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Lithostratigraphy of Radiolarian Limestones and Radiolarites of the Envelope Sequence in the Veľká Fatra Mts.

MILAN POLÁK[1] – ANNA ONDREJÍČKOVÁ[1]

[1]Dionýz Štút Institute of Geology, Mlynská dolina 1, 817 04 Bratislava

Abstract: For the first time it was possible to obtain radiolarians from radiolarian limestones and radiolarites of the envelope sequence in the Veľká Fatra Mts. On the basis of biostratigraphic analysis, the age of the formation has been established as Upper Bathonian - Callovian.

Key words: radiolarites, radiolarians, Upper Bathonian - Callovian, Envelope Unit, Western Carpathians, Veľká Fatra Mts.

Introduction

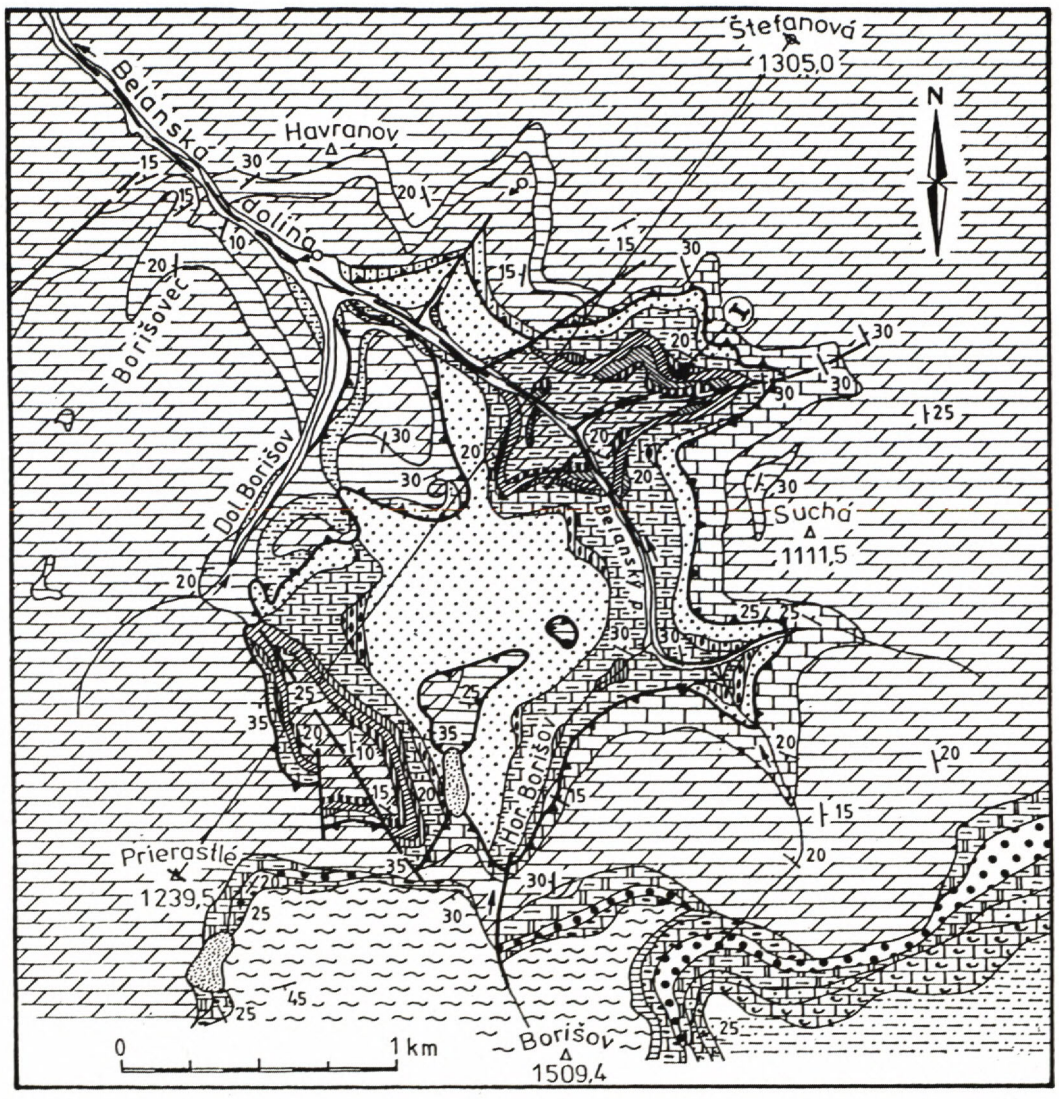
Within the project "Geodynamic Model of the Western Carpahtians", we started in the last time to analyse, besides radiolarian limestones and radiolarites of the Krížna nappe in the central part of the Western Carpathians, also the same formation from envelope sequences. The envelope sequence of the Veľká Fatra Mts. is very well exposed in the Belianska Valley (the side valley Došná – Fig. 1) where it occurs in the form of a tectonic window and where the whole stratigraphic succession is exposed, from the Middle Triassic to the Poruba Member of the Albian.

