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ARENIGIAN CHITINOZOANS FROM THE TULGHES GROUP, UPPER FORMATION (TG. 4) FROM BALAN ZONE, EASTERN CARPATHIANS, ROMANIA

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Abstract. There been analyzed the samples collected from Balan Nappe and Sandominic Nappe, from the Tulghes Group, Upper Formation (Tg. 4) from the Balan Zone. From the lithological succession of rocks and from palynological point of view, sericitous graphitous phyllites, black quartzites and grey sericitous schists had been analyzed, offering interesting chitinozoan assemblages. We notice the presence of some species such as *Lagenochitina esthonica, Conochitina symmetrica, Fustichitina grandicula, Rhabdochitina magna, Conochitina raymondii, Lagenochitina* cf. *combazi, Lagenochitina brevicollis, Desmochitina bulla*, all specific for the Arenigian age. The presence of these species does allow a correlation with similar assemblage from the Baltic Shield, Eastern European Platform, Laurentian Shield and Gondwanaland.

Keywords: Palynology, Chitinozoans, Tulghes Group, Eastern Carpathians, Romania.

INTRODUCTION

Tulgheş Group has a large spreading in Eastern Carpathians, starting in north in Maramureş Mountains down to south in Perşani Mountains. Its formations occur like stripes with small widths and lengths of tens of kilometers, being present in the basement of Central - Eastern Carpathians upper nappes, such as Bucovinic Nappe and Subbucovinic Nappe (Balintoni et al., 1983; Balintoni, 1997; Vodă, Balintoni, 1996; Vodă & Munteanu, 1996). Not all the formations of Tulgheş Group are presented simultaneously within the spreading areas of the above-mentioned nappes. The most complete lithological succession for the formations of Tulgheş Group is known in Broşteni region from Bistriţa Mountains (Vodă,1986; Kräutner, et al., 1986 fide Berbeleac, 1988; Kräutner, et al., 1992., Kräutner, Bindea, 1995). Concerning the age of the formations of Tulgheş Group, there had been some interesting studies, which, based on different acritarcha taxa, assigned them ages starting with Vendian - Lower Cambrian to Middle – Upper Cambrian for the entire lithological succession of Tulgheş Group (Iliescu, Mureşan, 1972; Iliescu & Kräutner 1975; Iliescu et al., 1983; Olaru, Gunia 1988; Olaru, Horaicu, 1989; Olaru, Apostoae, 1995; Horaicu, 1999; Olaru, 1991; Olaru, 2001). In a recent paper, Vaida (1999) emphasized, besides acritarchs, some chitinozoan taxa in the phyllitous quartzitic Upper Formation (Tg 4) of Tulgheş Group. At the lower part of this chitinozoan assemblage, more generically different and less specifically, the author sustains for this formation, from Bălan area, Lower Ordovician age.

Due to some doubts concerning the age of the Upper Formation (Tg 4) from Tulgheş Group and to the lack of some complete palynological data to argue this age, our study brings important arguments in order to clarify this problem. The contributions of our study are based on the separation and analyze of a rich chitinozoan assemblage, coming from the Upper Formation (Tg 4) from Bălan and Sândominic Nappes, Bălan region, Eastern Carpathians. Based on this rich chitinozoan assemblage, we consider that the age of the Upper Formation (Tg 4) of Tulgheş Group is Arenigian (Lower Ordovician). Considering these results, some biostratigraphical correlations were also made with classic regions from different areas of Europe, North America, Africa and Australia.

GEOLOGICAL CHARACTERIZATION OF THE STUDIED AREA

Within Tulgheş Group from Bălan area (Central part of Eastern Carpathians), two tectonic units were separated, from the Upper Formation (Tg 4), represented by Bălan Nappe and Sândominic Nappe (Vodă, 1986; Kräutner et al., 1986 fide Berbeleac, 1988; Kräutner et al., 1992; Kräutner, Bindea, 1995).

Bălan Nappe. From this tectonic unit, only the Upper Formation (Tg. 4) had been palinologically studied. From lithological point of view, this formation is represented by Arama Oltului Member with 800-900 m in thickness (Fig. 1). Chloritous-phyllitous, quartzitic, graphitous schists, with quartzite intercalations, microconglomerates, green schists, rhyolithic metatuffs with disseminate pyrite levels dominate the lithological composition. The samples for the palynological analyses were yielded only from chloritous-sercitous, graphitous schists.

Sândominic Nappe. The lithological composition of Sândominic Nappe is more complex, represented by three members (Fig. 2): Fundul Moldovei Member (300-400 m thick), Başca Member (600-1200 m thick) and Pârâul Crucii Member (1000-1500 m thick). In this geological formation (Tg 4) of Tulgheş Group from Sândominic Nappe, grey sercitous-chloritous phyllites dominate. Green schists and metabazites, black quartzites, white quartzites, graphitous phyllites, metaconglomerates and black quartzites are found subordinately or as intercalations. In addition, acid (rhyolitic) metavulcanites intercalations and limestones appear. The samples for the palynological analyses were yielded from grey chloritous-sericitous phyllites and

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black quartzites.

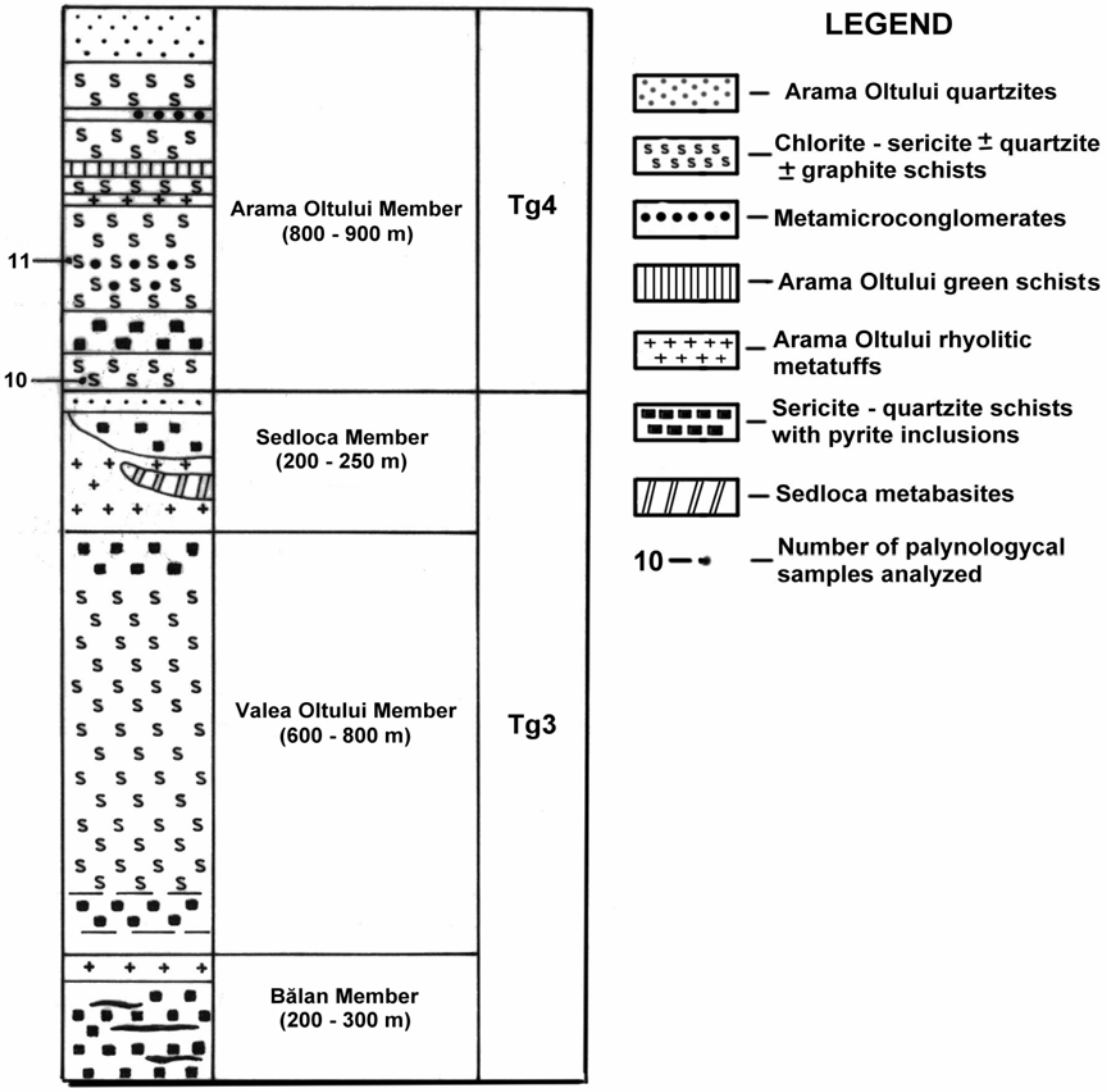

Figure 1. Geological column of the Upper Tulghes Formation (Tg4, Tulghes Group) from the Balan Nappe (after Kräutner & Bindea, 1995).

