Mineralia slovaca, 26 (1994), 7 - 19

Horná Lysá (Vršatec) - a new variety of the Kysuca Succession in the Pieniny Klippen Belt

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(Doručené 6.12.1993)

Abstract

The Lower Cretaceous in the Horná Lysá area is differently developed in comparison with the other profiles of the Kysuca unit. The Horná Lysá Limestone was deposited in pelagic sedimentation area influenced by numerous thin-bedded channelized grain flows and debris flows containing shallow-water biodetritus as fragments of crinoids and lithistid sponges as well as lithoclasts with calpionellids and microoncoids. Siliceous nodules contain residues of lepispheres and radiolarians of the U.A. 14 indicating Upper Valanginian - Hauterivian (maybe also Lowermost Barremian) age.

Key words: Western Carpathians, Pieniny Klippen Belt, Upper Jurassic, Neocomian, radiolarians, calciturbidites

Introduction

The westernmost klippe in the Vršatec are (7 km NW from Pruské) so-called klippe of Vršatec castle belonging to the Czorsztyn succession with shallow-water Jurassic and Lower Cretaceous was described by Mišík (1979). This paper concerns the klippe Horná Lysá (Fig. 1) belonging to the Kysuca succession. It occupies the externmost position being in the tectonic contact with Paleogene of the Flysch Belt. The klippe was mentioned in the excursion guide (Marschalko et al., 1980, p. 116 - 117) describing a profile in the roadcut leading to NW from the parking place at the Vršatec. But just the Lower Cretaceous strata with a peculiar development were tectonically absent in those outcrops and were uncovered later during the construction of the higher parallel road. Other outcrops of this noteworthy Lower Cretaceous strata (named by us Horná Lysá Limestone) crop out at the slopes and the crest.

Description of the lithostratigraphic units

The succession is in the normal position. It contains following lithostratigraphical units (Fig. 2).

a) ***Marly shales with the layers of dark spotty marly limestones*** with *Zoophycus* (facies „Fleckenmergel") and intercalations of dark spongolites and sandy crinoidal limestones (up to 10 cm).

The uncovered thickness is over 100 m. They correspond to Posidonia and Supraposidonia Beds (according to Birkenmajer, 1977, Harcygrund and Podzamcze Formations of Middle and Upper Bajocian age). We suppose a larger stratigraphical range, probably Aalenian - Middle Callovian because at the locality Trstená the Podzamcze Formation was dated by radiolarians as Lower and Middle Callovian (Ožvoldová, 1992).

b) ***Green and red thin-bedded radiolarites*** (Czajakowa Formation). Their thickness is 7 m. The stratigraphical range: Upper Callovian - Upper Oxfordian (?Lowermost Kimmeridgian) is based on radiolarians (Pl. I, Fig. 1 - 18; Pl. II, Fig. 1 - 8, 10, 11, 14).

The lowermost horizon contains the following association: *Acanthocircus suboblongus* (Yao), *Andromeda podbielensis* (Ožvoldová), *Emiluvia salensis* Pessagno, *Higumastra imbricata* (Ožvoldová), *Homoeoparonaella argolidensis* Baumgartner, *Hsuum brevicostatum* (Ožvoldová), *Mirifusus guadalupensis* Pessagno, *Paronaella kotura* Baumgartner, *P.* aff. *kotura* Baumgartner, *Podobursa helvetica* (Rüst), *P. triacantha* (Fischli), *Spongocapsula*

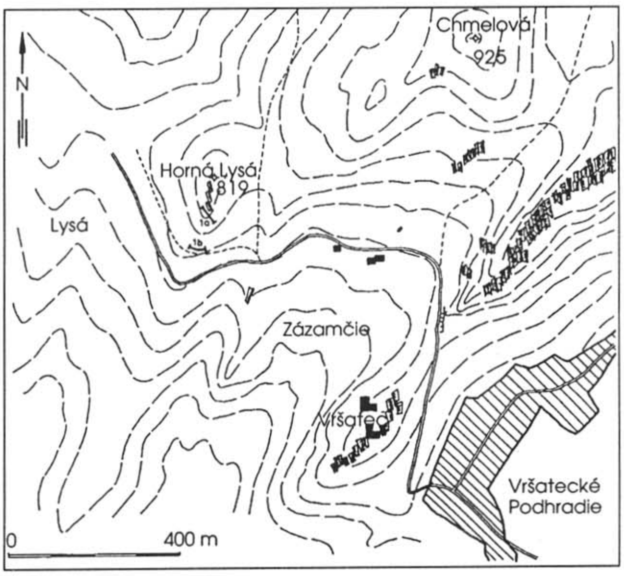
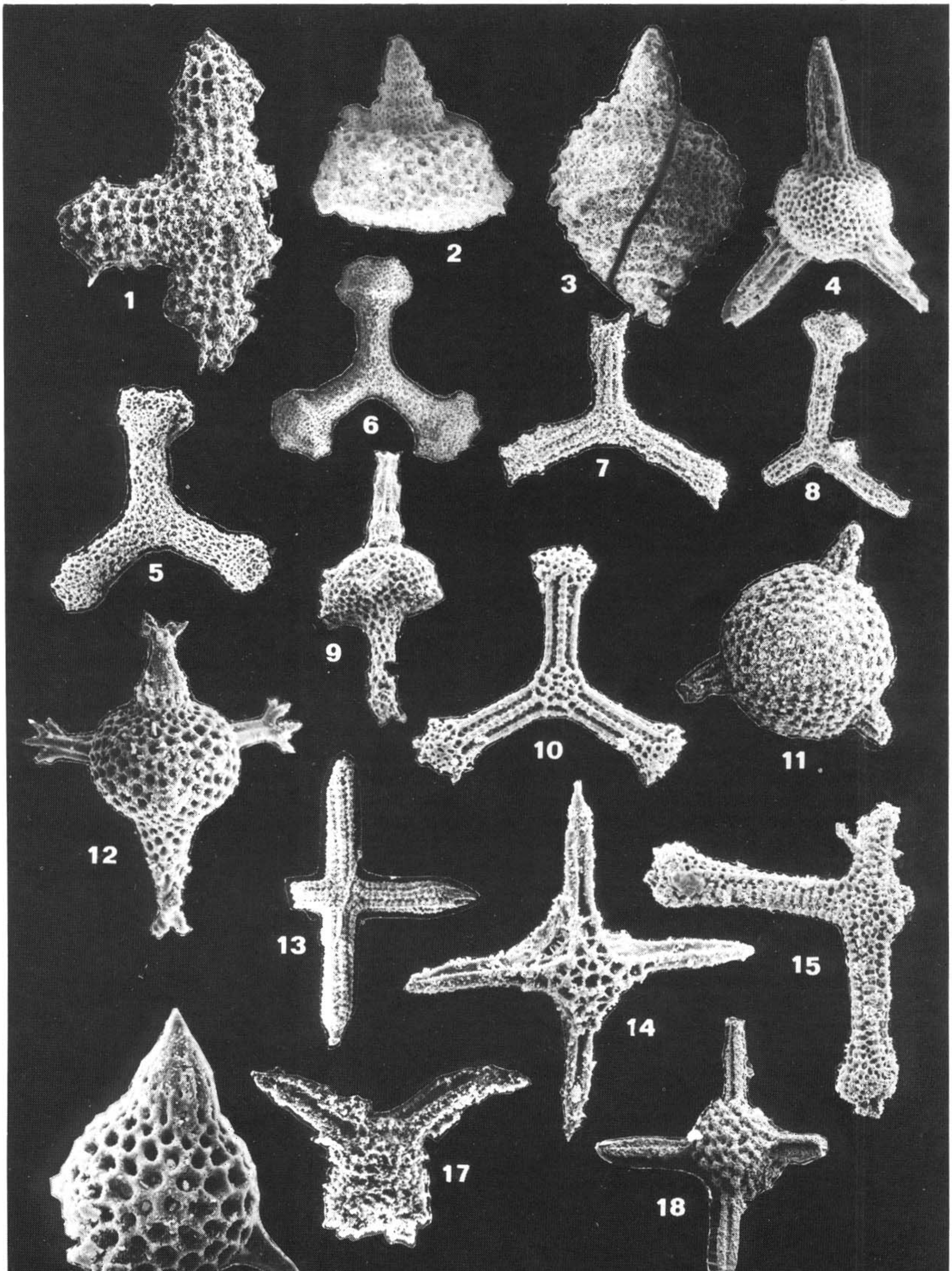


Fig. 1. Situation of the studied profile Horná Lysá.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perampla (Rüst), *Tetraditryma pseudoplena* Baumgartner, *Tetratrabs zealis* (Ožvoldová), *Triactoma blakei* (Pessagno), *T. cornuta* Baumgartner, *T. jonesi* (Pessagno), *Tritrabs ewingi* (Pessagno).

