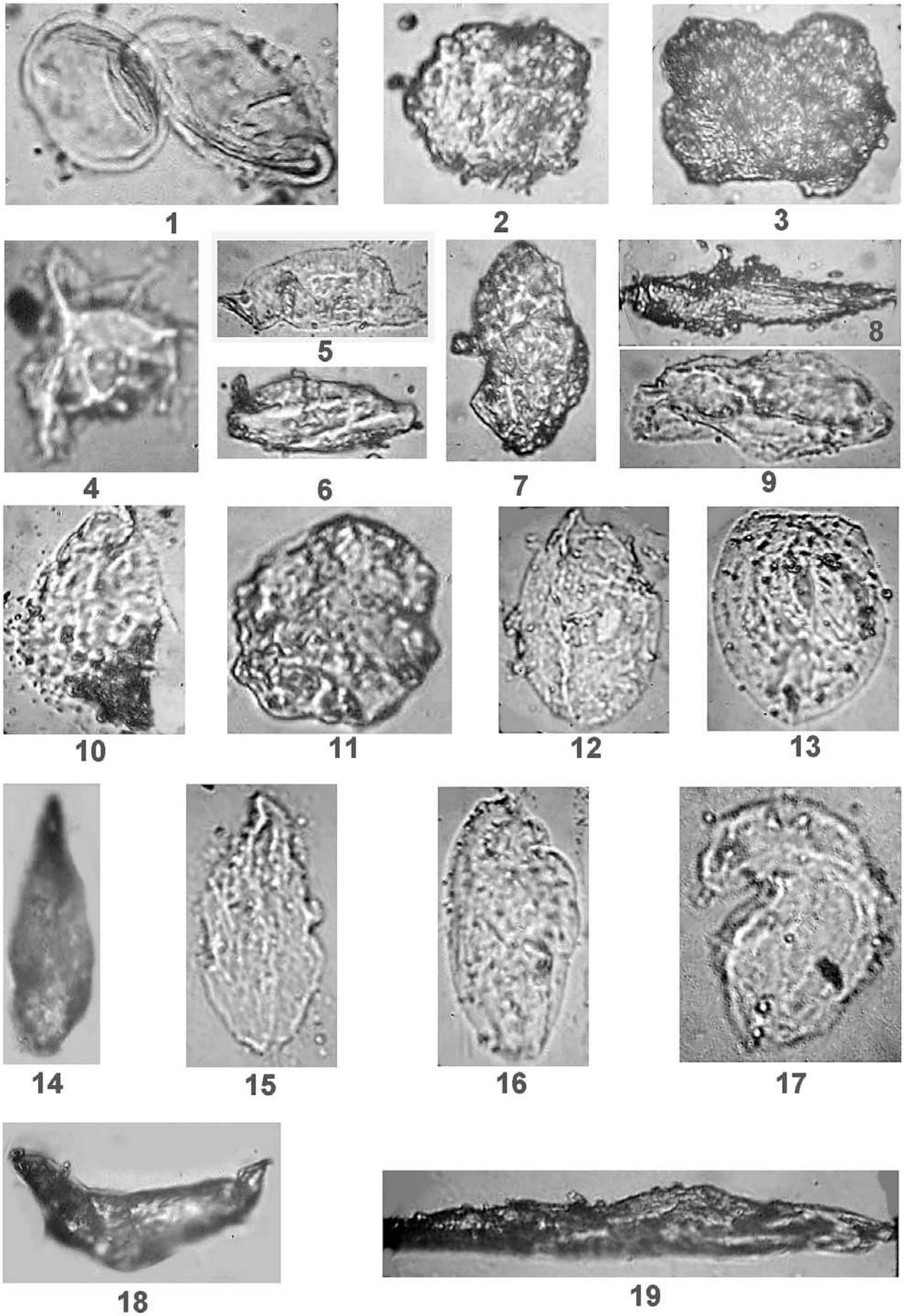
**PLATE IV**

1. *Conochitina symmetrica* Taug. & Jekh. (47 x 33 μm); sample no. 9, black graphitous phyllites with intercalations of black quartzites, Pârâul Crucii Member, Sândominic Formation.
2. *Conochitina symmetrica* Taug. & Jekh. (46 x 30 μm); sample no. 9, black graphitous phyllites with intercalations of black quartzites, Pârâul Crucii Member, Sândominic Formation.
3. *Conochitina symmetrica* Taug. & Jekh. (46 x 34 μm); sample no. 9, black graphitous phyllites with intercalations of black quartzites, Pârâul Crucii Member, Sândominic Formation.
4. *Fustichitina grandicula* Achab (77 x 20 μm); sample no. 1, black quartzites, Şindrila de Sus Brook, Pârâul Crucii Member, Sândominic Formation.
5. *Fustichitina grandicula* Achab (76 x 19 μm); sample no. 1, black quartzites, Şindrila de Sus Brook, Pârâul Crucii Member, Sândominic Formation.
6. *Rhabdochitina magna* Eisenack (87 x 18 μm); sample no. 1, black quartzites, Şindrila de Sus Brook, Pârâul Crucii Member, Sândominic Formation.
7. *Rhabdochitina magna* Eisenack (101 x 16 μm); sample no. 9, black graphitous phyllites with intercalations of black quartzites, Pârâul Crucii Member, Sândominic Formation.
8. *Clavachitina decipiens* Taug. & Jekh. (54 x 30 μm); sample no. 3, grey phyllites, Fagul Înalt Brook, Pârâul Crucii Member, Sândominic Formation.
9. *Clavachitina decipiens* Taug. & Jekh. (53 x 31 μm); sample no. 1, black quartzites, Şindrila de Sus Brook, Pârâul Crucii Member, Sândominic Formation.

10. *Conochitina decipiens* Taug. & Jekh. (49 x 23 µm); sample no. 3, grey phyllites, Fagul Înalt Brook, Pârâul Crucii Member, Sândominic Formation.
11. *Conochitina decipiens* Taug. & Jekh. (48 x 23 µm); sample no. 3, grey phyllites, Fagul Înalt Brook, Pârâul Crucii Member, Sândominic Formation.
12. *Conochitina decipiens* Taug. & Jekh. (47 x 23 µm); sample no. 3, grey phyllites, Fagul Înalt Brook, Pârâul Crucii Member, Sândominic Formation.
13. *Conochitina decipiens* Taug. & Jekh. (43 x 23 µm); sample no. 3, grey phyllites, Fagul Înalt Brook, Pârâul Crucii Member, Sândominic Formation.
14. *Clavachitina decipiens* Taug. & Jekh. (52 x 30 µm); sample no. 4, black quartzites, Babaşa Brook, Pârâul Crucii Member, Sândominic Formation.
15. *Clavachitina decipiens* Taug. & Jekh. (54 x 33 µm); sample no. 9, black graphitous phyllites with intercalations of black quartzites, Pârâul Crucii Member, Sândominic Formation.
16. *Conochitina decipiens* Taug & Jekh. (46 x 23 µm); sample no. 1, black quartzites, Şindrila de Sus Brook, Pârâul Crucii Member, Sândominic Formation.
17. *Lagenochitina* cf. *combazi* Finger (29 x 18 µm); sample no. 1, black quartzites, Şindrila de Sus Brook, Pârâul Crucii Member, Sândominic Formation.