The most productive samples - from palynologically (chitinozoans) point of view - come from phyllites, followed in descendent order by black quartzites and chloritous-sericitous schists. Perhaps the sedimentary environment was the main factor of this organic mass distribution. Some basin analysis data within the sedimentary geotectonic context for terrigenous deposits of Tulgheş Group point out the enormous pyroclastic and terrigenous material quantity deposited on the bottom during an increased subsidence of the sedimentary basin. This fact is more obvious during deposition of acid metavulcanite formation, which influenced both the lithological sequence composition and the following evolution conditions of the sedimentary basin (Vodă, 2000). After volcanic processes ended, namely during the deposition of the Upper Formation (Tg 4) of Tulgheş Group, the sedimentation had the same aspect, with domination of black terrigenous, graphitous, phyllitous, quartzitic deposits. These deposits offered optimal conditions of conservation for the numerous chitinozoan taxa. At that moment, the basin had a smaller depth, optimal conditions for the existence of benthic organisms, such as chitinozoans. The bottom of the basin had a large mobility, and as proof stands the granoclassify noticed in quartzites and the passing to fine schists and to thinner or thicker metagreywacke sequences.

The palynological content is dominated by acritarchs and is poor in chitinozoans in samples 10 and 11 from Arama Oltului Member from Bălan Nappe, and dominant in chitinozoans and poorer in acritarchs in the other samples coming from Sândominic Nappe, Başca and Pârâul Crucii Members.

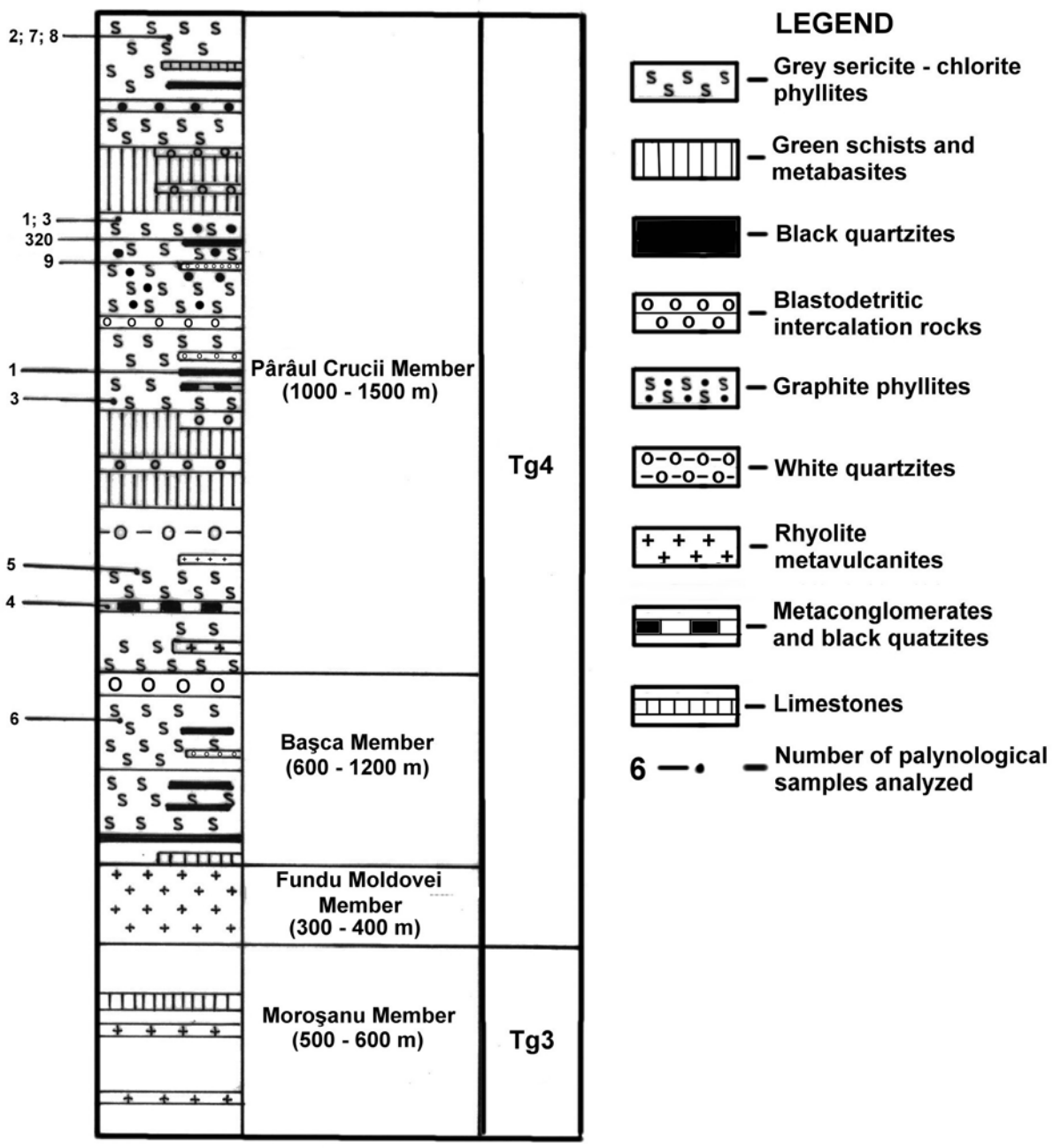

Figure 2. Geological column of the Upper Formation (Tg4, Tulghes Group) from the Sândominic Nappe(after Kräutner, Bindea, 1995).

In the present study, we looked after only the chitinozoan assemblage, leaving the study and the analysis of acritarcha content for other time. The chitinozoans for the Upper Formation (Tg 4) of Tulgheş Group represent a novelty and a certain biostratigraphical characteristic, being specific for this formation and lacking from the other formations of Tulgheş Group, where only acritarchs are present. Our study direction strictly based on the chitinozoan assemblage due to the fact that in a previous study (Vaida, 1999) are cited few species and more genera, with not enough argued biochronological and biostratigraphical conclusions.

In the present study, we separated and determined many chitinozoan species which led us to more precise biochronological and biostratigraphical conclusions concerning the Upper Formation (Tg 4) of Tulgheş Group. Thus, in the analyzed samples appear many chitinozoans of the following species: *Lagenochitina esthonica, Lagenochitina cf. combazi, Lagenochitina brevicollis, Conochitina symmetrica, Conochitina raymondii, Fustichitina grandicula, Rhabdochitina magna, Conochitina brevis, Desmochitina bulla, Conochitina decipiens, Clavachitina decipiens, Conochitina kryos, Euconochitina brevis conica, Euconochitina parvicola.*

SYSTEMATIC STUDY OF CHITINOZOAN SPECIES

Lagenochitina esthonica EISENACK, 1955
Plate I, Figures 1-14

1955 *Lagenochitina esthonica* Eisenack, p. 311, pl. 1, figs. 8, 9;
1958 *Lagenochitina esthonica* Eisenack, Eisenack, p. 395 - 400;
1968 *Lagenochitina esthonica* Eisenack, Eisenack, p. 156;
1973 *Lagenochitina esthonica* Eisenack, Obut, pl. X, figs. 6-8;
1980 *Lagenochitina esthonica* Eisenack, Achab, p. 234, pl. III, figs. 1-6;
1984 *Lagenochitina esthonica* Eisenack, Paris & Mergl, p. 55, pl. IV, figs. 1-6 ;
1985 *Lagenochitina esthonica* Eisenack, Achab, p. 693, pl. 2, figs. 16-18; pl. 4, figs. 1-3;

Description: This species has an elipsoidal panse, generally more height than width. The bottom is round or flat. Some specimens have a curved bottom with a small mucron in the center.