The species *Podobursa triacantha* (Fischli) appearing in the Upper Callovian (De Wever et al., 1986 and others) and *Higumastra imbricata* (Ožvoldová) which disappears in the U.A.6 (Baumgartner, 1984), in the Lowermost Oxfordian (O'Dogherty et al., 1989) allow us to range the association in the span Upper Callovian - Lowermost Oxfordian.

The upper beds contain: *Acanthocircus trizonalis* (Rüst), *A. dicranacanthos* (Squinabol), *Angulobracchia digitata* Baumgartner, *Archaeospongoprunum imlayi* Pessagno, *Bernoullius dicera* (Baumgartner), *Emiluvia orea* Baumgartner, *E. salensis* Pessagno, *?Haliodictya hojnosi* Riedel et Sanfilippo, *Homoeoparonaella argolidensis* Baumgartner, *Paronaella denudata* (Rüst), *P. kotura* Baumgartner, *P. mulleri* Pessagno, *Perispyridium ordinarium* Pessagno, *Podobursa spinosa* (Ožvoldová), *P. triacantha* (Fischli), *Spongocapsula perampla* (Rüst), *Tetraditryma pseudoplena* Baumgartner, *Tetratrabs zealis* (Ožvoldová), *Triactoma blakei* (Pessagno), *T. jonesi* (Pessagno), *Tritrabs casmaliaensis* (Pessagno), *T. exotica* (Pessagno), *T. rhododactylus* Baumgartner.

The species *Emiluvia orea* Baumgartner which starts in U.A. 7 (Baumgartner, 1984) in the upper part of Lower Oxfordian (O'Dogherty et al., 1989) was already found in these horizons. The presence of *Bernoullius dicera* (Baumgartner), *Tritrabs exotica* (Pessagno) or *T. casmaliaensis* (Pessagno) whose occurence ends in the U.A. 8 - in the Upper Oxfordian (ibidem) indicates the possibility to correlate the associations with U.A. 7 and U.A. 8 corresponding to the time span - upper part of the Lower Oxfordian - Upper Oxfordian (ibidem).

The sample MBP contained besides the fore-mentioned species also *?Acotripus sphaericus* Ožvoldová indicating already the uppermost part of the Upper Oxfordian.

The sample VKI contained a very poor association with the expressive predominance of *Nasselaria*. The following taxa were determined: *?Acotripus sphericus* Ožvoldová, *Archaeodictyomitra* sp., *Eucyrtidiellum ptyctum* Riedel et Sanfilippo, *Saitoum* sp. A Widz, *Stichocapsa* sp., *Thanarla* sp., *Triactoma jonesi* (Pessagno), *Zhamoidellum ovum* Dumitrica, Xitus sp.

The presence of the form *Saitoum* sp. A introduced by Widz (1991) from the Kimmeridgian of the Magura Succession of the Pieniny Klippen Belt and the genus *Xitus* probably indicates also the Lowermost Kimmeridgian.

As the uppermost radiolarite sample contained the association of the Upper Oxfordian (?Lower Kimmeridgian) and in the lowermost sample of the overlying red nodular limestones *Parastomiosphaera malmica* indicative the Lower Tithonian was found, the tectonic reduction of the Kimmeridgian part of the red nodular limestones in the profile must be supposed.

c) ***Red nodular limestones*** - Lower Tithonian-Upper Berriasian (Samples 21-23). According to Birkenmajer (1977) they could by identified with Upszar Limestone covering the stratigraphical range Kimmeridgian - Lower Tithonian, formerly quoted as pseudonodular limestone of the Branisko Succession (corresponding to our Kysuca Succession). But here they cover a larger time span - Lower Tithonian („malmica" zone) to Upper Berriasian („Calpionellopsis" zone). Also in the type profile of the Kysuca unit at the locality Brodno they reach only up to the Upper Tithonian (Michalík et al., 1990).

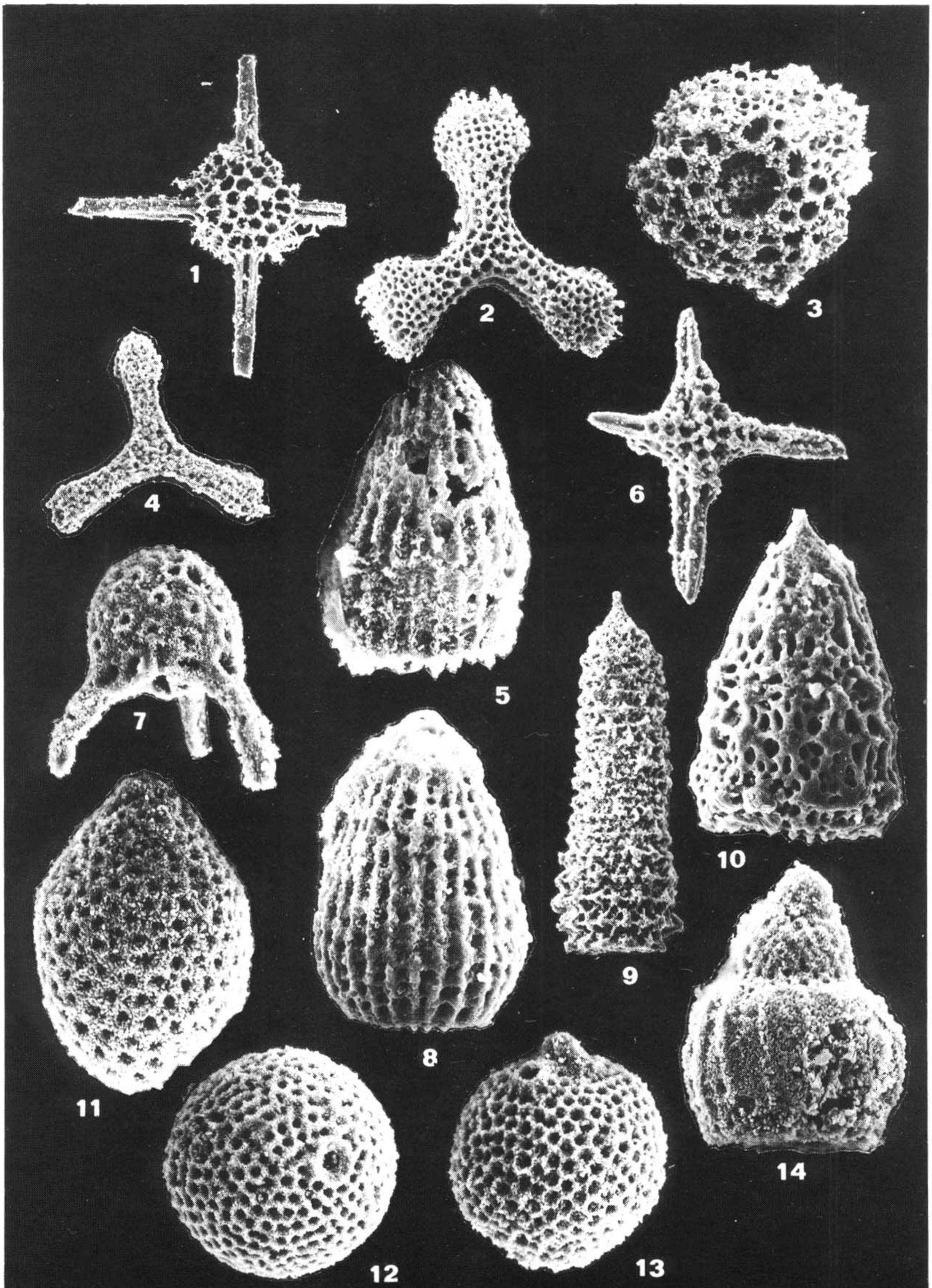
The microscopical features can be summarized from the study of 8 samples as follows.

