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NIŽNÁ SUBUNIT — NEW STRATIGRAPHICAL SEQUENCE OF THE KLIPPEN BELT (WEST CARPATHIANS)*(Text-figs. 1—3, Encl. 1)*

Abstract: In the paper is described the stratigraphical sequence, until now unknown, which was named Nižná Subunit. It is known from limited places in the Orava area in the vicinity of the village Nižná. Sequences of this subunit deposited in southern part of the Pieniny geosyncline in the area of the southern ridge.

Introduction

In the Klippen Belt, in the Orava area, between the village Nižná and Medvedzie (see encl. 1) occurs a series of klippens built of sequences which until now have not been described from the Klippen Belt. For these sequences I used the name Nižná Subunit (E. Scheibner 1966). Older beds of the Nižná Subunit are identical with those of the Kysuca Unit (Lias to Tithonian). Cretaceous sequences (Neocomian, Middle Cretaceous to Lower Santonian) have a special, mostly shallow-water character typical for the southern ridge.

Stratigraphy of the Nižná Subunit

In consequence of strong tectonic disturbance as well as in other places of the Klippen Belt, in the studied area do not occur the complete profiles starting from the oldest to youngest beds. Despite this, I have observed and studied a sufficient number of outcrops and profiles which allowed to distinguish the new subunit.

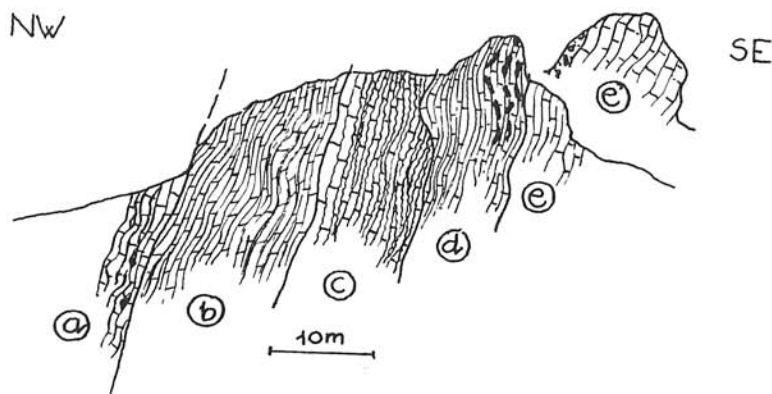
As a type profile I selected that (most complete) west of the village Krásna Hôrka, north of the village Nižná, east of the elevation point 608,1 (text-figs. 1, 2, 3). Further typical profiles are those north of the village Nižná through the elevation point 676,7 (Ostražica), south-west of the village Medvedzie and in the vicinity of the elevation point 703,8 (compare encl. 1).

As the oldest, until now known, sequence of this subunit is the Lower Lias in the Gresten facies. Near the village Krásna Hôrka (a quarry west of the village) occurs a special shallow facies of the Lower Lias unknown from other parts of the Klippen Belt. The Gresten facies known from the Klippen, Belt, however, is not of so shallow-water character. C. M. Paul (1867) was the first who mentioned this facies. He described it and mentioned some fossils (*Lima gigantea*) which have not been revised. This occurrence was detailly described by D. Andrusov (1931, p. 22—23).

Lower part of the Lias beds is formed of the coarse-grained sandstones with calcareous cement. The sandstones are light, white or yellowish. They form thick beds separated by intercalations of clay and marly shales of yellowish colour. There occur scarce intercalations of porous sandy limestones. The sandstones in places are coarser in grains and pass into finer-grained conglomerates with pebbles of quartz, weathered

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dolomites and dolomitic limestones of similar character as are those occurring in the Dogger crinoidal limestones of the Czorsztyn Unit. (Occurrences of the mentioned clastics have an importance for solution of palaeogeographical conditions and show the existence of the Triassic in the area of the southern ridge — E. Scheibner 1966).