Remarcks: Speciments of *Lagenochitina esthonica* prevail in the chitinozoan assemblage of all analyzed samples, coming from the phyllites, black quartzites and chloritous-sericitous graphitous schists. The size of all determined speciments is smaller than taxa coming from sedimentary rocks, unaffected by the metamorphism. All determined taxa have short forms with incomplete and deformed aspects of bodies.

Dimension: Original dimension of taxa coming from sedimentary rocks are 400-675 µm in height and 245-385 µm in width. Our analyzed taxa have smaller dimensions around of 46,28 – 36,28 µm in height, maximum 47 µm and 24,78 – 25,78 µm in width, maximum 28 µm.

Occurrence: Samples 1 and 4 from black quartzites, Pârâul Crucii Member, Sândominic Nappe; samples 3, 5, 6, 9, from grey sericite-graphite phyllites, from Pârâul Crucii Member, Sândominic Nappe; sample number 11, from chloritous-sericitous, quartzitic schists, from Arama Oltului Member, Balan Nappe.

Stratigraphical spreading: Middle and Upper Arenigian from Baltic region and Laurentian Shield. This species was found in the glauconitic limestones from Baltic Sea Region (Eisenack, 1955; 1962); in Spitsbergen Archipelago, the lower part of Valhallfonna Formation (Bockelie, 1980); in Siberian Platform, Novgorod District (Obut, 1973); in Klabava Formation from Bohemia (Paris & Mergl, 1984); in Lévis Formation, zones B and C, from Quebec, Canada (Achab, 1980, 1985).

Lagenochitina cf. *combazi* FINGER, 1982
Plate II, Figures 17-19; 34, 35

1982 *Lagenochitina combazi* Finger, p. 1488-1489;
1985 *Lagenochitina* cf. *L. combazi* Finger, Achab, p. 691, pl. 2, figs. 7-8; pl. 4, figs. 9, 10;

Description: The determined species has a stumpy form, with curved flanks and with little round bottom.

Remarks: Generally, all specimens have a globular aspect, with smaller dimensions than original diagnosis.

Dimensions: Medium dimensions in height are variable between 22,5 µm to 31,5 µm and in width are between 15,5 µm to 23 µm. All these dimensions are smaller than original ones, which are of 300 µm to 100 µm (Combaz & Péniguel, 1972).

Occurrence: Sample 1 from black quartzites of Pârâul Crucii Member, Sândominic Nappe and samples 5 and 9 from the same Pârâul Crucii Member, Sândominic Nappe, coming from grey sericitous-chloritous phyllites and from the same phyllites of sample 6, from Başca Member.

Stratigraphical spreading: It is known from Arenigian formations from Australia, Canning Basin, zone O_2 (Combaz and Péniguel, 1972), Quebec, Lévis Formation, zone C, and Terra Nova, Cow Head Group (Achab, 1980, 1985).

Lagenochitina brevicollis TAUGOURDEAU & DE JEKHOWSKY, 1960
Plate II, Figures 29, 30.

1968 *Lagenochitina brevicollis* Taugourdeau & de Jechowsky, Rauscher, p. 56, pl. 3, fig. 9;

Description: Species with a globular panse passing to the short neck and with rounded bottom.

Remarks: Described species has a deformed and incompleted form, smaller in dimensions and difficult to determine.

Dimensions: Last dimensions coming from Rauscher (1968) study are: length, 190 µm, width, 140 µm. Dimensions of described speciments are: 32,66 to 42,66 µm, maximum, 43 µm in length and 27,66 to 18,66 µm, maximum 31 µm in width.

Occurrence: Samples 3, 5, 9, from grey, sericitous-chloritous, graphitous phyllites of Pârâul Crucii Member, Sândominic Nappe.

Stratigraphical spreading: Arenigian Formations, represented by Lingules Sandstones of the Montagne Noire (France) within the area between Roquebrun and Lugné (Hérault) and from the south slope of Mont-Peyroux syncline (Rauscher, 1968).

Conochitina symmetrica TAUGOURDEAU & DE JEKHOWSKY 1960
Plate I, Figures 20-24; Plate II, Figures 1-3

1960 *Conochitina symmetrica* Taugourdeau & de Jekhowsky, p. 1223, Pl. IV, fig. 59;
1961 *Conochitina symmetrica* Taugourdeau & de Jekhowsky, Benoit & Taugourdeau, 1408, pl. 11, figs. 17-21;
1980 *Conochitina symmetrica* Taugourdeau & de

Jekhowsky, Achab, p. 226, pl. III, figs. 7-10;

Description: Short conoide panse with wide and flat base, having rounded edge. The short cillyndrical neck, more or less better different of the panse.

Remarks: Our species have a conic edge without difference between neck and pance. The bottom of panse is easy rounded.

Dimensions: Measurement of dimensions species coming from sedimentary rocks are following: total length 200-275 µm and total widts, 160-200 µm. Our measurements vary between 47 to 27,4 µm in length, maximum 52 µm, and 32,25 to 16,3 µm in width, maximum 35 µm.

Occurrence: This species was foud in all the analyzed samples, from Arama Oltului, Pârâul Crucii and Başca Members from the both nappes Balan and Sândominic, of phyllites, black quartzites and schists.

Stratigraphical spreading: It is specific for Lower Arenigian, as boundary species, between Tremadocian and Lower Arenigian. It was mainly found in the samples coming from ,,rue Fleuve'' section of Quebec (Achab, 1980, 1985). Lately it was separated together with *L. esthonica* in to specific microfaunistic assemblage for zone A, of Côte Bégin outcrop, Quebec (Achab, 1985). The outspreading of this species is larger and known in the following regions: Sahara, zone 2, Ordovician, the lower clay-sandstone complex (Taugourdeau & de Jekowsky, 1960; Benoit & Taugourdeau, 1961); Australia, zone O_2, Canning Basin (Achab and Millepied, 1980); Bohemia, the lower part of Klabava Basin (Paris & Mergl, 1984); Quebec, Lévis Formation, zone A (Achab, 1980, 1985).

Conochitina raymondii ACHAB, 1980
Plate II, Figures 23-27

1980 *Conochitina raymondii* Achab, p. 224, pl. II, figs. 1-5;
1985 *Conochitina raymondii* Achab, Achab, p. 691, pl. 2, figs. 4-6; pl. 3 figs. 9-12;

Description: Cilyndro-conoidal test with conoid panse which progressively enlarged to the base. The bottom of panse is flat or easy rounded. The passage of the col to the panse without a visible flexure.

Remarks: At the some speciments the width of panse is larger in the lower part which gives it a more globular aspect. This morphologic aspect divide this species in *C. poumoti*, which has a cilyndroid form; *C. kryos*, which is taller and thinner and with straighter flanks and of *Fustichitina langei*, which has a panse more globular and a rounded bottom.

Dimensions: Total length of holotype form is 500-800 µm and total width is 150-200 µm. For our speciments the length is variable between 46,6 to 66,7 µm, maximum 57µm and width is of 19,4 – 23,2 µm.

Occurrence: It was found in the samples 1, 3, 4, 6, 9 from Pârâul Crucii and Başca Members of Sândominic Nappe, of phyllites, black quartzites and chloritous-sericitous and graphitous schists.

Stratigraphic spreading: This species was found in Arenigian from Quebec, in Lévis Formation (Côte Bégin), zones B and C (Achab, 1980, 1985) and Terra Nova (Cow Head Group) (Achab, 1980, 1985). Paris (1996) mentions this species as characteristic for Arenigian from Laurentia, zone D. Together with *L. esthonica* (immediate over on zone C) and with *C. symmetrica*, is characteristic for Lower Arenigian.

Conochitina decipiens TAUGOURDEAU & DE JEKHOWSKY 1960
Plate I, Figures 9 – 11; Plate II, Figures 11-13, 15, 16

1960 *Conochitina decipiens* Taugourdeau & de Jekhowsky, p. 1222, pl. IV, figs. 50-54;
1968 *Conochitina decipiens* (Taugourdeau & de Jekhowsky), Rauscher, p. 52, pl. 1, figs. 2-7;
1980 *Conochitina decipiens* Taugourdeau &t de Jekhowsky, Achab, p. 224, pl. I, figs. 9-11;
1984 *Conochitina decipiens* (Taugourdeau) Paris & Mergl, p. 44, pl. II, figs. 5-7;
1985 *Conochitina decipiens* Taugourdeau & de Jekhowsky, Achab, p. 689, pl. 2, figs. 1-3;

Description: Test cilyndro-conoidal with straight flanks, which turn into convex form at the lower part of the panse. The passage of col to the panse is without obvious flexure. The bottom of panse is flat or easy rounded. The col has a cilyndroid form.