Lithology

A complete profile across the raldiolarite and radiolarian limestone formation is exposed on the SW ridge of Štefanová. The direct underlier consists of a dark marly shale formation alternating with dark spotted limestones (Allgäu Formation - Fleckenmergel) of the Toarcian age (MIŠÍK – RAKÚS, 1964). The total thickness of the radiolarite formation does not exceed 4 m. This profile displays one of the highest radiolarite frequencies in this formation, in envelope sequences as well as in the Krížna nappe.

The lower part of the profile is formed by red platy (5–15 cm) limestones. They are fine-grained to massive, slightly marly limestones of biomicrite texture, with predominant radiolarian microfacies (Fig. 2). Above them, there is a bed of red, violet shales, passing into red, strongly laminated limestones. Laminae filled with micro-organisms, predominantly radiolarians, less frequently fragments of crinoids, alternate here with signs of gradation. The latter are lighter in colour and strongly quartzified. Dark laminae are significantly poorer in the micro-organic component, with a higher proportion of clay component and increased FeO content. It is a microturbidite layer (DIERSCHE, 1980; SCHLÄGER, W. & SCHLÄGER, M., 1969) or pelagic turbidites (Kälin et al., 1979). Next is a passage formed by red, platy (10–15 cm) radiolarian limestones with frequent nodules of red radiolarites alternating with red clayey shales. The limestones are strongly biomicritic, with a predominance of radiolarian microfacies. Following is a single layer (20 cm) of dark brown radiolarites in the whole formation, which yielded identifiable radiolarites. After a thin layer (3 cm) of clayey shales there follows a bed of red massive radiolarite in which radiolarians have been found as well. Following is a section of 80 cm thick, thin-bedded red radiolarian limestones, with sporadic nodules of red radiolarites and intercalations of red clayey shales. Microfacially, they are biomicrites with a monotonous filling of organic remnants consisting of radiolarians. Above them there is lying another conspicuous layer (25 cm) of red radiolarites, which yielded again identifiable radiolarians. The upper part is formed by several beds of red radiolarites, microfacially biomicrites of the radiolarian microfacies. The silicite layers and nodules may be described as siliceous-calcareous radiolarites (DIERSCHE, 1980). By their composition they correspond to silica-calcareous biomicrites with a relatively high frequency of radiolarians, which are mostly calcified, a substantially lower quantity preserved their original siliceous tests.