Text-fig. 1. Profile of the klippen east of the elevation point 608,1, partially exposed in a desolate quarry, a) tectonically disintegrated Tithonian Neocomian of the Kysuca Unit; Nižná Subunit; b) radiolarites and radiolarian limestones (Kellaway—Oxford); c) nodular limestones (Kimmeridge—Lower Tithonian); d) bedded, higher cherty limestones (Tithonian—Neocomian); e) Nižná Limestone (Barremian—Aptian—Lower Albanian); e') isolated klippen at the base of the Nižná Limestone distinct breccias.

In places, in the sandstones occur fragments of crinoidal articles and they pass into the sandy crinoidal limestones. Thickness of these beds is about 40 m.

Microscopically, interesting are fine-grained sandstones which locally form transitions to siltstones with less frequent carbonatic matrix. Quartz grains show a various degree of cataclasis. Except for this, there occur grains of feldspars, mainly albite. Less frequent are fragments of crinoidal particles.

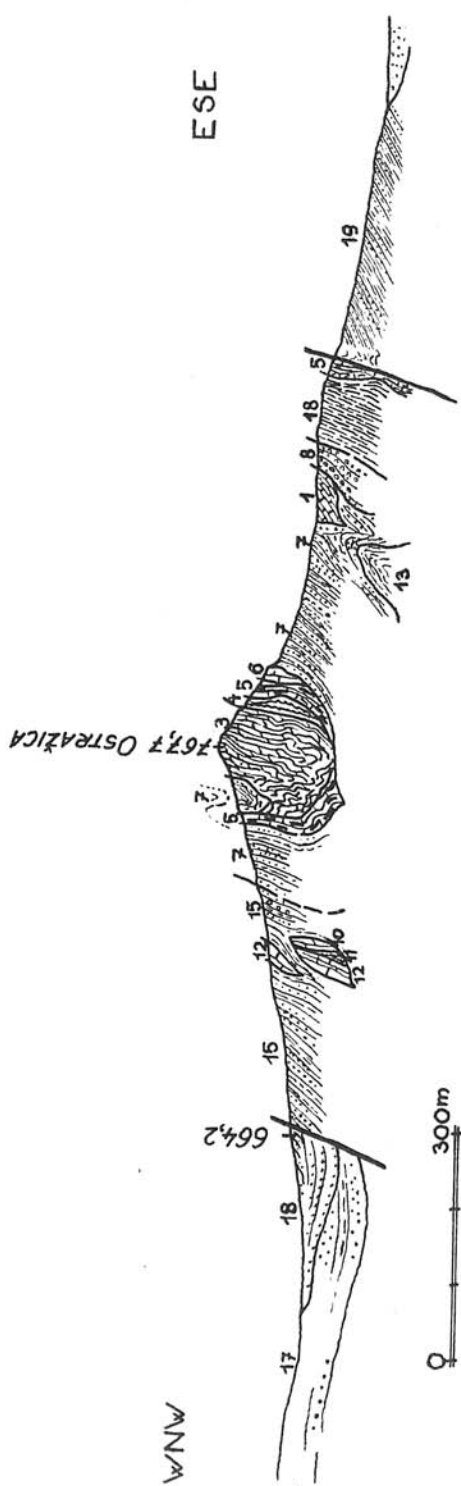
Porous sandy limestones are fine-crystalline with frequent clay substance. They contain spicules of Sponges and quartz grains.

Over the described beds, over the quarry in a smaller outcrop occur rocks of a different composition and smaller thickness. They are dark-gray sandy, fine-micaceous marly shales intercalating with bedded to thick-bedded dark-gray fine-grained to massive organodetrital limestones with lamellibranchs and similar limestones with fragments of crinoids. In the limestones were found: *Rhynchonella* sp., *Pecten* sp. and other undeterminable fossils. Probably, *Lima gigantea* described by C. M. Paul (1867) came from these limestones.