Structures - biomicrites and intrabiomicrudites; rosy nodules represent larger intraclasts differing by quantity and composition of the microfossils; red matrix contains dissolution seams („Flaser"); the bioturbation is frequent.

The lower part is characterized by *Saccocoma, Globochaete,* frequent *Parastomiosphaera malmica* (Borza) and rare *Stomiosphaera moluccana* Wanner. Higher up *Chitinoidella boneti* Doben (Middle Tithonian) accompanies *Saccocoma* and *Globochaete.* Higher layers with *Crassicollaria* (Upper Tithonian) contain also voids after dissolved radiolarians filled by calcite, abundant *Globochaete* and rare fragments of bivalvian with thin shells and foraminifers (e. g. *Bigenerina* sp. Pl. IV, Fig. 1). The fragments of Saccocoma disappear. In spite of the abundant radiolarians, siliceous nodules were not formed.

In the Calpionella alpina zone (Berriasian, sample No. 23) frequent *Globochaete, Colomisphaera,* several *Involutina* sp., aptychi etc. were found. The age was confirmed also by the ammonite *Beriasella* sp. (determined by Dr. M. Rakús, CSc.). In the Calpionellopsis zone frequent *C. simplex* (Colom) - Pl. IV, Fig. 2, *Tintinnopsella longa* (Colom), radiolarians filled by calcite and several *Cadosina fusca* Wanner occur. It is surprising that *Globochaete alpina* Lombard is missing; the oscillations in the abundance of *Globochaete* and radiolarians are noteworthy. Other organic remains are very rare: echinoderm plates, echinid spines, aptychi, agglutinated foraminifers, *Involutina, Lenticulina, Dentalina, Spirillina, Nodosaria,*

◄ Pl. 1. Radiolarians extracted from the Czajakowa radiolarites (Upper Callovian - Lowermost Oxfordian, sample V-2), upper part of the Lower Oxfordian - Upper Oxfordian (?Lower Kimmeridgian), samples V-6, MBP; Fig. 1. *Higumastra imbricata* (Ožvoldová) - 4625, x160, V-2; Fig. 2. *Andromeda podbielensis* (Ožvoldová) - 1996, x120, V-2; Fig. 3. *Mirifusus guadalupensis* Pessagno - 2271, x110, V-2; Fig. 4. *Triactoma jonesi* (Pessagno) - 2280, x140, V-2; Fig. 5. *Paronaella kotura* Baumgartner - 0865, x80, V-2; Fig. 6. *Paronaella aff. kotura* Baumgartner - 0333, x70, V-2; Fig. 7. *Tritrabs rhododactylus* Baumgartner - 0318, x105, V-2; Fig. 8. *Homoeoparonaella argolidensis* Baumgartner - 1995, x85, V-2; Fig. 9. *Podobursa helvetica* (Rüst) - 2007, x130, V-2; Fig. 10. *Tritrabs exotica* (Pessagno) - 1941, x115, MBP; Fig. 11. *Triactoma blakei* (Pessagno) - 0871, x155, V-6; Fig. 12. *Podobursa spinosa* (Ožvoldová) - 1953, x115, MBP; Fig. 13. *Tetratrabs zealis* (Ožvoldová) - 0317, x75, V-6; Fig. 14. *Emiluvia salensis* Pessagno - 1963, x140, MBP; Fig. 15. *Tetratrabs bulbosa* Baumgartner - 1944, x95, MBP; Fig. 16. *?Acotripus sphericus* Ožvoldová - 1965, x225, MBP; Fig. 17. *Bernoullius dicera* (Baumgartner) - 0339, x160, V-6; Fig. 18. *Emiluvia orea* Baumgartner - 4624, x80, V-6.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juvenile ammonites, phosphatic fish scales, single gastropod, brachiopod, rhyncholite, *Didemnoides moreti* (Durand Delga). Clastic quartz and chalcedony are totally absent.

The following lithostratigraphical member was sampled at the crest over the road immediately above the red nodular limestones, then without interruption (11 successive samples from the profile and 10 more to complete the microscopical characteristic).

d) ***Light grey, rarely rosy to violet red micritic limestones with dispersed crinoidal segments and small lithoclasts,*** bedded (5 - 20 cm), in the upper part with black and brown nodular cherts - Horná Lysá Limestone (proposed new term).

The uncovered thickness is 21 m (the continuation was cut by tectonic contact). Interval of the samples No. 24-34. Age: Upper Berriasian - Hauterivian (?Lower Barremian ?). In the lower part Berriasian brachiopods were found, in the uppermost part radiolarian association U.A. 14 was found.

Microscopical features, stratigraphical range and facial interpretation of the Horná Lysá Limestone

The characteristic constituents in the thin sections are echinoderm segments, aptychi and in several horizons fragments of lithistid sponges. The presence of small lithoclasts (1 - 2 mm) of the Upper Tithonian limestones with *Crassicollaria* is noteworthy.

Structures: biomicrite, biolithomicrite to calclithite (wackestone, rarely packstone), frequent bioturbation. The following bioclasts occur:

Echinoderm segments frequently corroded are without syntaxial rims, rarely with thick twinning lamellae. The section of the lower part of the crinoid calyx (five infrabasalia) is figured in Pl. IV, Fig. 4.

Aptychi posses the cellular structure; they were sometimes broken during the compaction. They represent the only biodetrital constituent affected by rare silicification. The aptychi are always of microscopical size (juvenile specimens); no macroscopic aptychus was found. In contrast with the abundant juvenile aptychi the juvenile ammonites are extremely rare. Their aragonitic shells were dissolved before being covered by the sediment; then the depth under the ACL and high above the CCL can be deduced.

The lithistid sponges occur in the form of fragments (Pl. V, Fig. 2), exceptionally the whole small skeletons were preserved (Pl. V, Fig. 3). Isolated desmosponge and monaxone spicules are frequent (Pl. V, Fig. 4). In the neighbourhood of the siliceous nodules they are filled by chalcedony. In the siliceous nodules, they are sometimes replaced by calcite and can be extracted by HF (Pl. V, Fig. 5 - 7; Pl. VI, Fig. 1). The voids after dissolved spicules in limestone are filled by fine-grained calcite.

Meanwhile the isolated spicules of the silicisponges are frequent, their skeleton fragments rarely occured in the Pieniny Klippen Belt. We found them up till now only in the Liassic (localities Lutý Potok and Krásna Hôrka, both Nižná unit, Orava) and very scarce specimens of the whole sponges of microscopical size were present in the Middle Tithonian (loc. Babina-Bohunice) and Neocomian limestones (loc. Kamenica, East Slovakia) both belonging to Czorsztyn unit. Macroscopical calcareous sponges belonging to the *Inozoa* are in the Oxfordian biohermal limestones of the Czorsztyn unit in the Vršatec-castle klippe (Mišík, 1979).

The skeleton fragments described here (as well as those from the locality Lutý Potok) are always filled by micrite; after the dead of the sponge only fine mud was filtrated inward (bafflestone). This micrite is usually more fine-grained and darker than the micrite in the matrix. Thus, it is probable that the sponge skeletons were redeposited at a short distance as intraclasts.

Radiolarians had been abundant in some horizons; they were all dissolved during the early diagenesis and voids after them were filled by fine-grained drusy calcite or by mud (in this case visible as ghosts).

Foraminifers in a small number are regularly present. They belong mostly to the genus *Lenticulina* (up to 6 specimens in one thin section, almost always damaged by transport, frequently bored by boring algae, thus redeposited from the euphotic zone).