18. *Lagenochitina* cf. *combazi* Finger (19 x 11 µm); sample no. 5, grey phyllites, Pârâul Scurt Brook, Pârâul Crucii Member, Sândominic Formation.
19. *Lagenochitina* cf. *combazi* Finger (18 x 10 µm); sample no. 9, black graphitous phyllites with intercalations of black quartzites, Pârâul Crucii Member, Sândominic Formation.
20. *Euconochitina brevis conica* (Taug. & Jekh.) (40 x 20 µm); sample no. 3, grey phyllites, Fagul Înalt Brook, Pârâul Crucii Member, Sândominic Formation.
21. *Euconochitina brevis conica* (Taug. & Jekh.) (40 x 20 µm); sample no. 3, grey phyllites, Fagul Înalt Brook, Pârâul Crucii Member, Sândominic Formation.
22. *Euconochitina parvicola* (Taug.) (23 x 19 µm); sample no. 3, grey phyllites, Fagul Înalt Brook, Pârâul Crucii Member, Sândominic Formation.
23. *Conochitina raymondii* Achab (57 x 17 µm); sample no. 3, grey phyllites, Fagul Înalt Brook, Pârâul Crucii Member, Sândominic Formation.
24. *Conochitina raymondii* Achab (55 x 19 µm); sample no. 3, grey phyllites, Fagul Înalt Brook, Pârâul Crucii Member, Sândominic Formation.
25. *Conochitina raymondii* Achab (38 x 20 µm); sample no. 4, black quartzites, Babaşa Brook, Pârâul Crucii Member, Sândominic Formation.
26. *Conochitina raymondii* Achab (46 x 21 µm); sample no. 6, grey sericitous-graphitous phyllites, Şipoş Valley, Başca Member, Sândomonic Formation.
27. *Conochitina raymondii* Achab (37 x 20 µm); sample no. 9, black graphitous phyllites with intercalations of black quartzites, Pârâul Crucii Member, Sândominic Formation.
28. *Conochitina kryos* Bockelie (72 x 25 µm); sample no. 9, black graphitous phyllites with intercalations of black quartzites, Pârâul Crucii Member, Sândominic Formation.
29. *Lagenochitina brevicollis* (Taug. & Jekh.) (43 x 28 µm); sample no. 3, grey phyllites, Fagul Înalt Brook, Pârâul Crucii Member, Sândominic Formation.
30. *Lagenochitina brevicollis* (Taug. & Jekh.) (42 x 31 µm); sample no. 5, grey phyllites, Pârâul Scurt Brook, Pârâul Crucii Member, Sândominic Formation.
31. *Conochitina brevis* Taug. & Jekh. (37 x 25 µm); sample no. 9, black graphitous phyllites with intercalations of black quartzites, Pârâul Crucii Member, Sândominic Formation.
32. *Clathrochitina oblonga* Ben. & Taug. (46 x 30 µm); sample no. 9, black graphitous phyllites with intercalations of black quartzites, Pârâul Crucii Member, Sândominic Formation.
33. *Lagenochitina brevicollis* (Taug. & Jekh.) (43 x 24 µm); sample no. 9, black graphitous phyllites with intercalations of black quartzites, Pârâul Crucii Member, Sândominic Formation.
34. *Lagenochitina* cf. *combazi* Finger (23 x 18 µm); sample no. 6, grey sericitous-graphitous phyllites, Şipoş Valley, Başca Member, Sândomonic Formation.
35. *Lagenochitina* cf. *combazi* Finger (30 x 23 µm); sample no. 5, grey phyllites, Pârâul Scurt Brook, Pârâul Crucii Member, Sândominic Formation.