The chemical composition confirms the character and type of radiolarites (chem. analysis No. 493, geol. sample No. VF-10/73, locality: Belianska Valley – Došná, analyst: MIKLEOVÁ, May 14, 1975).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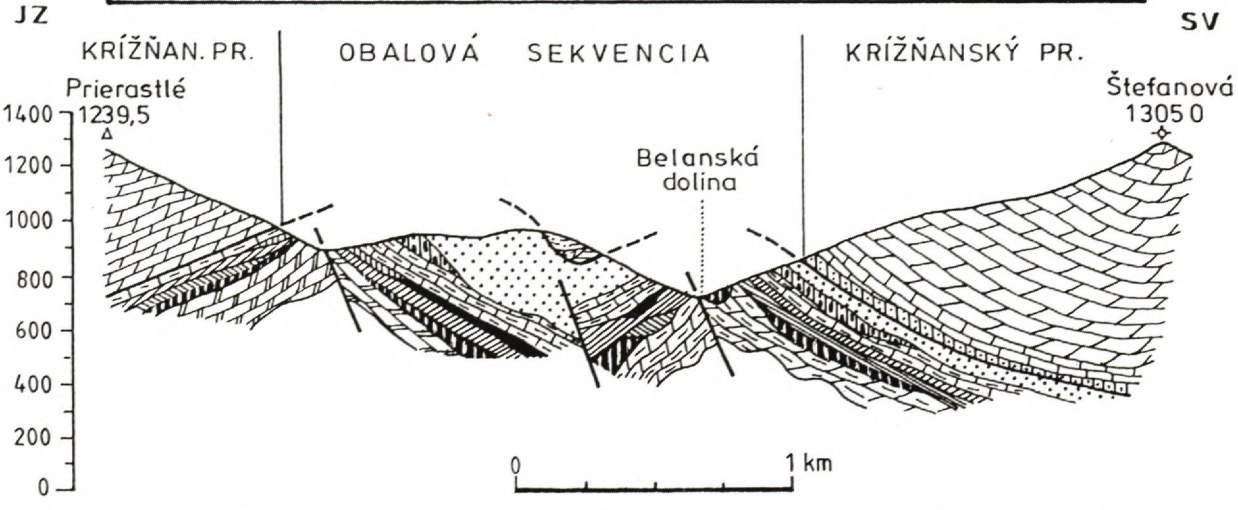
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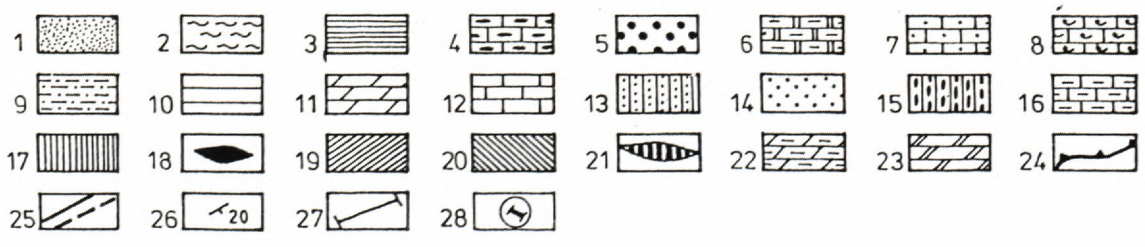
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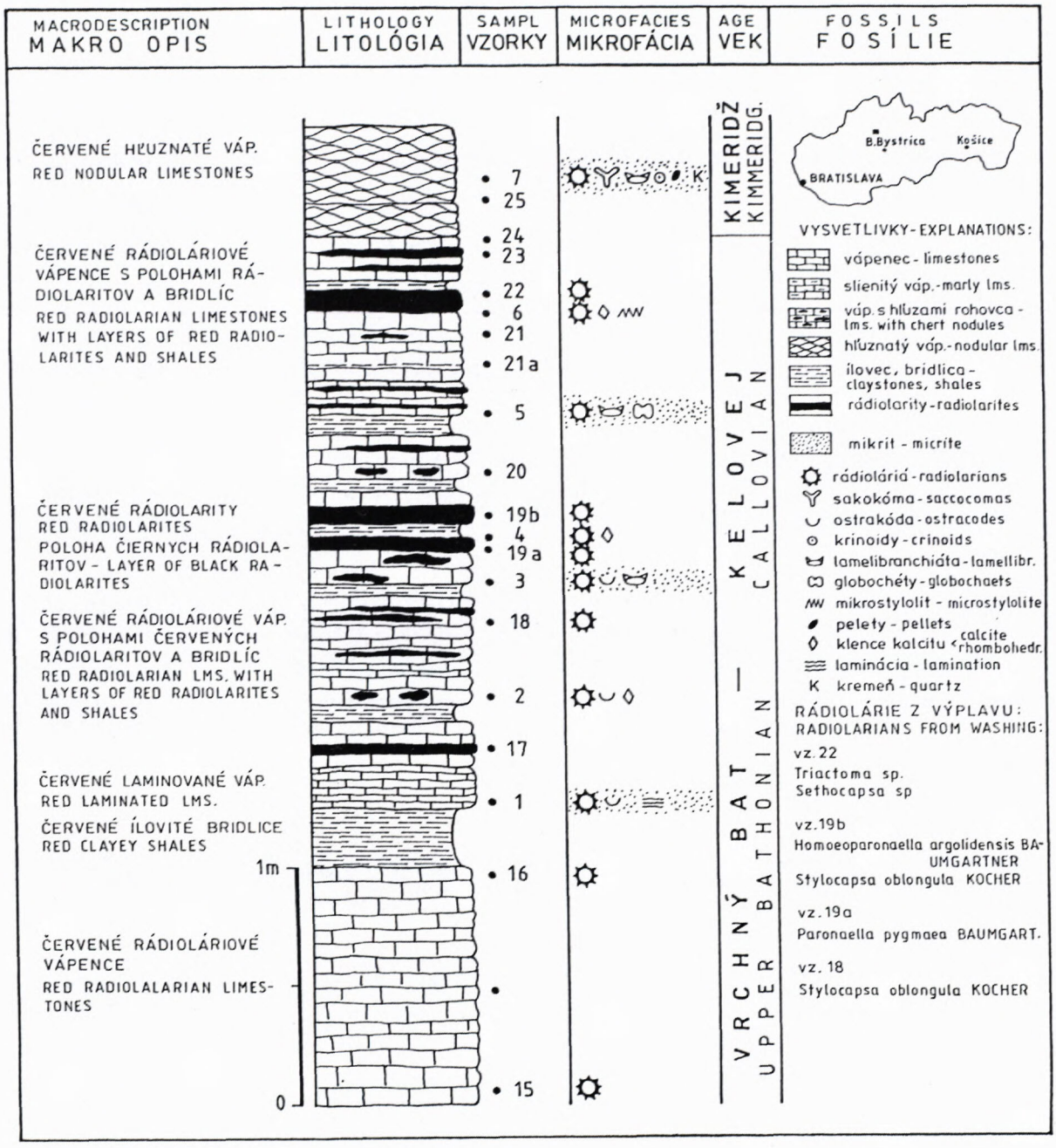