Cadosina fusca fusca Wanner, usually 4 - 5 specimes in one thin section (No. 24, 25, 29) is the sole representative of the *Calciodinellaceae.*

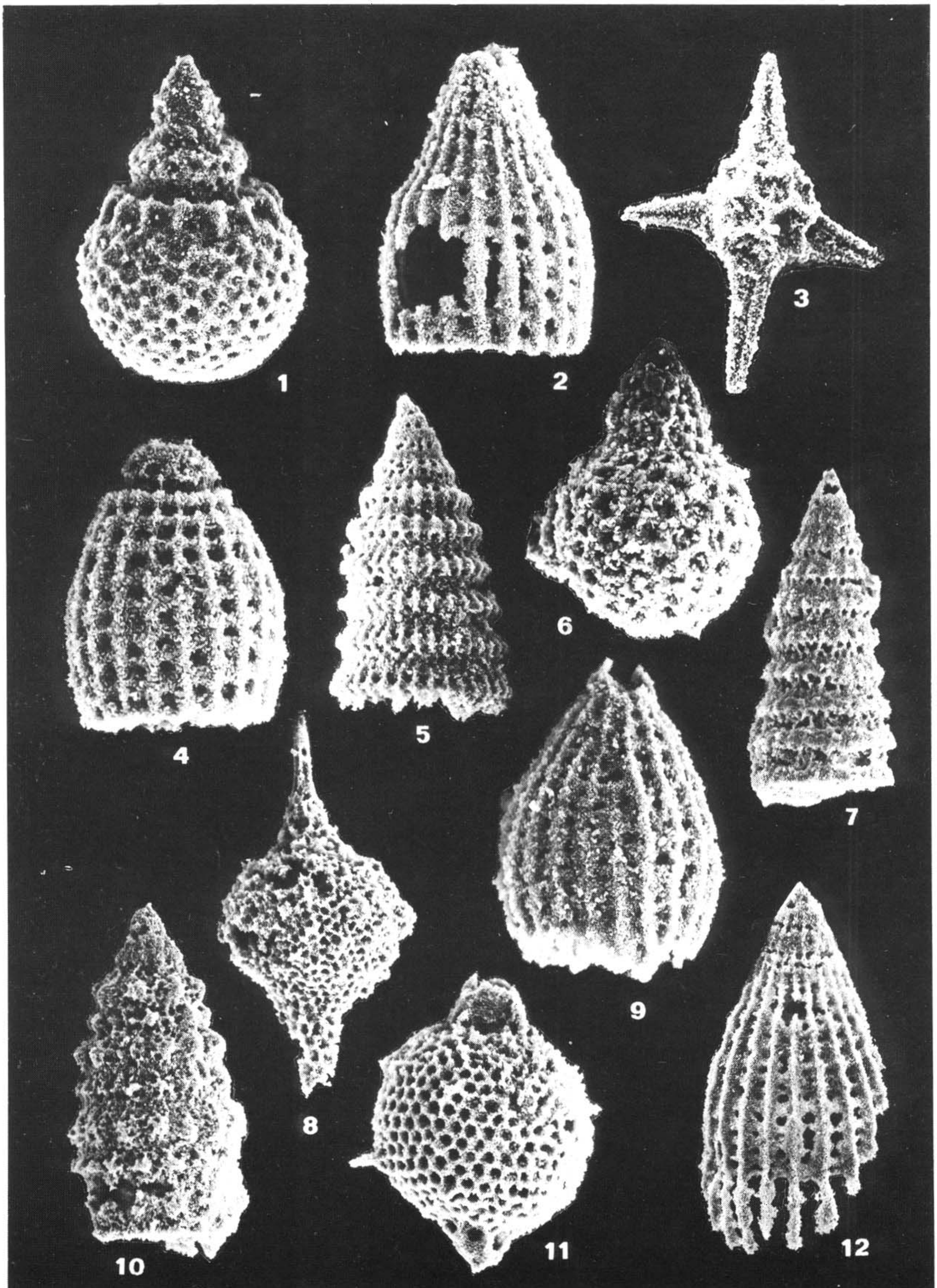
Bivalvians in fragments of thin shells originally aragonitic are current, the calcitic ones with prismatic structure are rare.

Very rare constituents are phosphatic remains (scales and fish teeth echinid spicules, juvenile ammonites, ostracods, rhyncholites, ophiuroid segments, gastropods, fragment of bryozoans and brachiopods.

Lithoclasts (1 - 2 mm) are mostly micritic, sometimes with Fe-coloured margins, strongly damaged by boring algae (their tiny channels well visible due to the Fe-hydroxides). Less abundant are biomicrites with *Crassicollaria* redeposited from Upper Tithonian sediments (Pl. IV, Fig. 6), rare biomicrite with „filaments“ and pelsparite with microncoids (Pl. IV, Fig. 5). The nucleus of the microoncoids is sometimes represented by *Globochaete alpina,* rarely by *Crassicollaria* and perhaps also by *Saccocoma.*

The characteristic microoncoid microfacies is not known from the Pieniny Klippen Belt in the primary posi-

◄ Pl. II. Radiolarians extracted from the Czajakowa radiolarites - upper part of the Lower Oxfordian - Upper Oxfordian (?Lower Kimmeridgian), samples V-6, MBP, VKI and from the chert nodules - Upper Valanginian - Hauterivian (?Lower Barremian), sample 33; Fig. 1. *Staurosphaera antiqua* Rüst - 1946, x100, MBP; Fig. 2. *?Angulobracchia* sp. - 1943, x145, MBP; Fig. 3. *Orbiculiforma* sp. - 1949, x160, MBP; Fig. 4. *Angulobracchia digitata* Baumgartner - 0325, x130, V-6; Fig. 5. *Archaeodictyomitra* sp. - 4031, x500, VKI; Fig. 6. *Emiluvia premyogii* Baumgartner - 1942, x170, MBP; Fig. 7. *Saitoum* sp. A Widz - 4025, x350, VKI; Fig. 8. *Archaeodictyomitra* sp. - 4016, x500, VKI; Fig. 9. *Ristola* sp. - 1978, x160, 33; Fig. 10. *Xitus* sp. - 4021, x390, VKI; Fig. 11. *Zhamoidellum ovum* Dumitrica - 4030, x350, VKI; Fig. 12. *Holocryptocanium barbui* Dumitrica - 1979, x290, 33; Fig. 13. *Cryptamphorella* sp. - 4687, x280, 33; Fig. 14. *Eucyrtidiellum ptyctum* (Riedel et Sanfilippo) - 4019, x500, VKI.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tion, in outcrops. But it is frequently found as blocks and pebbles derived from an exotic source - Andrusov ridge in the Senonian conglomerates belonging to the Klape and Kysuca units (Mišík and Sýkora, 1981, p. 27), in the Paleocene conglomerates (Mišík et al., 1991, p. 28), redeposited pebbles in the Neogene Jablonica conglomerates (Mišík, 1986, p. 424). Microoncolites are characteristic for the Uppermost Jurassic of the Vysoké Tatry Succession (Lefeld and Radwanski, 1960). Therefore the transport of lithoclasts with microoncoids in the described locality of the Kysuca Succession from the south is probable.

Meanwhile the terrigenous admixture (mainly heavy minerals) of the Middle Jurassic of the Czorsztyn and Kysuca units are similar and indicative for the transport from the north (Aubrecht, 1993), in the Lowermost Cretaceous already a southern source began to influence the Kysuca sedimentation area. The southern source rendering exotic rocks („Upohlav" conglomerates) is well represented in the Snežnica Formation (Upper Turonian - Cogniacian of the Kysuca unit).

The total lack of the clastic quartz in the thin sections has to be stressed.

A surprising phenomenon - small anastomosing synsedimentary cracks filled by mud (Pl. V, Fig. 1) was registered in the samples No. 24, 30, 34. It was caused by diagenetic dehydratation or by a short interruption of the sedimentation accompanied by the inicial lithification.

Microstylolites impregnated by Fe-hydroxides or filled by authigenic clay minerals are frequent. The tiny subparallel veinlets (shear cracks) currently occur. Their coalescence gave origin to recrystallization veinlets with secondary formed prismatic calcite aggregates. The recrystallization veinlets (Mišík, 1971) can be easily recognized when fossil remains traverse the veinlet without being torn, sometimes their yellow pigmented phantoms can be seen in the veinlet.

The silicification in the limestone beds without siliceous nodules is very rare, only some aptychi were partially replaced by silica.