Without dimensions scale

## PLATE I



# PLATE II

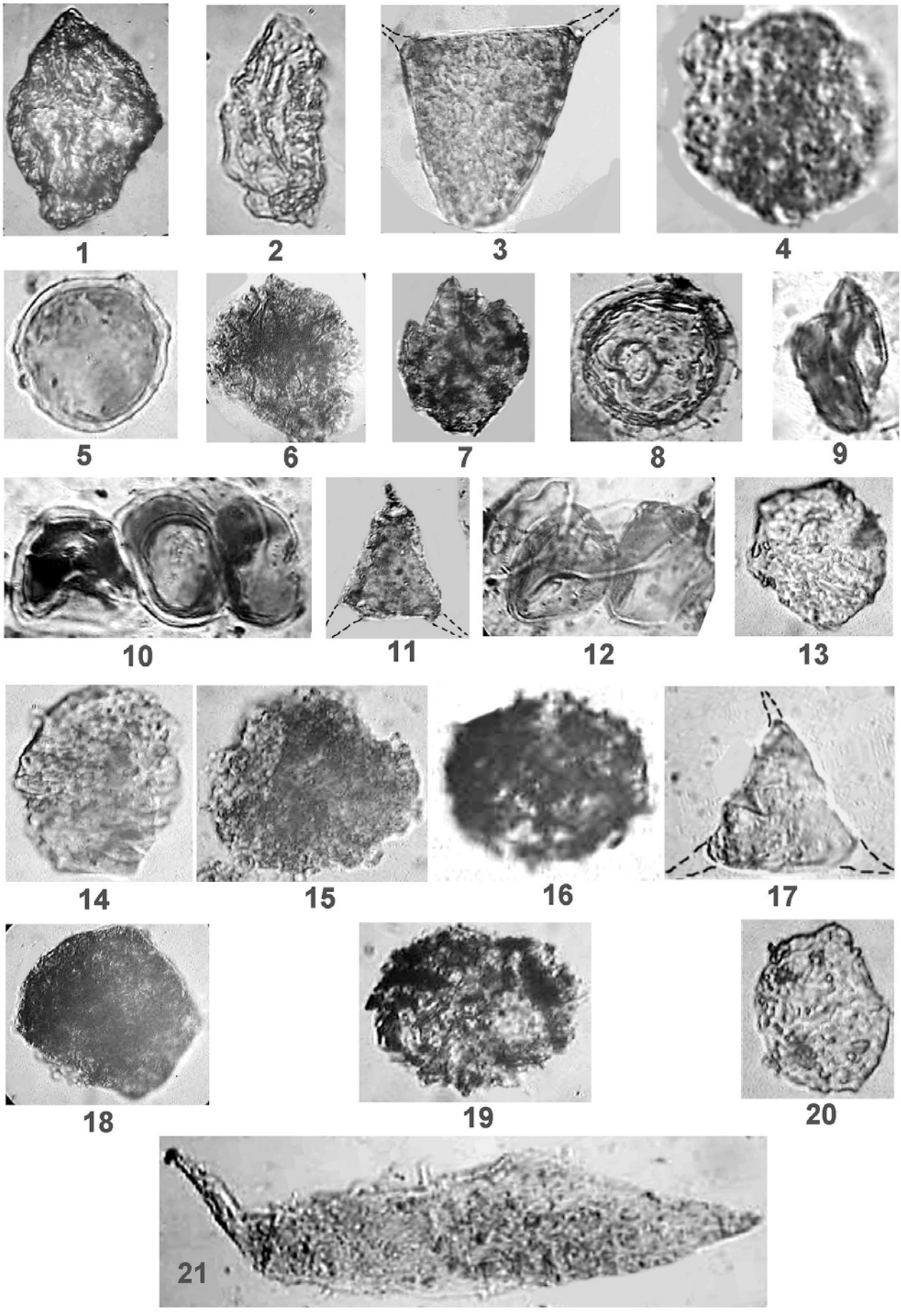
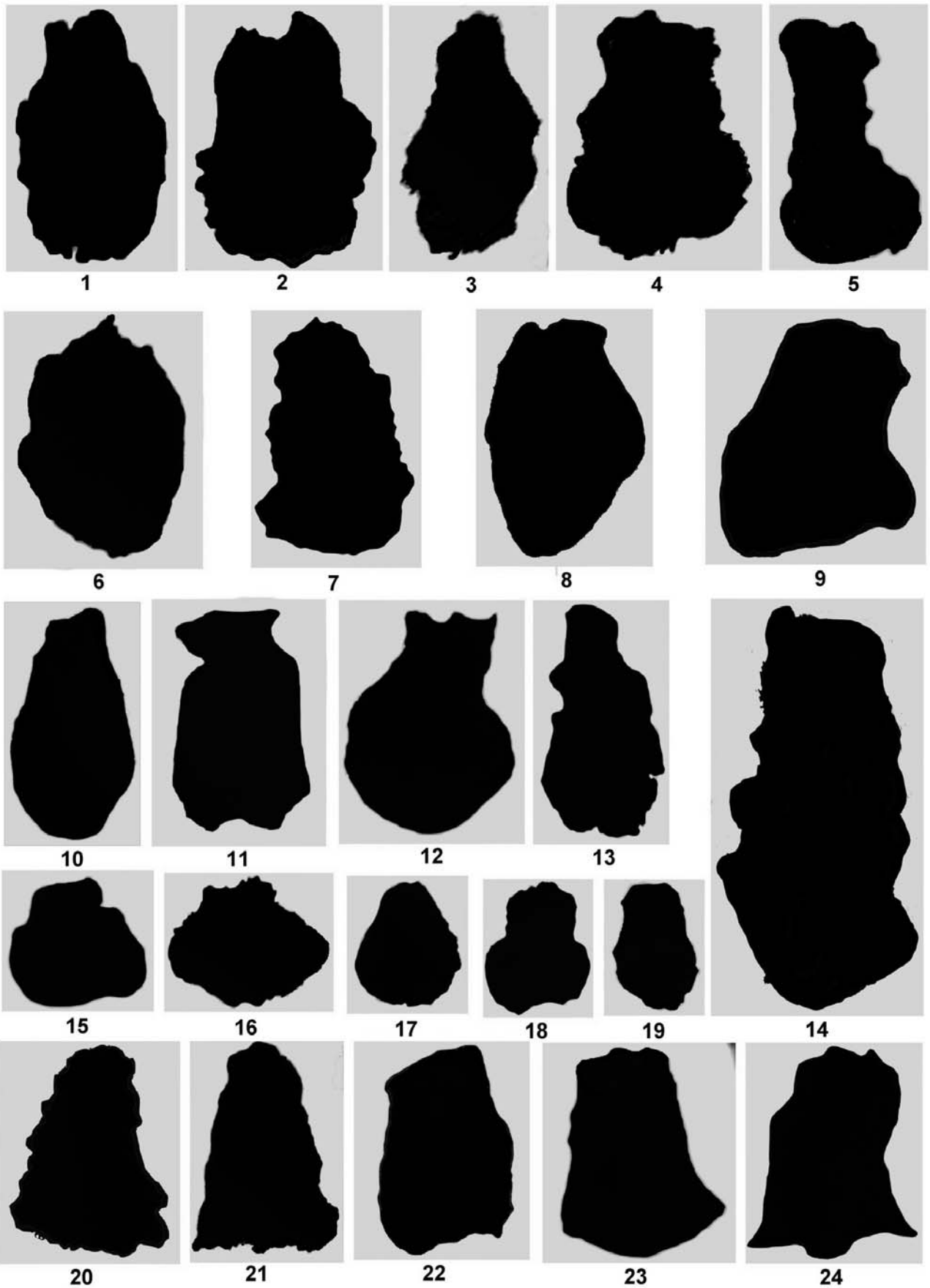