Fig. 2 Lithostratigraphic section, locality: Belianska Valley – Došná, envelope unit, Veľká Fatra Mts.

Fig. 1 Geological map of the area of Borišov
1– Quaternary; 2–13 Krížna nappe: 2– marly limestones, shales (Berriasian–Barremian); 3 – marly platy limestones (Kimmeridgian); 4 – radiolarian limestones, radiolarites (Upper Callovian - Oxfordian); 5 – siliceous Fleckenmergel (Aalenian); 6 – Allgäu Member - Fleckenmergel (Lotharingian); 7 – Kopienec Formation (Hettangian – Sinemurian); 8 –Fatra Member (Rhaetian); 9 – Carpathian Keuper (Norian); 10 – Podhradie Limestones (Ladinian); 11 –. Ramsau Dolomites (Ladinian); Gutenstein Limestones (Anisian); 13 – Lúžna Formation (Lower Triassic); 14–23 Envelope sequence: 14 – Poruba Formation (Albian – Cenomanian); 15 – dark-grey, black cherty limestones (Aptian); 16 –. Lučivná Formation (Upper Berriasian - Lower Aptian); 17 – red nodular limestones (Kimmeridgian); 18 – radiolarian limestones, radiolarites (Upper Bathonian – Callovian); 19 – Allgäu Formation - Fleckenmergel (Domerian - Toarcian); 20 – Trlenská Formation (Hettangian – Sinemurian); 2 1– Carpathian Keuper (Norian); 22 – Došná Formation (Ladinian–Lower Carnian); 23 – Ramsau Dolomites (Ladinian); 24 – ovethrust lines; 25 – faults : established, assumed; 26 – strike and dip of strata; 27– profile line; 28 – studied lithostratigraphic profile.