Nodular cherts

Black and brown siliceous nodules occur in the light grey limestones and the brown ones also in the pink crinoidal biomicrite (wackestone).

Rare carbonate rhombohedra (under 0.15 mm) and pyrite pigment were present only in the black nodules. Sponge spicules and radiolarians are filled by clear chalcedony in a little coarser aggregate than in the surrounding chalcedony matrix; therefore they are better visible in the polarised light. Some spicules can be recognized only due to the filling of their canals by calcite or brown pigment. The selective calcitization of the spicules by a calcite monocrystal is rare.

Almost all radiolarians were dissolved after their deposition. The majority of voids after them remained empty and was later filled by clear chalcedony. The voids after them in the surrounding limestone were filled by fine-grained drusy calcite. That proves a very early origin of nodular cherts because never a case of replacement of that drusy calcite by the silica was observed. Empty voids in the future siliceous nodule was filled exceptionally by a calcite monocrystal with spherical outline. Other voids are filled by micrite, usually a darker one (probably specimens redeposited by currents). In such cases only phantom of radiolarian is visible in a thin section of limestone. The equivalents of mud-filled specimes in the siliceous nodules are spherical voids filled by brown almost isotropic silica with very fine grains of Fe-pigment.

In the brown siliceous nodules also aptychi, lenticulines and lithoclasts can be discerned due to the boring algae; their tiny canals were made expressive due to the Fe-pigment (Pl. VI, Fig. 5). Agglutinate foraminifers disappeared completely during the silicification; the calcite composition of echinoderm plates remains mostly preserved. Phosphatic scales remained intact; a dinocyst was found (Pl. VI, Fig. 2).

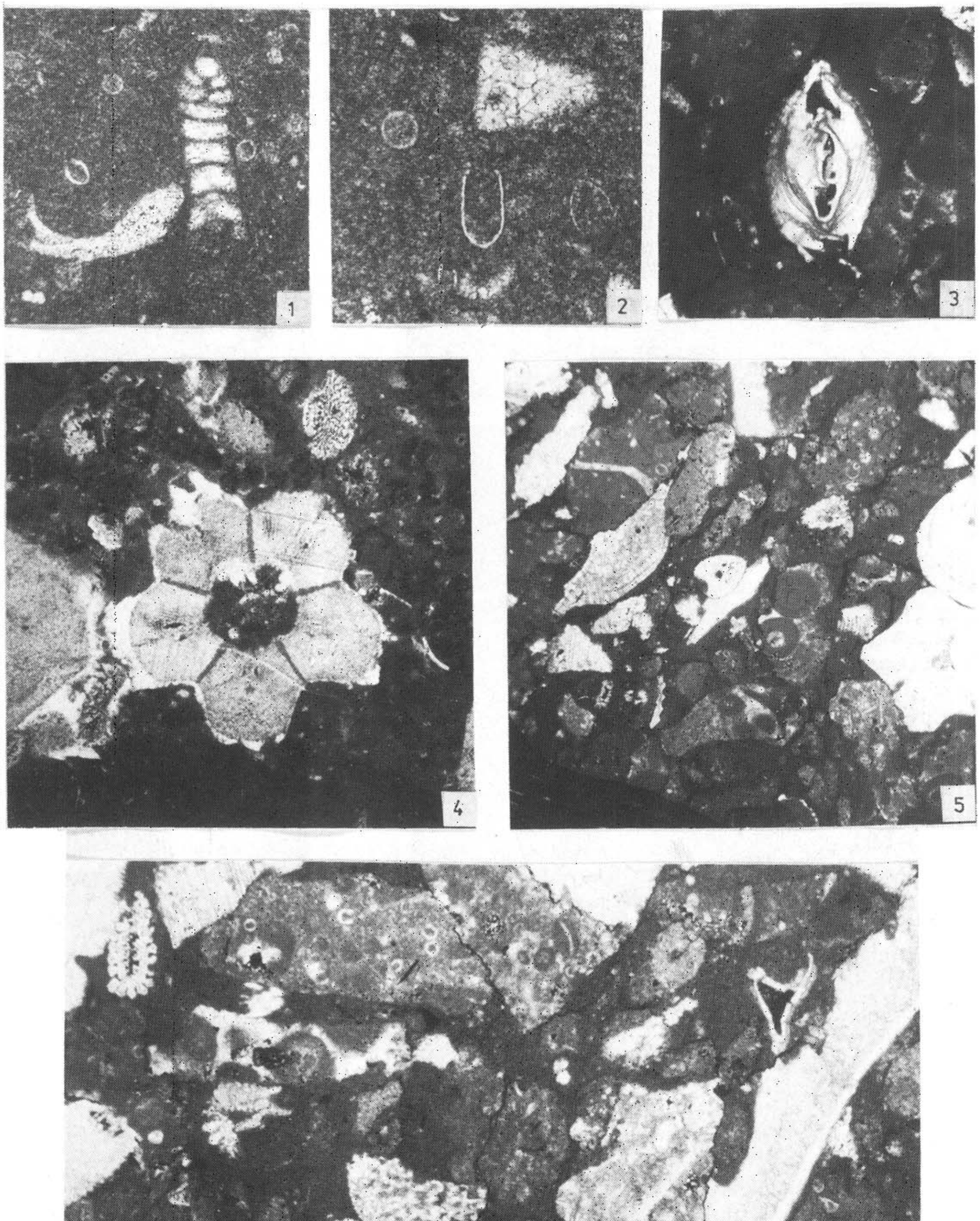
Rare remnants of lepispheres (tiny globules) were found in all four thin sections from the siliceous nodules; they were preserved in the new-formed calcite grains (Pl. VI, Fig. 3; more data Mišík, 1993).

Siliceous nodules contain several generations of veinlets. The oldest one sometimes limit a part of the nodule. They preceded the formation of the nodule, the growth of which was stopped on that obstacle (Pl. VI, Fig. 4). Metasomatic calcite veinlets (Pl. VI, Fig. 6) were synchronous with the nodule formation. They are fullfilled by fluid and silica inclusions what lowers the index of refraction of the large calcite grains forming metasomatic veinlets. Ghosts of radiolarians (Pl. VI, Fig. 7) may be sometimes found in them. Another variety of metasomatic veinlets are the bordered veinlets (Mišík, 1973, Fig. 32). They are characterized by a clear middle part (its calcite crystallized into the open crack) symmetrically bordered by two dark metasomatic stripes. The grey stripes are formed by the calcite which penetrated and replaced the silica matrix highly porous in those times. The previosly mentioned „exclusively metasomatic" veinlets were also formed from the tiny crack supplying solutions but of submicroscopical thickness. Thin chalcedony veinlets, also contemporaneous with the nodule formation, are rare. Posttectonic veinlets are cracks filled by the clear aggregate of twinned calcite grains.