Remarks: Some described specimens are larger at the level of panse. The passage from neck to the panse is lightly without visible flexure. The bottom of panse is flat or very little rounded. It is more changes in the morphological aspect of the described speciments.

Dimensions: Our described speciments have different dimensions comparatively with speciments coming from the sedimentary rocks. These dimensions are following: 46,5 µm in length, maximum 53 µm and 22,23 µm in width, maximum 23 µm. Speciments coming from sedimentary rocks have 370-450 µm in length and 130-140 µm in widts.

Occurrence: Described speciments coming from samples 1, 3, 9, from Pârâul Crucii Member, Sândominic Nappe, represented by black quartzites, grey phyllites and sericitous-chloritous phyllites.

Stratigraphical spreading: It was described characteristic species for Arenigian from Sahara (Taugourdeau & de Jekhowsky, 1960); France, Arenigian, from Montagne Noire (Rauscher, 1968); Bohemia, Klabava Formation, Arenigian (Paris & Mergl, 1984); Quebec, Lévis Formation, zone A (Achab, 1980, 1985); Terra Nova, Arenigian, Cow Head Group (Achab, 1985).

Clavachitina decipiens TAUGOURDEAU &

DE JEKHOWSKY, 1960
Plate II, Figures 8, 9, 14, 15

1968 *Clavachitina decipiens* Taugourdeau & de Jekhowsky, Rauscher, p. 52, pl. 1, figs. 2-7;

Description: *Clavachitina decipiens* was separated of *Conochitina decipiens* by Taugourdeau and Jekhowsky (1966) as a more great forms 250-500 µm in length and 120-160 µm in width, and with morphological differences which are also visible, as more globular panse with flat or little concave bottom. The same morphological differences are visible and for determined species in this study, but for more little general dimensions. Great morphological variety of this species causes the establish of intermediate species such as *Euconochitina brevis, Rhabdochitina parvicollis* and others, which show the inaccurate morphological limits of this species.

Remarks: At the determined species from analyzed samples all the important morphological modifications and more little dimensions due to metamorphic and tectonic influences after sedimentological processes.

Dimensions: For determined species of analyzed samples were established medium dimensions as: 53,25 µm in length with maximum 54 µm and 31 µm in width, with maximum 33 µm.

Occurrence: Described speciments coming from samples 1, 3, 4 from grey sericitous-chloritous phyllites of the Pârâul Crucii Member, Sândominic Nappe, and from black quartzites of the same lithological member.

Stratigraphical spreading: *Clavachitina decipiens,* was described like *Conochitina decipiens* in Arenigian from Montagne Noire (France) in Lingules Sandstone, which outcrops between Roquebrun and Lugné (Hérault) and on the southern slope of Mont Peyroux syncline (Rauscher, 1968). Previously, this species was also mentioned by some other authors, for the Lower and Middle Arenigian from the same region (Thoral, 1935; Géze, 1949) which represent controversial decisions after on the study of the graptolite fauna.

Conochitina brevis TAUGOURDEAU & DE JEKHOWSKY, 1960
Plate II, Figures 31

1960 *Conochitina brevis* Taugourdeau & de Jekhowsky, p. 1222, pl. III, figs. 47-49;
1961 *Conochitina brevis* (Taugourdeau & de Jekhowsky), Benoit & Taugourdeau, p. 1405, fig. 2;
1969 *Conochitina brevis* (Taugourdeau & de Jekhowsky), Umnova, pl. I, figs. 18, 19;
1985 *Conochitina brevis* (Taugourdeau & de Jekhowsky), Achab, pl. 1, figs. 13-18; pl. 2, fig. 10;

Description: Small type with cilyndrical form. The col and panse are not differentiate, with straight flanks. The base of panse is small rounded.

Remarks: Small and incomplete form in the upper part, with straight flanks and with bottom of panse rounded.

Dimensions: Generally small dimensions, having 35-40 µm in length and 25-27 µm in width. Species coming from sedimentary rocks have 150-200 µm in length and 90-120 µm in width.

Occurrence: It was separate from sample 9 yielded from sericitous-graphitous phyllites of Pârâul Crucii Member, Sândominic Nappe.

Stratigraphical spreading: It was found in different Arenigian formation such as: Sahara, zones O_2 and O_3 (Taugourdeau & de Jekhowsky, 1960; Benoit & Taugourdeau, 1961); Russian Platform, Leetse, Volkov and Tallin Stages (Umnova, 1969, 1981); Quebec, zones C and D (Achab, 1982, 1985).

Euconochitina brevis conica TAUGOURDEAU & DE JEKHOWSKY, 1960
Plate II, Figures 20, 21

1968 *Euconochitina brevis conica* (Taugourdeau & de Jekhowsky), Rauscher, p. 54, pl. 3, fig, 1;

Remarks: This subspecies separated due to variability of morphological aspects of *Conochitina brevis* and *Clavachitina brevis*. It has subcylindrical to easy conoidal aspect, with straight flanks or easy conical and with bottom easy rounded. At this subspecies dimensions were variate, too.

Dimensions: Described forms are small dimensions, around 40 µm in length and 20 µm in width. Speciments coming from sedimentary rocks have no more 200 µm in length and 90-100 µm in width.

Stratigraphical spreading: It was found in Arenigian from Montagne Noire region, France (Rauscher, 1968) and Sahara.

Euconochitina parvicola TAUGOURDEAU, 1965
Plate II, Figure 22

1968 *Euconochitina parvicola* (Taugourdeau) Rauscher, p. 54, pl. 3, fig. 3 ;

Description: It is a smaller dize species with cilyndrical, easy cinical form without difference between col and panse, and with visible round bottom.

Remarks: This species was separated by Taugourdeau (1965) due to variability in morphology and dimensions of species *Conochitina decipiens* and *Clavachitina decipiens*.

Dimensions: Described species has a 23 µm in length and 19 µm in width, comparatively with 100 µm of original species.

Occurrence: It was found only in the sample 3, yielded of grey phyllites from Pârâul Crucii Member of Sândominic Nappe.

Stratigraphical spreading: It was initially described in Ordovician of Oklahoma (USA) by

Taugourdeau (1965). Later on was found in Arenigian of Montagne Noire region (Rauscher, 1968).

Conochitina kryos BOCKELIE, 1980
Plate II, Figure 28

1980 *Conochitina kryos* Bockelie, p. 10, pl. 1, fig. 2, 5-7; 11, 13;
1982 *Conochitina* cf. *kryos* (Bockelie) Achab, p. 1300, pl. 2, figs. 4-7 ;
1985 *Conochitina kryos* (Bockelie) Achab, p. 689, pl. 1, figs. 4, 5 ; pl. 3, figs. 5-8 ;

Descriptions: Described species has a hight silhouette easy curved flanks, with nonglobular panse prolonged to the neck and ended with flat bottom.

Remarks: Determined species is different of the original one by easy convex flanks, comparatively with original species, which has conical flanks. The panse is up prolonged and ended with flat bottom.

Dimensions: It was established following dimensions: 72 µm in lenght and 17,5 – 25 µm in width. Original species has 520 - 630 µm in length and 120 – 150 µm in the level of panse.

Occurrence: It is found this species in the 9 sample, yielded from sericitous-graphitous phyllites of Pârâul Crucii Member, from Sândominic Nappe.

Stratigraphical spreading: Its stratigraphical spreading is similar to Arenigian age from different regions, such as Spitsbergen Archipelago, Valhallfonna Formation, *I. victoriae* zone (Bockelie, 1980); Quebec, Lévis Formation, zone C and D (Achab, 1982, 1985).