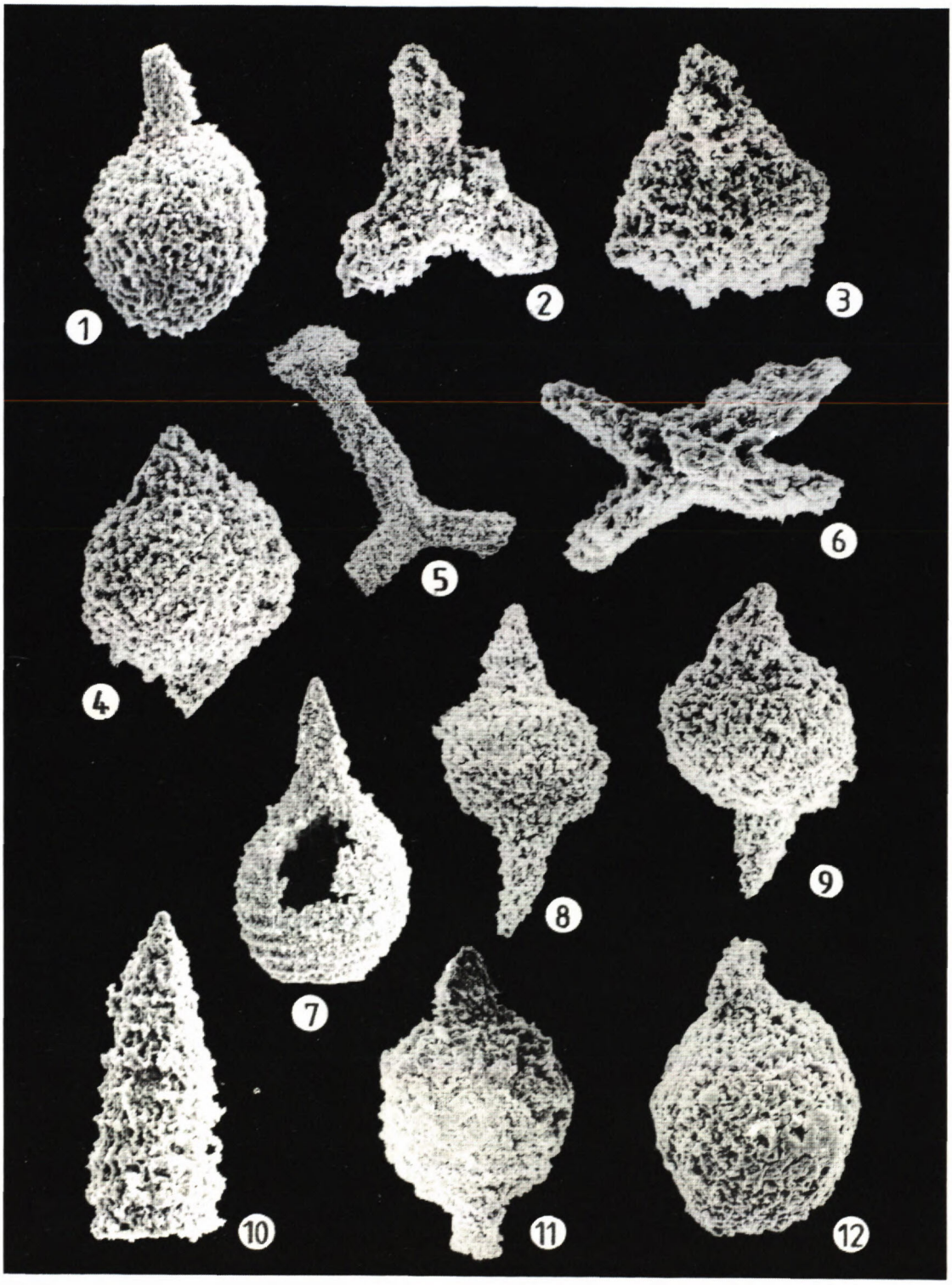

Fig. 3 Belianska dolina – Došná. Samples 18, 19a and 19b:
1 – *Stylocapsa oblongula* KOCHER– 0878, 300x, Došná 18, 2 – *Paronaella pygmaea* BAUMGARTNER – 4773, 175x, Došná 19a, 3 – *Eucyrtidiellum sp.* – 4775, 190x, Došná 19a, 4 – *Tricolocapsa* cf. *yaoi* MATSUOKA – 4772, 160x, Došná 19a, 5 – *Homoeoparonaella argolidensis* BAUMGARTNER – 4752, 100x, Došná 19b, 6 – *Pseudocrucella* sp. – 4765, 190x, Došná 19b, 7 – *Mirifusus fragilis* BAUMGARTNER – 1363, 100x, Došná 19b, 8, 9 – *Podobursa* sp. – 4753, 135x, - 4757, 160x, Došná 19b, 10 – *? Parvicingula* cf. *decora* (PESSAGNO – WHALEN) – 1371, 150x, Došná 19b, 11– *Mirifusus* sp. – 4760, 150x, Došná 19b, 12 – *Stylocapsa* cf. *oblongula* KOCHER – 4764, 300x, Došná 19b.

Result in %:

SiO_2	52,390	CaO	26,250
Al_2O_3	2,420	MgO	0,590
Fe_2O_3	0,480	Na_2O	0,400
FeO	0,360	K_2O	0,120
TiO_2	stopy	CO_2	15,740
MnO	0,004	loss by dryinf	–
P_2O_5	0,025	loss by burning	19,400

Above the whole complex there is a formation of red nodular limestones of Kimmeridgian age.

Fossil content

Radiolarians have been found in all collected samples marked in the profile, however, their preservation is imperfect and in many cases unsuitable for identification. Different calcification degrees may be observed in thin sections, from slight disturbance to total replacement of the siliceous material in the test by calcite. The fossils, after extraction from rock, appear only as cores. For the extraction, hydrofluoric acid diluted 1 : 9 or 2 : 8 with water was used. The listed radiolarians are from samples No. 18, 19a, 19b and 22.