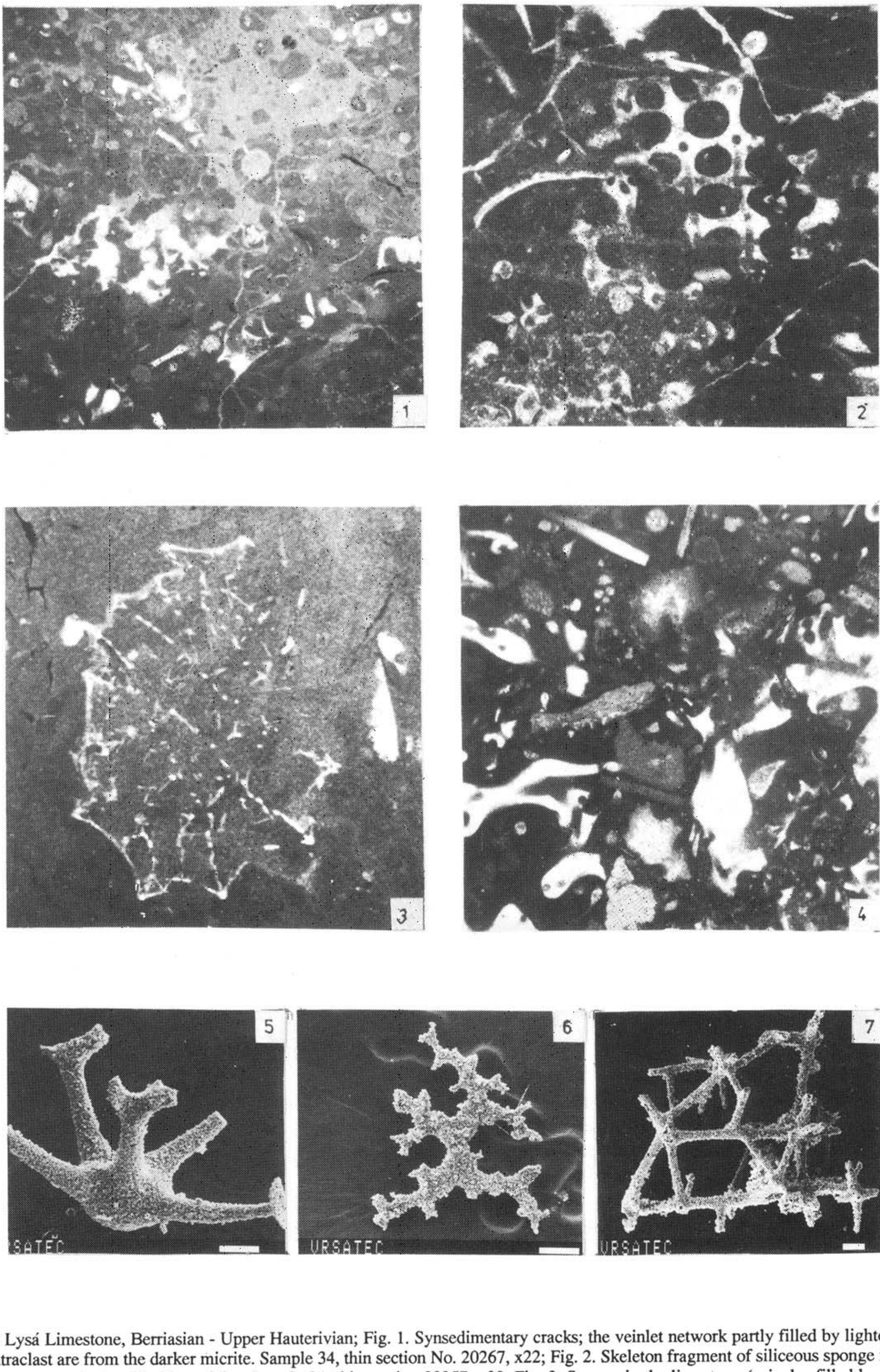
Associations of radiolarians extracted from the nodular cherts

The nodules were dissolved in HF. We succeeded to loose those radiolarians which escaped to dissolution du-

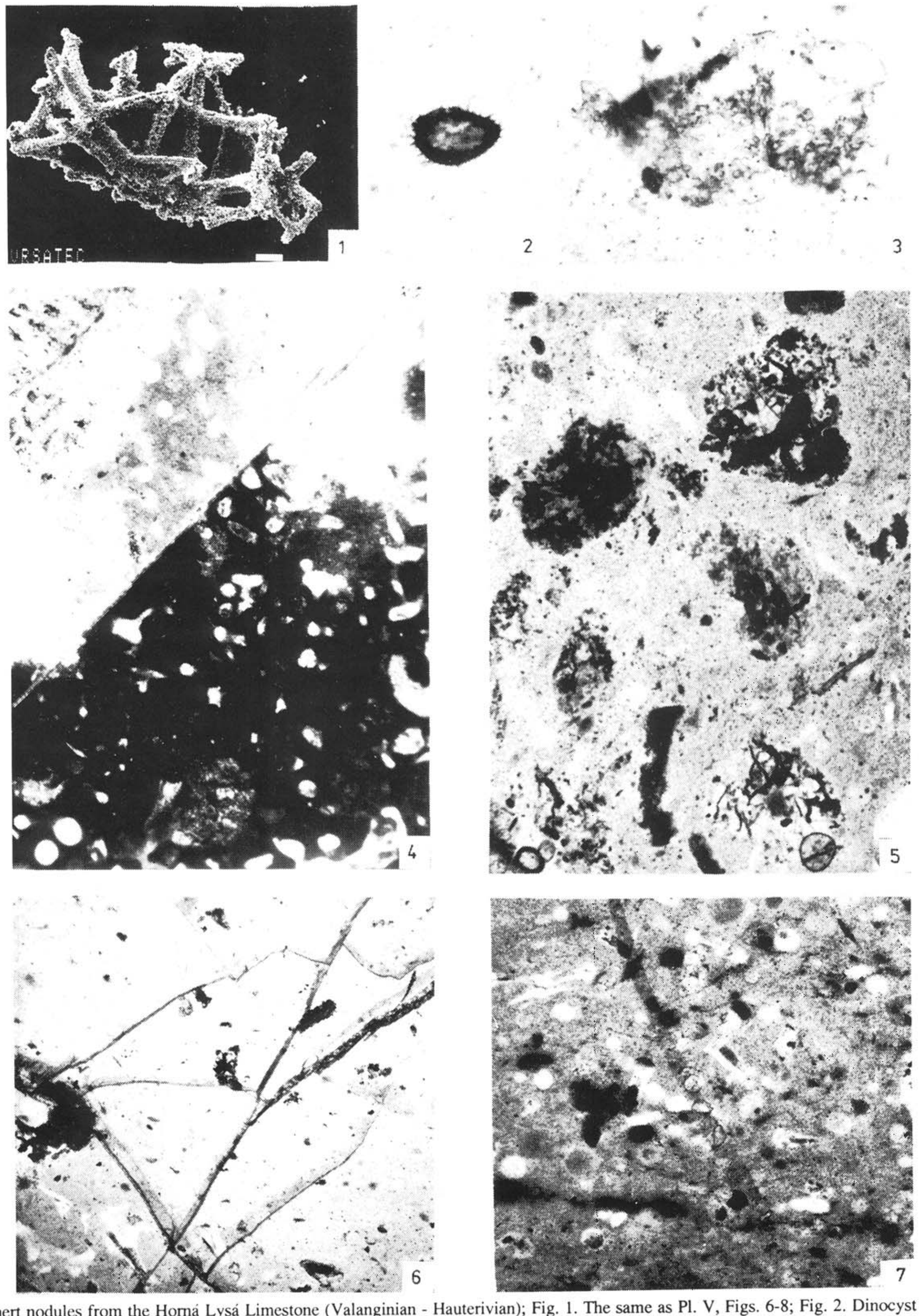
◄ Pl. III. Radiolarians extracted from the chert nodules of the Horná Lysá Limestone - Upper Valanginian - Hauterivian (?Lower Barremian), samples 33 and 18414; Fig. 1. *Sethocapsa uterculus* (Parona) - 1984, x300, 33; Fig. 2. *Thanarla elegantissima* (Cita) - 4704, x360, 33; Fig. 3. *Cecrops septemporatus* (Parona) - 3621, x170, 18414; Fig. 4. *?Archaeodictyomitra savignanensis* (Neviani) - 1973, x500, 33; Fig. 5. *Parvicingula hsui* Pessagno - 1986, x210, 33; Fig. 6. *?Siphocampium davidi* Schaaf - 2822, x300, 18414; Fig. 7. *Pseudodictyomitra lilyae* (Tan Sin Hok) - 4689, x240, 33; Fig. 8. *Syringocapsa limatum* Foreman - 4682, x180, 33; Fig. 9. *Thanarla conica* (Aliev) - 4691, x450, 33; Fig. 10. *Xitus spicularius* (Aliev) - 1992, x220, 33; Fig. 11. *Syringocapsa agolarium* Foreman - 1992, x300, 33; Fig. 12. *Thanarla* sp. 1980, x280, 33.