Desmochitina bulla TAUGOURDEAU & DE JEKHOWSKY, 1960
Plate I, Figures 15-19

1960 *Desmochitina (D.) bulla* Taugourdeau & de Jekhowsky, pl. 1, figs. 8-11 ; pl. 2, fig. 1 ;
1984 *Desmochitina (D.) bulla* (Taugourdeau & de Jekhowsky), Elaouad-Debbaj, p. 73-75, pl. 1, figs. 1-3, 5 ;
1984 *Desmochitina (D.) bulla* Taugourdeau & de Jekhowsky, Paris & Mergl, p. 39-42, pl. 1, figs. 1-4, 8 ; pl. 2, figs. 1-4, 8 ;
1985 *Desmochitina bulla* & de Jekhowsky, Achab, p. 691, pl. 4, fig. 4 ;
1993 *Desmochitina (D.) bulla* Taugourdeau & de Jekhowsky, Soufiane& Achab, p. 538, pl. 1, figs. 8-11; pl. 2, fig. 1;

Description: The species with ovoidal panse or generally with subsphaerical form, and with short col. This species has a flexure and shoulders well marked. At the aboral pole the panse is ended with one mucron.

Remarks: Determined speciments have small dimensions with short col, with straight or easy conical flanks and with more or little ovoidal panse. At some speciments it can observed the presence one mucron.

Dimensions: Small dimensions were measurement to separated speciments, such as: 20-22 µm in lenght and 10-18 µm in width. Dimensions of species coming from sedimentary rocks have 150-300 µm in width.

Occurrence: Described speciments were separated from samples 1, 3, 6, 9 yielded from black quartzites, grey sericitous-graphitous phyllites, of Pârâul Crucii Member, Sândominic Nappe.

Stratigraphical spreading: It was described that boundary species between Upper Arenigian and Lower Llanvirnian in different regions, such as: Klabava Formation, Bohemia, Upper Arenigian (Paris & Mergl, 1984), Gondwanaland and Baltic region, as boundary species between Arenigian and Llanvirnian (Paris, 1981; Paris, 1996). This species was also mentioned for Upper Arenigian from Tadla Basin, Marocco, Sahara (Soufiane and Achab, 1993); Bohemia, Baltic region and Russia (Achab, 1985) and for Arenigian from Côte Bégin section, Quebec, Canada (Achab, 1985).

Fustichitina grandicula ACHAB, 1980
Plate II, Figures 4, 5

1980 *Fustichitina grandicula* Achab, p. 231, pl. IV, figs. 1-3;

Description: It is a great species which has generally form of club. The passage between col and panse due to progressively, without of flexure and visible shoulders. The col has a cilyndroid form. The panse has a globular form in the lower part and ended with the convex base.

Remarks: Determined species, also have a great forms and some particularities. Thus, these have a cilyndroid lenght col with straight flanks and easy passage to panse, and with a little visible flexure. The panse has a more or little globular form, ended with the convex base.

Dimensions: It was measured and established medium dimensions as, 76,5 µm in length, maximum 77 µm and 20 µm in width. Holotype species has a 750-920 µm in length and 170-200 µm in width (Achab, 1980).

Occurrence: It was found in samples 1, 5, 6 coming from black quartzites and sericitous-graphitous phyllites of Pârâul Crucii and Başca Members, from Sândominic Nappe.

Stratigraphical spreading: This species was described as holotype in Lévis Formation, Quebec, than characteristic species for Lower Arenigian (Achab, 1980).

Rhabdochitina magna EISENACK, 1931
Plate II, Figures 4, 5

Description: It is a great species with a length form without passage between long col and panse.

The body's aspect is cilyndroid – little conoid. The panse has a nonglobular form, which ended with a convex base.

Remarks: Determined speciments have a great cilyndroid form, prolonged, with straight flanks to very little conic aspect. The panse is weakly emphasized which ended with a round base. It is similar with *Rhabdochitina tubularis* Umnova, but differs from that by its larger dimensions.

Dimensions: It was established medium dimensions as 94 µm in length and 18 µm in width, with a maximum value of 101 µm in length.

Occurrence: This species was found in samples 1 and 9, yielded from black quartzites and sericitous-graphitous grey phyllites of Pârâul Crucii Member, Sândominic Nappe.

Stratigraphical spreading: For the first time was described by Eisenack (1931) in Ordovician from Baltic Sea region. Also it was mentioned in Lower Arenigian from Lévis Formation, zones A and B, Quebec, Canada (Achab, 1980).

Clathrochitina oblonga BENOIT & TAUGOURDEAU, 1961
Plate II, Figure 32

Remarks: It is species with a marked conical form, with a prolonged and narrow col, and with width panse which ended by flat bottom. It is also a visible flexure to passage between col and panse.

Dimensions: It was measured 46 µm in length and 30 µm in width to the level of lower part of panse.

Occurrence: It was found only in sample 9, yielded from sericitous-graphitous phyllites of Pârâul Crucii Member, Sândominic Nappe.

Stratigraphical spreading: It was found in Middle Arenigian from Sahara (Benoit & Taugourdeau, 1961) and later found in Marocco and South-West Europe (Elaouad-Debbaj, 1984). It is present in Arenigian from Quebec, zone D, Lévis Formation (Achab, 1985), together with *Lagenochitina esthonica*. It was mentioned in the same formation in Bohemia, Baltic region, Terra Nova and Sahara (Paris & Mergl, 1984).

BIOSTRATIGRAPHICAL CORRELATION

Based on the presented palynological study, the Upper Formation (Tg 4) of Tulgheş Group, which includes the Arenigian chitinozoan assemblage, can be correlated with different regions on globe, as follows:

Laurentian Shield

- Lévis Formation (zone A, B, C, D), Côte Bégin region, Quebec, Canada (Achab, 1980, 1982, 1985, 1986, 1989, 1991).
- Cow Head Group from Terra Nova, Canada.

In this region with sedimentary formations, chitinozoan assemblage division into zones was made according to determined graptolite species (Achab, 1989) from that region, the same with that which offered the chitinozoan samples (Achab, 1980, 1985, 1986, 1989, 1991).

For zone A, there were determined: *Conograptus flexis* (J. Hall, 1858), *C. rigidus* (J. Hall, 1858), *Tetragraptus quadribranchiatus* (J. Hall, 1858), *T. serra* (Brongniart, 1858) and *T. approximatus* (Nicholson, 1873).

For zone B, there were determined species such as: *Phyllograptus typus* (J. Hall, 1858), *T. quadribranchiatus* (J. Hall, 1858), *Dichograptus octobranchiatus* (J. Hall, 1858).

For zone C, the zone with *Didymograptus* was established. This zone was also divided into 3 subzones (C_1, C_2, C_3) based on some species of *Didymograptus* (Achab, 1989).

For zone D, the zone with *Diplograptus dentatus* was established, divided into two subzones (D_1 and D_2), also based on some species of *Diplograptus*, and on some other species of graptolites such as *Dictyonema*, very abundant in subzone D_1. Zone D is equivalent to zone with *Didymograptus hirundo*, characteristic for final (upper) part of Arenigian and where *Desmochitina bulla* can be found (Sahara, Bohemia) as boundary species for Arenigian – Llanvirnian (Achab, 1982, 1989; Paris, 1992).

The division into zones can continue for Terra Nova, and the correlation can extend to trilobite zones from Utah, USA (Paris, 1992).

Gondwanaland

Two important correlation regions were studied and offered rich chitinozoan assemblages, meaning Canning basin with zones O2 and O3, for Australia, and Tadla basin (Morocco) for Sahara. In order to divide into zones, in these regions also were used graptolites and less conodontes. For Australia, important correlation studies were made by Combaz and Péniguel (1972), Achab and Millepied (1980) on samples coming from Nambett Formation from Canning basin, which offered a chitinozoan assemblage with *Conochitina symmetrca*, equivalent to the zone with conodontes with *Prionodus proteus* and the 3rd zone from Lancefeldian (Arenigian).

In Sahara, important studies were made by Taugourdeau and de Jekhowsky (1960), Benoit and Taugourdeau (1961), Taugourdeau (1963), Elaouad-Debbaj (1987, 1988), Paris (1990), Paris (1996). Here, the presence of *Conochitina symmetrica* I also mentioned, beside *Conochitina esthonica*, equivalent to zone with *Tetragraptus approximatus*, characteristic for Arenigian. Also in Sahara, Taugourdeau and de Jekhowsky (1960) and Elaouad-Debbaj (1984) determined *Desmochitina bulla* in the base of Tachilla Formation (Morocco) and in Tazeka Shale (Marhoumi et al., 1982;

Soufiane, Achab, 1993) which consider as species for Arenigian upper limit. This is the assemblage with *Cyathochitina calyx* (Paris, 1996).