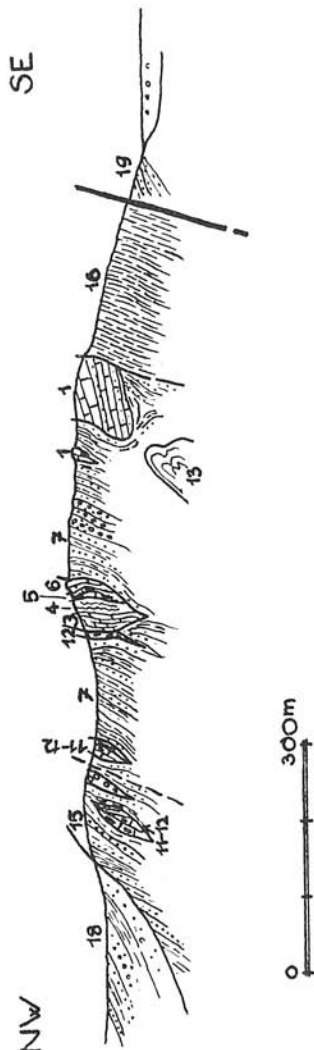
Recently, there was found a fragment of *Arietites* sp. which shows the Lower-Middle Liassic age (Sinemurian—Lower Pliensbachian).

Microscopically, the dark limestones are organogenous to organodetrital with a micritic or fine-crystalline matrix. Besides the organic detritus formed of fragments of lamellibranchs, brachiopods, sponge spicules and fragments of crinoids, occur the clastic quartz grains.

Over the limestone beds occur again sandstones as in the part of the described beds. D. Andrusov (1931) mentioned here bryozoans. In a bed of arcose-like sandstone



Text-fig. 2. Geological profile east of the elevation point 308.1 crossing the old quarries. Nizná Subunit: 1. Gresten Member; 3. radiolarites; 4. nodular limestones; 5. Calpionella and cherty limestones; 6. Cenomanian conglomerates; 9. Santonian flysch beds; Kysuca Unit: 10. radiolarites; 11. nodular limestones; 12. Tithonian—Neocomian; 13. Rudina and Green Globotruncana Members; Upper Cretaceous; 15. Santonian—Campanian; 16. Campanian—Maastrichtian; Magura—Palaeogene; 17. lower part of the Magura Palaeogene; 18. upper part of the Magura Palaeogene; Central Carpathian Palaeogene; 19. Zakopané Member.



Text-fig. 3. Geological profile north of Nizná trough Ostrážica Hill. Explanations the same as in textfig. 2.

were found nodule-like forms formed of bryozoans however, without more detailed identification.

North-east over the village Nižná, east of the Ostražica Hill by an artificial ditch was outcropped a sequence of the thickness to 25 m, which can be placed also into the Lias. In this sequence alternate spotted sponge limestones, slightly sandy sponge spotted limestones, sandy marly shales, bedded micaceous sandstones, strongly sandy shales, bedded arcose-like sandstones, yellow siltstones, disintegrating sandstones, spotted marly limestones and shales.

Microscopically, these rocks are mostly spotted, marly, sponge, slightly sandy; organic detritus is formed of spicules of *Silicispongia* (mainly *Tetractinellida* — the most frequent are monaxones, tetraxones, less numerous are forms from the calcitrop — oxyaster and several polyaxial sclerites — sphaeraster). The spicules are mostly calcified, and some spicules form one monocrystal of calcite, others are composed of crystalline aggregates. Part of spicules is of chalcedony or fine-crystalline quartz. We see frequently replacement by the basal marly mass. Besides the sponge occur rare sections of foraminifers, calcified radiolarians and numerous sections of fine-walled lamellibranchs, which form indistinct filamentous microfacies. The clastic material is composed of grains of quartz (0.1–0.3 mm) and there occur also the authigenic quartz. Very rare is muscovite. There occur grains of glauconite and frequent pyrite forming minute globules. The pyrite originated also epigenetically; there occur smudges of the pyrite grains running across the lamination.

The sponge microfacies and mainly sandy sponge limestones are typical for the Lower-Middle Lias and spotted marly limestones mainly in the Kysuca Unit occur in the Middle-Upper Lias.