Pl. IV. Fig. 1. *Bigenerina* sp. in association with *Crassicollaria* (Upper Tithonian); sample 3-91, thin section No. 19765, x80; Fig. 2. *Calpionellopsis simplex* (Colom) in the red nodular limestones, Berriasian; sample 23, thin section No. 20751, x120; Fig. 3. ?*Protopeneroplis* sp. in the Upper Berriasian limestone; sample st-1, thin section No. 20754, x40; Fig. 4. Section through the crinoidal calyx (infrabasalia) in the Upper Berriassian limestone; sample 29, thin section No. 20262, x26; Fig. 5. Lithoclasts of microoncoidal limestones (in the centre and right lower corner), rhyncholite (left) and pentagonal columnalium (right) in the Horná Lysá Limestone (Upper Berriasian - Valanginian); sample st-1, thin section No. 20754, x20; Fig. 6. Lithoclasts with *Crassicollaria,* echinoderm segments, aptychus broken by compaction; matrix is almost absent, dissolution sutures around the allochems. See previous figure; thin section No. 17415, x40.



Pl. V. Horná Lysá Limestone, Berriasian - Upper Hauterivian; Fig. 1. Synsedimentary cracks; the veinlet network partly filled by lighter micrite, partly by sparite, intraclast are from the darker micrite. Sample 34, thin section No. 20267, x22; Fig. 2. Skeleton fragment of siliceous sponge in the limestone; voids after dissolved spicules filled by calcite. Sample 24, thin section 20257, x30; Fig. 3. Sponge in the limestone (spicules filled by calcite). Sample 31, thin section No. 20264, x40; Fig. 4. Spicules of lithistid sponges filled by chalcedony. Thin section No. 18415, x26; Figs. 5-7. Fragments of siliceous sponges skeletons extracted from the same sample with small chert nodules (scale bar = 0.1 mm).



Pl. VI. Chert nodules from the Horná Lysá Limestone (Valanginian - Hauterivian); Fig. 1. The same as Pl. V, Figs. 6-8; Fig. 2. Dinocyst in the chert nodule; sample 33, thin section No. 20266, x240; Fig. 3. Tiny globules - remains of lepisheres in a new-formed calcite grain; sample 1/91, thin section No. 19796, x120; Fig. 4. Veinlet preceding the formation of the nodular cherts represented an obstacle for the growing nodule (clear). Spicules in the surrounding limestone are filled by chalcedony, x40; Fig. 5. Ghosts of lithoclasts in the chert nodule penetrated by channels of boring algae accentuated by Fe-hydroxides; thin section No. 20775, x40; Fig. 6. Network of metasomatic calcite veinlets in the chert nodule with radiolarians. The veinlets are sharply limited at one side only. Sample 1/91, thin section No. 20775, x20; Fig. 7. Metasomatic calcite veinlet in chert seized some radiolarians, they are filled by calcite. Other voids after dissolved radiolarians were filled by chalcedony. Sample 33, thin section No. 20266, x20. All microphotographs are from the rocks of the Horná Lysá klippe, Vršatec area. Microphotographs: L. Osvald, scan photos: J. Stankovič.

ring the sedimentation and early diagenesis. It was confirmed under the polarizing microscope that the separated specimens are of the chalcedony and not calcitic (we have described selectively calcitized radiolarians from the Oxfordian radiolarites - Mišík, Jablonský, Ožvoldová and Halásová, 1992; their extracted skeletons were converted in fluorite). Such well preserved radiolarians were not observed in thin sections, as the probability of their interception is incomparably lower (a thin section 2 x 2 cm large and 0.003 - 0.006 mm thick contain the rock volume 1.2 - 2.4 mm^3, meanwhile the dissolved sample equalling a cube with the edge 2 cm represents the volume of 8000 mm^3).

The sample No. 33 contained a rich association (Pl. II, Fig. 9, 12, 13; Pl. III, Fig. 1, 2, 4, 5, 7 - 12) strongly dominated by *Nassellaria*. The following genera and species have been determined: *Acanthocircus dicranacanthos* (Squinabol), *A. trizonalis* (Rüst), *Archaeodictyomitra savignanensis* (Cita), *Cecrops septemporatus* (Parona), *Cryptamphorella* sp., *Cyrtocapsa grutterinki* Tan Sin Hok, *Holocryptocanium barbui* Dumitrica, *Parvicingula hsui* Pessagno, *Praeconocaryomma* sp., *Pseudodictyomitra lilyae* (Tan Sin Hok), *Ristola* sp., *Sethocapsa leiostraca* Foreman, *S. uterculus* (Parona), *Syringocapsa agolarium* Foreman, *S. limatum* Foreman, *Thanarla conica* (Aliev), *T. elegantissima* (Cita), *T.* sp., *Neotripocyclia echiodes* (Foreman), *Xitus spicularius* (Aliev).

Sethocapsa uterculus (Parona) started in the Hauterivian according to Schaaf (1984), in the Uppermost Valanginian according to Sanfilippo and Riedel (1985) and already in the Upper Valanginian according to Baumgartner (1984). The Upper Valanginian can be therefore considered to be the lower limit for our association. The upper limit is determined by the presence of *Acanthocircus dicranacanthos* (Squinabol) which terminates in the Hauterivian according to Schaaf (1984). The association can be correlated with U.A. 14 (Baumgartner, 1984, 1987).

The sample No. 18414 contained a poor association (Pl. III, Fig. 3, 6) with *Acaeniotyle diaphorogona* Foreman, *Cecrops septemporatus* (Parona), *Parvicingula hsui* Pessagno, *?Siphocampium davidi* Schaaf, *Thanarla conica* (Aliev), *Xitus spicularius* (Aliev). The decisive species *?Siphocampium davidi* Schaaf has the stratigraphical range: upper part of the Lower Hauterivian - Lower Barremian (Schaaf, 1984).

Sedimentary environment

The benthonic organisms (abundant echinoderm plates, lithistid sponges, majority of foraminifers, bivalvian fragments, echinid spines, ostracods, rare brachiopods and gastropods) are more numerous than planctonic (abundant radiolarians, *Cadosina fusca*) and nectonic ones (aptychi, very rare juvenile ammonites, rhyncholite, fish teeth and scales). The structures indicate that shallow-water bioclasts were repeatedly transported into the shallower bathyal. Almost complete absence of juvenile ammonite contrasting with abundant aptychi indicates the depth under the ACL. The described lithostratigraphic member strikingly differs from the typical pelagic Lower Cretaceous limestones of Kysuca unit. Expressively littoral elements are missing among the bioclasts transported down the slope (perhaps only the boring algae activity took place at the lower margin of the photic zone). Lithistid sponges living in relatively deeper water were transported at the shortest distance as bigger skeleton fragments and complete smaller specimes. *Lagenidae* (mostly *Lenticulina*) prevailed among the foraminifers; they are almost always damaged by transport and borings. Rare agglutinated foraminifers are not damaged; they represent autochtonous component. The most conspicuous redeposites are abundant lithoclasts with *Crassicollaria* etc. The intercalated layers of crinoidal biomicrite (packstone) lack the graded bedding and other signs of typical calciturbidites. The absence of *Globochaete* and *Nannoconus* is noteworthy (perhaps the diagenetic destruction?).

The main part of described Horná Lysá Limestone represent thin-bedded channelized grain flows and debris flows similar to the sediments with redeposited material in lowstand tracts (e. g. Upper Tithonian - Lower Neocomian sediments from Vocontian trough described by Strohmenger and Strasser, 1993). As in our case the alternation with typical pelagic sediments, representing highstand tracts, does not occur, the abundant redeposites were caused more probably by synsedimentary tectonics.

The sedimentation area of Horná Lysá Succession was situated nearer to the Czorsztyn area than the typical Kysuca Succession. A shallowing took place in the Czorsztyn area during the Neocomian and probably from there the crinoidal fragments were transported into the Horná Lysá Succession (more intensively during the eustatic declines) together with lithoclasts eroded from the channels on the steep slope. On the other hand, lithoclasts of microoncoidal limestones with *Saccocoma* and *Globochaete* could be considered as an argument to situate the Horná Lysá sedimentation area at the internal (southern) margin of the Kysuca through as that microfacies is known only from the pebbles of Pieniny exotic ridge and High Tatra unit and it is not known from the Czorsztyn unit.