Europe

One of the classic regions from Europe concerning the Ordovician chitinozoan studies is Bohemia. Paris and Mergl (1984) found *Conochitina symmetrica* as zone species for Arenigian lower limit, separated within the Klabava Lower Formation, which coexists in this region with *Calavograptus zone.* The above mentioned authors tried to correlate this zone with that of *Tetragraptus approximatus* (Kraft and Mergl, 1979), the same which was mentioned in Sahara. In the upper part of Klabava Formation from Bohemia, Paris & Mergl (1984) determine *Desmochitina bulla*, considering it as boundary species for Arenigian-Llanvirnian, assigned to *Didymograptus artus* zone.

Another important zone studied in Europe is Montagne Noire region (France) and Mont Peyroux syncline, from south of France, Languedoc Department and Rhone mouth. These can be cited studies such as those of Deflandre (1942, 1944), Géze (1949), Taugourdeau (1966), Rauscher (1968). An important chitinozoan assemblage was separated, including *Clavachitina decipiens, Euconochitina brevis, E. brevis conica, Lagenochitina brevicollis*, which sustain the Arenigian age for analyzed formations, using them in order to correlate with the results from North Gondwanaland (Sahara).

In Baltic Shield region, in Spitsbergen Archipelago, Valhallfonna Formation, Bockelie (1980) shows an Arenigian chitinozoan assemblage with *Conochitina kryos, C. poumoti, Lagenochitina esthonica,* which belongs to the lower section of this formation. In Estonia, Eisenack (1955) determined for the first time *Lagenochitina esthonica*, in glauconitic limestones, which assigns it to Lower Arenigian.

In Russian Platform, in Leetse, Volkov and Tallin (Estonia) stages, Arenigian chitinozoan assemblages were found (Umnova, 1969, 1981; Grahn, 1980, 1981, 1984) with *Conochitina brevis* and *Desmochitina bulla*, which assigns for the entire Arenigian.

Asia

In Siberian Platform, in Novgorod district, Obut (1973) found a chitinozoan assemblage with *Lagenochitina esthonica*, Lower Arenigian, which compares it with similar assemblages from glauconitic limestones from Baltic region, with the lower part of Valhallfonna Formation (Spitsbergen), with Klabava Formation (Bohemia) and with Lévis Formation, Quebec, Canada. This assemblage is assigned to *Didymograptus protobifidus* zone (Bockelie, 1980).

In China, in Yichang region, in Hunghuayuan Formation, an assemblage with *Conochitina symmetrica* and other species was found, assigned to Lower Arenigian (Geng, 1984).

In all mentioned areas with sedimentary formations, the chitinozoan assemblages were correlated with standard graptolite assemblages, and, if was allowed, with conodontes, thus establishing biozones, very useful to biostratigraphical correlations, especially for far regions. Starting with chitinozoan assemblage, established by palynological studies from lithologic members of the Upper Formation (Tg. 4), we could make these correlations with similar standard assemblages, found in sedimentary rocks, not disturbed by tectonic and metamorphic events. On their turn, these were equalized to the established biozones based on trilobites and conodontes, offering the possibility of useful biostratigraphical conclusions.

DISCUSSIONS AND CONCLUSIONS

The chitinozoan assemblage established for the Upper Formation (Tg 4) of Tulgheş Group from Bălan area – Eastern Carpathians is very important for the palaeochronological and biostratigraphical characterization of this formation. It is important to mention that the most abundant chitinozoans were found and separated in grey sericite-graphitous phyllites, graphitous phyllites and black quartzite intercalations from Başca and Pârâul Crucii lithological Members, which belong to Sândominic Nappe. The presence of chitinozoans in Arama Oltului Member from Bălan Nappe is smaller. In this lithological member, acritarchs prevail, but they stand as material for a later palynological study (samples 10 and 11). Chitinozoans also have a massive abundance in the other samples, where acritarchs have a smaller one (samples 1, 3, 4, 5, 6, 9).

The environmental and sedimentary conditions were the main factors, which influenced these benthic microorganisms, kept by fossilization in the muddy bottom of marine sedimentary basin, before metamorphic phases that later affected the first deposited geological formations, which also include chitinozoans.

Metamorphism, by its successive phases that affected the rocks of the Upper Formation (Tg 4) from Tulgheş Group also marked these fossil microorganisms. Thus, the majority of determined chitinozoan taxa is broken, incomplete, torsioned and deformed, no longer as they initially looked. All of them were dehydrated and with smaller dimensions at about one measurement order comparing to those determined within sedimentary rocks unaffected by metamorphism (Quebec,

Bohemia, Sahara, Russian Platform, and Australia).

The temperature and pressure are condition that influenced these microorganisms determined their carbonification by increasing the amount of carbon, hydrogen and oxygen elimination and implicitly of water, as proof standing their black color.

The age of this chitinozoan assemblage is Arenigian, established on the presence of characteristic species such as *Lagenochitina esthonica, Conochitina symmetrica, Lagenochitina* cf. *combazi, Conochitina raymondii, Conochitina decipiens, Lagenochitina brevicollis, Conochitina brevis, Conochitina kryos, Desmochitina bulla, Fustichitina grandicula, Rhabdochitina magna.*

The Arenigian age may be also given to Upper Formation (Tg 4) from Tulgheş Group where chitinozoan species come from. The assumed absolute age is 485 - 470 m.y.

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PLATES

PLATE I

1. *Lagenochitina esthonica* Eisenack (39 x 23 µm); sample no. 1, black quartzites, Şindrila de Sus Brook, Pârâul Crucii Member, Sândominic Nappe.
2. *Lagenochitina esthonica* Eisenack (39 x 26 µm); sample no. 3, grey phyllites, Fagul Înalt Brook, Pârâul Crucii Member, Sândominic Nappe.
3. *Lagenochitina esthonica* Eisenack (36 x 23 µm); sample no. 3, grey phyllites, Fagul Înalt Brook, Pârâul Crucii Member, Sândominic Nappe.
4. *Lagenochitina esthonica* Eisenack (38 x 26 µm); sample no. 3, grey phyllites, Fagul Înalt Brook, Pârâul Crucii Member, Sândominic Nappe.
5. *Lagenochitina esthonica* Eisenack (43 x 23 µm); sample no. 5, grey phyllites, Pârâul Scurt Brook, Pârâul Crucii Member, Sândominic Nappe.
6. *Lagenochitina esthonica* Eisenack (38 x 24 µm); sample no. 3, grey phyllites, Fagul Înalt Brook, Pârâul Crucii Member, Sândominic Nappe.
7. *Lagenochitina esthonica* Eisenack (37 x 24 µm); sample no. 4, black quartzites, Babaşa Brook, Pârâul Crucii Member, Sândominic Nappe.
8. *Lagenochitina esthonica* Eisenack (38 x 27 µm); sample no. 4, black quartzites, Babaşa Brook, Pârâul Crucii Member, Sândominic Nappe.
9. *Lagenochitina esthonica* Eisenack (40 x 28 µm); sample no. 4, black quartzites, Babaşa Brook, Pârâul Crucii Member, Sândominic Nappe.
10. *Lagenochitina esthonica* Eisenack (38 x 23 µm); sample no. 9, black graphitous phyllites with intercalations of black quartzites, Pârâul Crucii Member, Sândominic Nappe.
11. *Lagenochitina esthonica* Eisenack (39 x 24 µm); sample no. 5, grey phyllites, Pârâul Scurt Brook, Pârâul Crucii Member, Sândominic Nappe.
12. *Lagenochitina esthonica* Eisenack (43 x 27 µm); sample no. 5, grey phyllites, Pârâul Scurt Brook, Pârâul Crucii Member, Sândominic Nappe.
13. *Lagenochitina esthonica* Eisenack (35 x 21 µm); sample no. 9, black graphitous phyllites with intercalations of black quartzites, Pârâul Crucii Member, Sândominic Nappe.
14. *Lagenochitina esthonica* Eisenack (47 x 28 µm); sample no. 4, black quartzites, Babaşa Brook, Pârâul Crucii Member, Sândominic Nappe.
15. *Desmochitina bulla* Taug. & Jekh. (20 x 15 µm); sample no. 1, black quartzites, Şindrila de Sus Brook, Pârâul Crucii Member, Sândominic Nappe.
16. *Desmochitina bulla* Taug. & Jekh. (22 x 18 µm); sample no. 3, grey phyllites, Fagul Înalt Brook, Pârâul Crucii Member, Sândominic Nappe.
17. *Desmochitina bulla* Taug. & Jekh. (17 x 12 µm); sample no. 3, grey phyllites, Fagul Înalt Brook, Pârâul Crucii Member, Sândominic Nappe.
18. *Desmochitina bulla* Taug. & Jekh. (17 x 13 µm); sample no. 6, grey sericitous-graphitous phyllites, Şipoş Valley, Başca Member, Sândomonic Nappe.
19. *Desmochitina bulla* Taug. & Jekh. (15 x 10 µm); sample no. 9, black graphitous phyllites with intercalations of black quartzites, Pârâul Crucii Member, Sândominic Nappe.
20. *Conochitina symmetrica* Taug. & Jekh. (46 x 31 µm); sample no. 3, grey phyllites, Fagul Înalt Brook, Pârâul Crucii Member, Sândominic Nappe.
21. *Conochitina symmetrica* Taug. & Jekh. (47 x 32 µm); sample no. 3, grey phyllites, Fagul Înalt Brook, Pârâul Crucii Member, Sândominic Nappe.
22. *Conochitina symmetrica* Taug. & Jekh. (45 x 30 µm); sample no. 4, black quartzites, Babaşa Brook, Pârâul Crucii Member, Sândominic Nappe.
23. *Conochitina symmetrica* Taug. & Jekh. (47 x 33 µm); sample no. 5, grey phyllites, Pârâul Scurt Brook, Pârâul Crucii Member, Sândominic Nappe.
24. *Conochitina symmetrica* Taug. & Jekh. (52 x 35 µm); sample no. 6, grey sericitous-graphitous phyllites, Şipoş Valley, Başca Member, Sândomonic Nappe.