Sample No. 18 (lab. sample No. 1070): ? *Archaeospongoprunum* sp., *Triactoma* sp., *Eucyrtidiellum* sp., *Podobursa* sp., *Stichocapsa* sp., *Stylocapsa oblongula* KOCHER, *Tricolocapsa* sp., sponge spicule.

Sample No. 19a (lab. sample No. 1071): *Paronaella pygmaea* BAUMGARTNER, *Eucytidiellum* sp., *Tricolocapsa* cf. *yaoi* MATSUOKA.

Sample No. 19b (lab. sample No. 1072): ? *Archaeospongoprunum* sp., *Cenosphaera* sp., *Homoeopronaella argolidensis* BAUMGARTNER, *Paronaella* sp. ?, *Pseudocrucella* sp., *Triactoma* sp., *Tritrabs* sp., *Archaeodictyomitra* sp., *Eucyrtidiellum* sp., *Transhsuum, Mirifusus fragilis* BAUMGARTNER, *Mirifusus* sp., *Parvicingula* cf. *decora* (PESSAGNO – WHALEN), *Podobursa* sp., *Stylocapsa* ef. *oblongula* KOCHER.

Sample No. 22 (lab. sample No. 1074): *Triactoma* sp., ?*Mirifusus* sp., *Podobursa* sp., *Sethocapsa* sp.

In all samples, representatives of Nassellaria predominate over Spumellaria in the radiolarian communities. However, we must note that in spite of the abundant occurrence of radiolarians in all thin sections, due to their bad preservation in the sediment, only a part of the radiolarian association could be identified. For the identified species, we suggest the following stratigraphic ranges expressed in Unit Associations (UA), according to BAUMGARTNER (1984). They are: *Stylocapsa oblongula* KOCHER (sample No. 18) occurs in UA 3-5, *Paronaella pygmaea* BAUMGARTNER (sample No. 19a) in UA 3-10, *Homoeoparonaella argolidensis* BAUMGARTNER in UA 1-10 and *Mirifusus fragilis* BAUMGARTNER in UA 0-5 (sample No. 19b). From the above facts it follows that the narrowest stratigraphic range is ascribed to *Stylocapsa oblongula* KORCHER, which occurs in UA 3 to UA 5, corresponding according to BAUMGARTNER (1987) to the upper part of zone A1 and lower part of zone A2. The above range corresponds to the time interval of Upper Bathonian – Callovian, according to the chronostratigraphic scale of O´DOGHERTY et al. (1989).

Discussion

Upper Jurassic sequences of radiolarites and radiolarian limestones in the Pieniny section of the Klippen Belt have been divided by BIRKENMAJER (1977) into the lower radiolarite formation of Sokolica, classified as Bathonian – Callovian in age, and upper radiolarites of Czajakowa – Oxfordian to Kimmeridgian.

While in the predominant part of the Krížna Nappe radiolarites of the Western Carpathians the age of the formation has been determined as Upper Callovian to Oxfordian (POLÁK – ONDREJIČKOVÁ, 1993), in the radiolarite formation of the envelope sequence in the Veľká Fatra Mts. Upper Bathonian-Callovian age has been determined. When correlated with the above mentioned radiolarites in the Pieniny Klippen Belt, radiolarites of the envelope sequence in the Veľká Fatra Mts. would correspond to the Sokolica Formation and Krížna nappe of the Czajakowa Formation.

The determination of accurate age of radiolarian limestones and radiolarites in the Krížna nappe, as well as in the envelope sequence, is accompanied by the problem of the stratigraphic position of the underlying Allgäu Formation (Fleckenmergel), which in the majority of outcrops in the Šiprun sequence have the Toarcian age (MIŠÍK & RAKÚS, 1964). In a few cases, a formation of siliceous Fleckenmergel occurs above, classified as Aalenian in age. It is very probable that the age is Aalenian-Lower Bathonian. It is very improbable and not supported by any evidence that there is a hiatus. There is a similar situation in the Krížna nappe of the Veľká and Malá Fatra Mts., where, in view of the stratigraphic position of the Allgäu Formation (Lotharingian-Domerian) (RAKÚS, 1964), the range of the siliceous Fleckenmergel is ?Toarcian – Lower Callovian ?.

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