Stratigraphical range

Upper Berriasian - Hauterivian (?Lower Barremian) can be derived from the following data. The highest level of the underlying red nodular limestones belongs to the Upper Berriasian. The lowest part of Horná Lysá Limestone did not contain any tinntinids or other age indicating microorganisms, but following brachiopods were found (determined by RNDr. M. Siblík, CSc.): *„Rhynchonella“ agassizi* (Zejszner) with time span Tithonian-Berriasian and *Nucleata bouei* (Zejszner) indicating Oxfordian-Berriasian. The highest uncovered horizon according to radiolarians belongs to Upper Hauterivian (?Lower Barremian). The continuation is tectonically cut. Red Globotruncana marls separate the Horná Lysá klippe of Kysuca unit from the klippe Chmelová belonging to Czorsztyn unit.

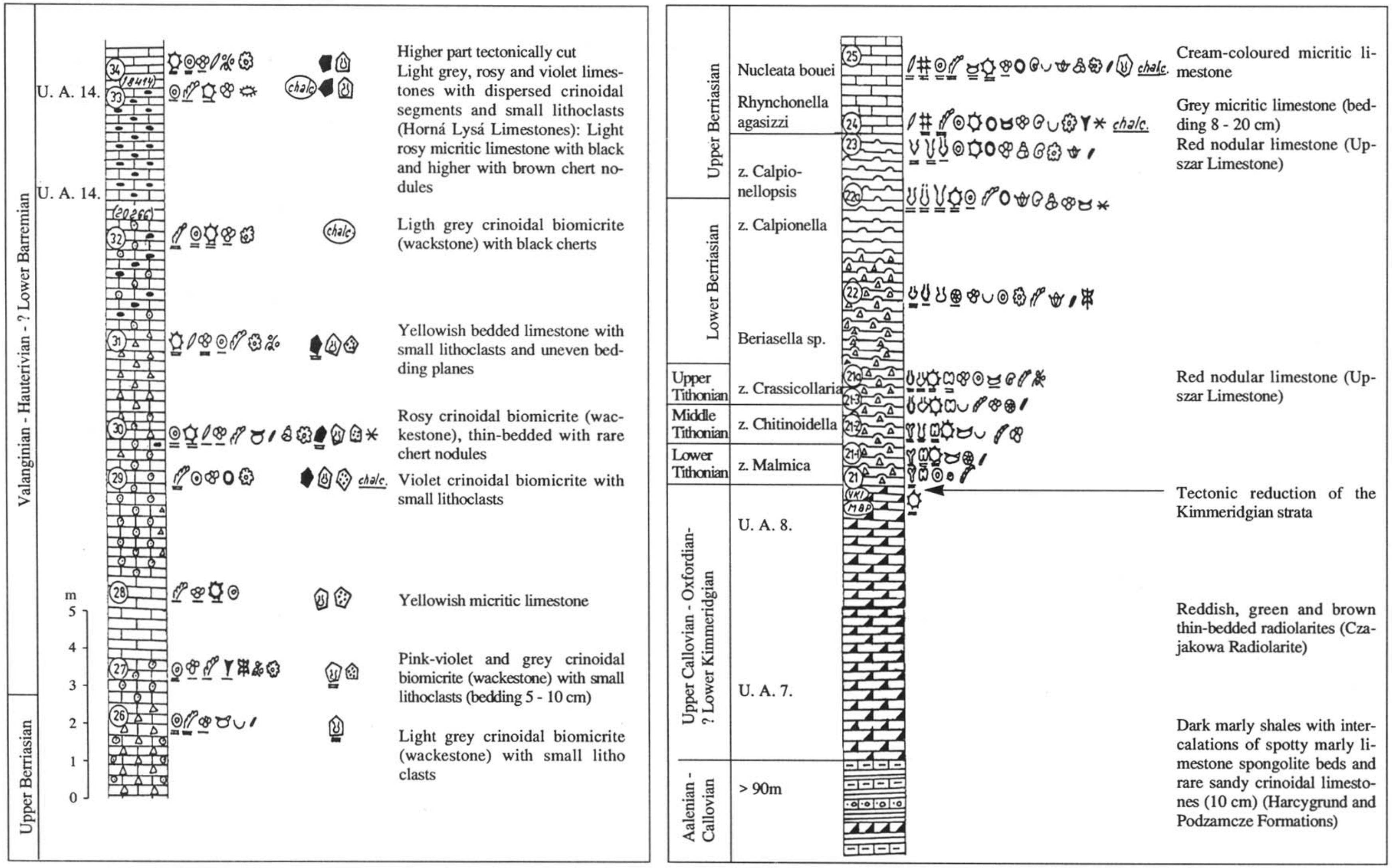


Fig. 2. Klippe Horná Lysá (Vršatec).

radiolarians
crinoidal segments
foraminifers
isolated sponge spicules
fragments of sponge skeletons
aptychi
echinid spines
bivalvians
gastropods
globochaete
Saccocoma
Crassicollaria
Chitinoidella
Calpionella alpina
Tintinnopsella carpatica
Tintinnopsella longa
Calpionellopsis oblonga
Parastomiosphaera malmica
Stomiosphaera moluccana
Colomishpaera sp.
Cadosina fusca fusca
dinocysts
ostracods
rhyncholites
juvenile ammonites
bryozoans
segments of Ophiuroidea
fish scales
fish teeth
micritic lithoclasts
lithoclasts with Crassicollaria
lithoclasts with microoncoids
synsedimentary cracks
chalc. slight silicification

Terminology

The described limestones have not any equivalent among the lithostratigraphical units established for the Pieniny Klippen Belt by Birkenmajer (1977). They are partly akin to Valanginian Walentowa Breccia Member characterized as detrital, microbreccia limestone with fragments of calpionellid limestone and crinoid segments in the matrix. The other signs are absent; its thickness is about ten times smaller. Walentowa Breccia Member occurs only in the Czorsztyn unit.

There are some analogies to the Sobótka Limestone Member which contains intercalations of detrital (microbreccia) limestones and layers of white and red crinoidal limestone. It is massive (almost without bedding), it does not contain siliceous nodules and fragments of sponge skeletons; its thickness is much smaller. According to Birkenmajer (1977) the Sobótka limestone is not present in the Branisko (= Kysuca) unit.

Thus, the described lithostratigraphical member is a new one and we suggest the name Horná Lysá Limestone derived from the elevation point 819 Horná Lysá (700 m NW from the elevation point 925 Chmelová) in the Vršatec area (Fig. 1).

As the type profile of the Kysuca Succession near Brodno by Žilina contains a totally different Neocomian - facies „biancone“ or „majolica“ (Scheibner and Scheibnerová, 1969; Michalík, Reháková and Peterčáková, 1990) we designate the succession as Horná Lysá variety of the Kysuca unit.

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Nová varieta kysuckej sukcesie pieninského bradlového pásma z bradla Horná Lysá (Vršatec)

V bradle Horná Lysá v skupine Vršatca pri Pruskom, ktoré patrí do kysuckej sukcesie, sa zistil odchylný vývoj spodnej kriedy. Červené hľuznaté vápence tu výnimočne siahajú až do beriasu (zóna Calpionellopsis). Nad nimi leží hornolyský vápenec (nový termín): svetlosivé, zriedkavejšie ružové a červenkastofialové mikritické vápence s vtrúsenými krinoidovými článkami a drobnými litoklastmi, vrstvovité 5 - 20 cm lavice, vo vyššej časti s čiernymi a hnedými rohovcami. Ich mocnosť je 21 m. Radioláriá U.A. 14 (Baumgartner, 1984) a zriedkavé brachiopóda určujú rozpätie súvrstvia na vrchný berias - hoteriv (? spodný barém). Pre hornolyský vápenec je charakteristická prítomnosť litoklastov s Crassicollaria (redepozity z vrchného titónu) a úlomkov mikroonkolitového vápenca so Saccocoma a Globochaete, ktoré boli doteraz známe len z obliakov v upohlavských zlepencoch a z vysokotatranskej jednotky. Pozoruhodné sú úlomky kostier silicispongií. V rohovcových hľuzách boli zistené relikty lepisfér. Hornolyský vápenec sa usádzal v pelagickom prostredí ovplyvňovanom početnými kanalizovanými zrnotokmi a úlomkotokmi, produkovanými pravdepodobne synsedimentárnou tektonikou v susednom území. Prvky vyložene plytkovodných litorálnych sedimentov v týchto alopadických vložkách chýbajú.