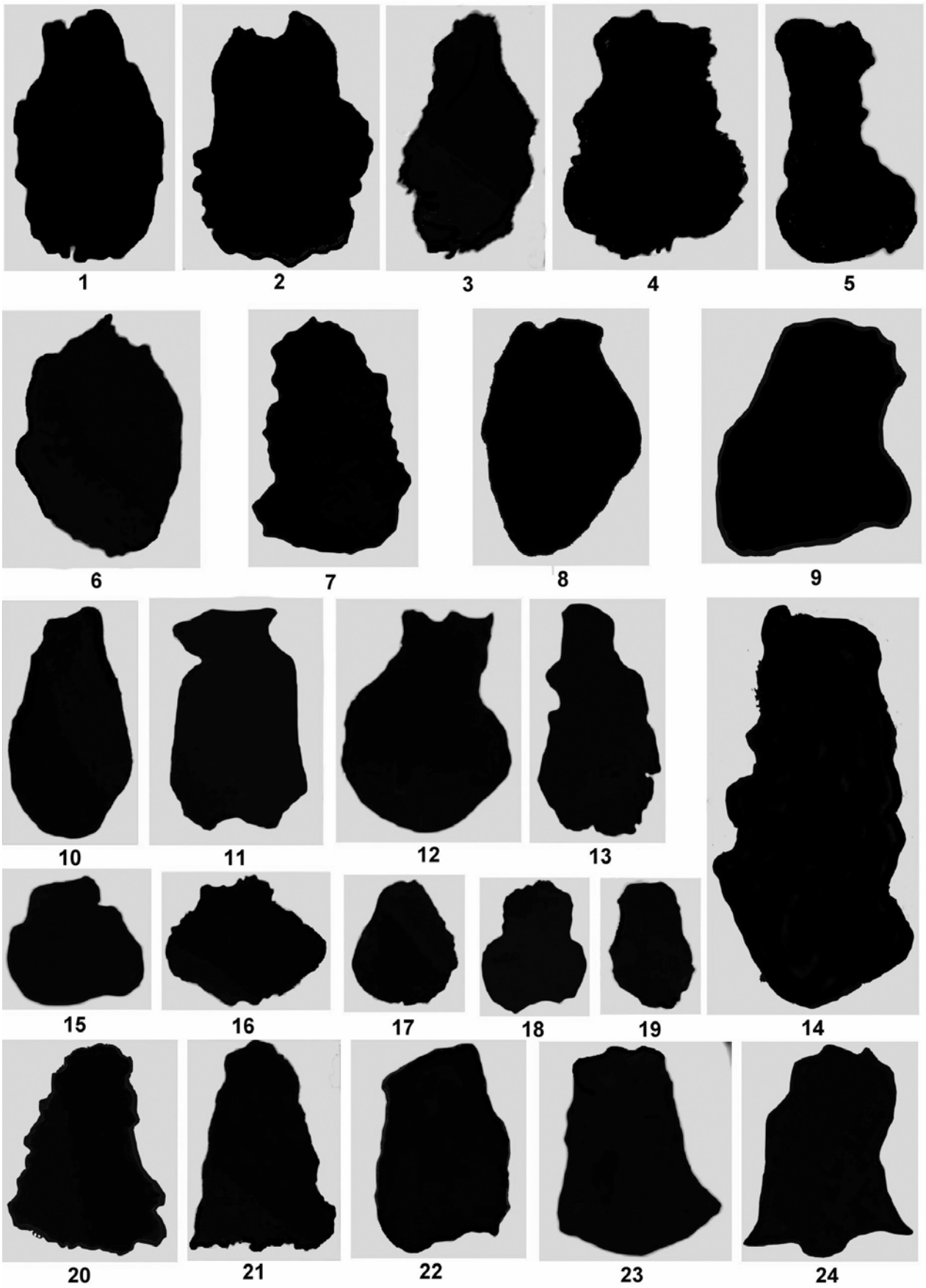
Without dimensions scale

PLATE II

1. *Conochitina symmetrica* Taug. & Jekh. (47 x 33 µm); sample no. 9, black graphitous phyllites with intercalations of black quartzites, Pârâul Crucii Member, Sândominic Nappe.
2. *Conochitina symmetrica* Taug. & Jekh. (46 x 30 µm); sample no. 9, black graphitous phyllites with intercalations of black quartzites, Pârâul Crucii Member, Sândominic Nappe.
3. *Conochitina symmetrica* Taug. & Jekh. (46 x 34 µm); sample no. 9, black graphitous phyllites with intercalations of black quartzites, Pârâul Crucii Member, Sândominic Nappe.
4. *Fustichitina grandicula* Achab (77 x 20 µm); sample no. 1, black quartzites, Şindrila de Sus Brook, Pârâul Crucii Member, Sândominic Nappe.
5. *Fustichitina grandicula* Achab (76 x 19 µm); sample no. 1, black quartzites, Şindrila de Sus Brook, Pârâul Crucii Member, Sândominic Nappe.
6. *Rhabdochitina magna* Eisenack (87 x 18 µm); sample no. 1, black quartzites, Şindrila de Sus Brook, Pârâul Crucii Member, Sândominic Nappe.
7. *Rhabdochitina magna* Eisenack (101 x 16 µm); sample no. 9, black graphitous phyllites with intercalations of black quartzites, Pârâul Crucii Member, Sândominic Nappe.
8. *Clavachitina decipiens* Taug. & Jekh. (54 x 30 µm); sample no. 3, grey phyllites, Fagul Înalt Brook, Pârâul Crucii Member, Sândominic Nappe.
9. *Clavachitina decipiens* Taug. & Jekh. (53 x 31 µm); sample no. 1, black quartzites, Şindrila de Sus Brook, Pârâul Crucii Member, Sândominic Nappe.
10. *Conochitina decipiens* Taug. & Jekh. (49 x 23 µm); sample no. 3, grey phyllites, Fagul Înalt Brook, Pârâul Crucii Member, Sândominic Nappe.
11. *Conochitina decipiens* Taug. & Jekh. (48 x 23 µm); sample no. 3, grey phyllites, Fagul Înalt Brook, Pârâul Crucii Member, Sândominic Nappe.
12. *Conochitina decipiens* Taug. & Jekh. (47 x 23 µm); sample no. 3, grey phyllites, Fagul Înalt Brook, Pârâul Crucii Member, Sândominic Nappe.
13. *Conochitina decipiens* Taug. & Jekh. (43 x 23 µm); sample no. 3, grey phyllites, Fagul Înalt Brook, Pârâul Crucii Member, Sândominic Nappe.
14. *Clavachitina decipiens* Taug. & Jekh. (52 x 30 µm); sample no. 4, black quartzites, Babaşa Brook, Pârâul Crucii Member, Sândominic Nappe.
15. *Clavachitina decipiens* Taug. & Jekh. (54 x 33 µm); sample no. 9, black graphitous phyllites with intercalations of black quartzites, Pârâul Crucii Member, Sândominic Nappe.
16. *Conochitina decipiens* Taug & Jekh. (46 x 23 µm); sample no. 1, black quartzites, Şindrila de Sus Brook, Pârâul Crucii Member, Sândominic Nappe.
17. *Lagenochitina* cf. *combazi* Finger (29 x 18 µm); sample no. 1, black quartzites, Şindrila de Sus Brook, Pârâul Crucii Member, Sândominic Nappe.
18. *Lagenochitina* cf. *combazi* Finger (19 x 11 µm); sample no. 5, grey phyllites, Pârâul Scurt Brook, Pârâul Crucii Member, Sândominic Nappe.