**PLATE III**



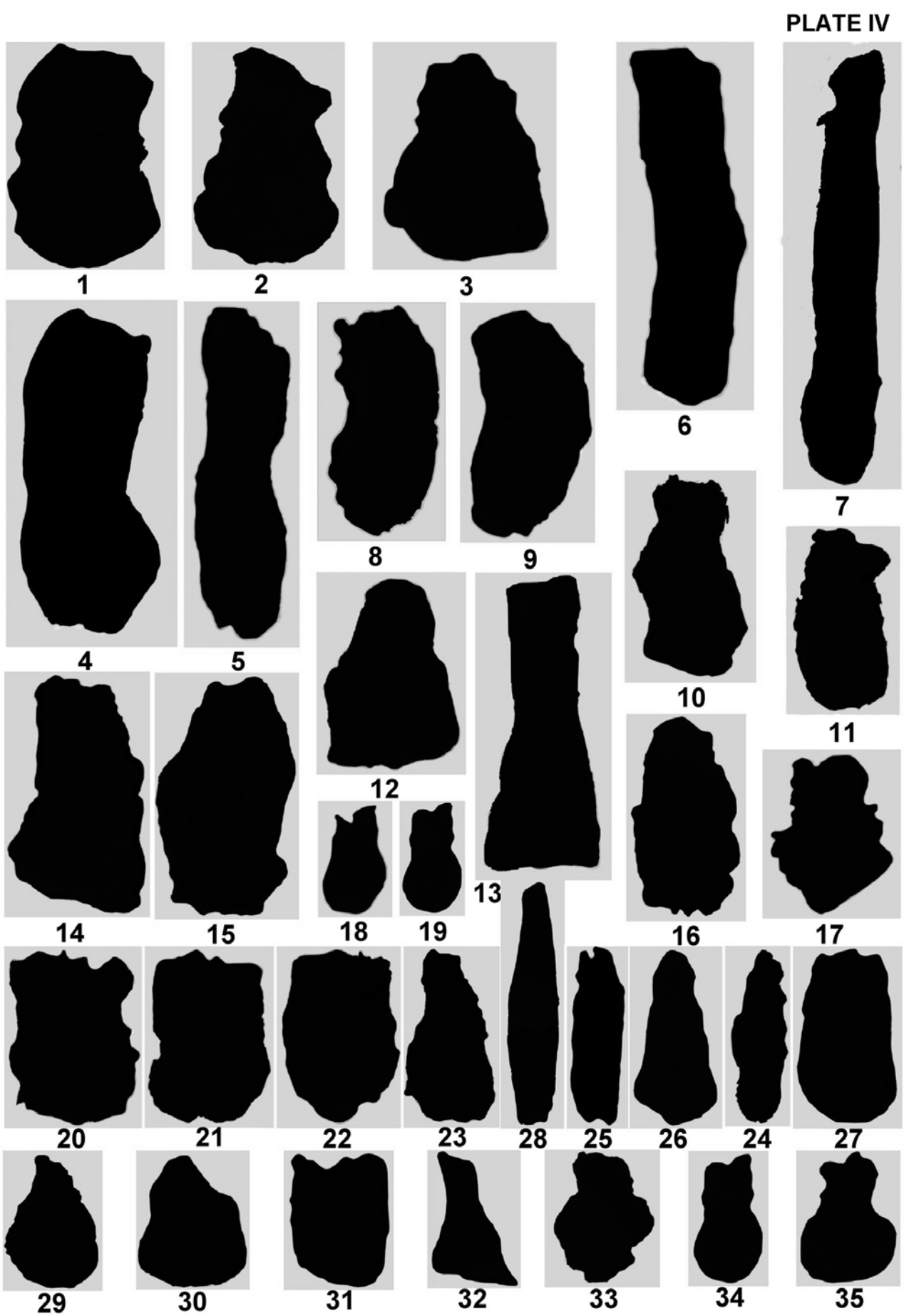


PLATE IV
1
2
3
6
7
8
9
4
5
10
11
12
13
14
15
18
19
16
17
20
21
22
23
28
25
26
24
27
29
30
31
32
33
34
35