19. *Lagenochitina* cf. *combazi* Finger (18 x 10 µm); sample no. 9, black graphitous phyllites with intercalations of black quartzites, Pârâul Crucii Member, Sândominic Nappe.
20. *Euconochitina brevis conica* (Taug. & Jekh.) (40 x 20 µm); sample no. 3, grey phyllites, Fagul Înalt Brook, Pârâul Crucii Member, Sândominic Nappe.
21. *Euconochitina brevis conica* (Taug. & Jekh.) (40 x 20 µm); sample no. 3, grey phyllites, Fagul Înalt Brook, Pârâul Crucii Member, Sândominic Nappe.
22. *Euconochitina parvicola* (Taug.) (23 x 19 µm); sample no. 3, grey phyllites, Fagul Înalt Brook, Pârâul Crucii Member, Sândominic Nappe.
23. *Conochitina raymondii* Achab (57 x 17 µm); sample no. 3, grey phyllites, Fagul Înalt Brook, Pârâul Crucii Member, Sândominic Nappe.
24. *Conochitina raymondii* Achab (55 x 19 µm); sample no. 3, grey phyllites, Fagul Înalt Brook, Pârâul Crucii Member, Sândominic Nappe.
25. *Conochitina raymondii* Achab (38 x 20 µm); sample no. 4, black quartzites, Babaşa Brook, Pârâul Crucii Member, Sândominic Nappe.
26. *Conochitina raymondii* Achab (46 x 21 µm); sample no. 6, grey sericitous-graphitous phyllites, Şipoş Valley, Başca Member, Sândomonic Nappe.
27. *Conochitina raymondii* Achab (37 x 20 µm); sample no. 9, black graphitous phyllites with intercalations of black quartzites, Pârâul Crucii Member, Sândominic Nappe.
28. *Conochitina kryos* Bockelie (72 x 25 µm); sample no. 9, black graphitous phyllites with intercalations of black quartzites, Pârâul Crucii Member, Sândominic Nappe.
29. *Lagenochitina brevicollis* (Taug. & Jekh.) (43 x 28 µm); sample no. 3, grey phyllites, Fagul Înalt Brook,

Pârâul Crucii Member, Sândominic Nappe.
30. *Lagenochitina brevicollis* (Taug. & Jekh.) (42 x 31 μm); sample no. 5, grey phyllites, Pârâul Scurt Brook, Pârâul Crucii Member, Sândominic Nappe.
31. *Conochitina brevis* Taug. & Jekh. (37 x 25 μm); sample no. 9, black graphitous phyllites with intercalations of black quartzites, Pârâul Crucii Member, Sândominic Nappe.
32. *Clathrochitina oblonga* Ben. & Taug. (46 x 30 μm); sample no. 9, black graphitous phyllites with intercalations of black quartzites, Pârâul Crucii Member, Sândominic Nappe.
33. *Lagenochitina brevicollis* (Taug. & Jekh.) (43 x 24 μm); sample no. 9, black graphitous phyllites with intercalations of black quartzites, Pârâul Crucii Member, Sândominic Nappe.
34. *Lagenochitina* cf. *combazi* Finger (23 x 18 μm); sample no. 6, grey sericitous-graphitous phyllites, Şipoş Valley, Başca Member, Sândomonic Nappe.
35. *Lagenochitina* cf. *combazi* Finger (30 x 23 μm); sample no. 5, grey phyllites, Pârâul Scurt Brook, Pârâul Crucii Member, Sândominic Nappe.

Without dimensions scale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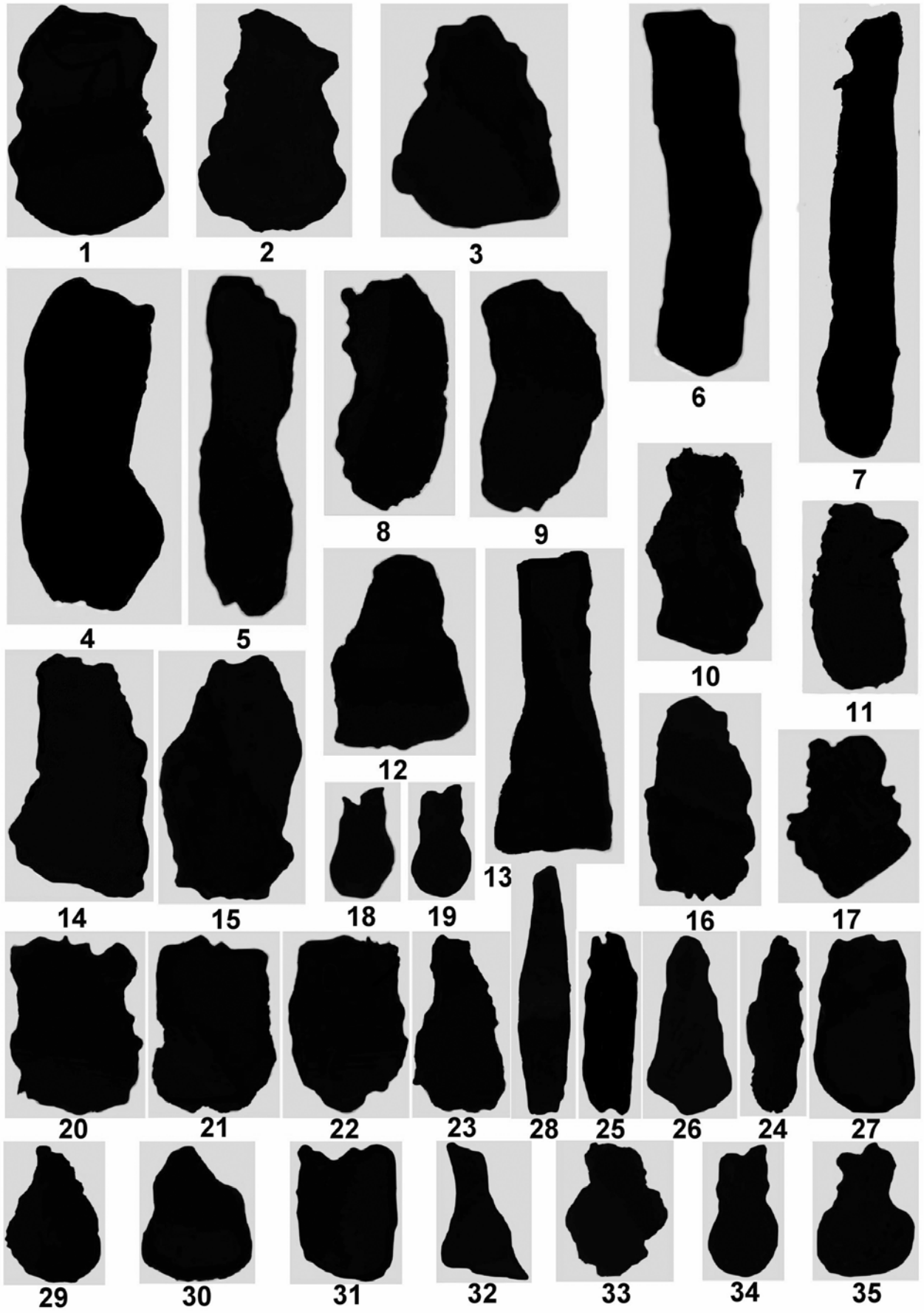
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