The Posidonia Member represents a further member of the Nižná Subunit. These beds have a similar stratigraphical position as in other places of the Klippen Belt (Aellenian). They occur on the both sides of a stream in the village Medvedzie in a sequence of larger klippen occurring south-west over the village. They are represented by black to dark-gray bituminous clay and marly shales with irregular disintegration. In places we see the typical disintegration of the Posidonia Member with uneven surface of stratification planes with a plenty of shells of *Posidonia alpina* (Gras). In the shales occur intercalations of dark-gray to black calcareous sandstones with transitions into the sandy limestones and rare discoidal (Ø up to 10 cm) dark-gray pelocarbonatic concretions. These beds form tectonical fragments and represent only a part of the member.

The Supraposidonia Member, which probably occurs in this subunit, until now has not been found.

Radiolarites and radiolarian limestones are developed similarly as in the Kysuca Unit.

At the base, there occur the Mn-radiolarites occurring together with the abovedescribed Posidonia Member in a stream in the village Medvedzie. They are in the tectonical contact with the Posidonia Member, Mn-radiolarites form a bed of 1.5 m thickness. They are composed of black bedded to thin-bedded radiolarites with thin intercalations (up to 2 cm) of black clay-siliceous shales. Mn-oxides form covers on the weathered planes.

Green and red radiolarites occur in several klippens. They are best outcropped in a quarry north-west of Krásna Hôrka, east of the elevation point 608.1. In the western part of the quarry occur bedded and thick-bedded radiolarites and radiolarian limestones with thin intercalations of siliceous clayey shales. These rocks are of gray, green-gray, and green colours in uppermost parts brownish, red-brown and pass into the bedded, indistinctly nodular limestones of the Kimmeridge. Thickness is about 15 m.

Microscopically, the radiolarites (jaspers) are formed in the main by radiolarians which

occur in pelitomorphic, rarely fine-grained, probably recrystallized marly or clay-siliceous basal mass. SiO_2 is in the form of chalcedony or quartz. Besides the mentioned we see minute idiomorphic hexahedra of dolomite, sometimes directly in radiolarians formed of chalcedony. The radiolarians are frequently calcified and are of *Nassellaria* and *Spumellaria* type. The radiolarian limestones represent the organodetrital micritic limestones with marly basal mass. Organic detritus is formed of radiolarians, sponge spicules and „filaments“. Sometimes we see the distinct lamination.

On the stratification planes of the mentioned rocks, mainly on their lower side, there occur aptichi showing Upper Kelloway—Oxfordian age. The limestones afforded: *Lamellaptychus* gr. *C. thoro* Oppel and *Laevaptychus* (*Latuslaevaptychus*) which show the horizon II by S. M. Gąsiorowski.

Nodular limestones are connected by transitions with radiolarites and radiolarian limestones and build some klippens. The best outcrops are in the destitute quarry north-west of Krásna Hôrka (thickness of about 10 m) and south-west of Medvedzie (thickness of about 5 m). The mentioned beds are formed of limestones of red, red-brown and pink colours, mostly bedded, thin-bedded to thick-bedded with uneven nodular surface. In places, they are distinctly nodular with shaly to nodular disintegration. In the bedded limestones nodularity manifests in irregular distribution of organodetrital material. Light, white, pink, medium-grained „nodules“ are surrounded by red fine-grained marly mass.

Microscopically, the „nodules“ are coarser-grained, organodetrital, frequently crinoidal limestones with fine- to coarse-grained recrystallized calcitic basal mass, while the surrounding mass is organodetrital micritic limestone with marly basal mass, red coloured by hematitic pigment. The organic detritus in these limestones is formed of skeleton fragments of the genus *Saccocoma* (crinoid). In places, in the limestones with shaly disintegration were found the whole minute calixes (Ø 3–5 mm) belonging to this genus. Besides this, there occur *Globochaete*, *Stomiosphaera*, radiolarians, ostracods, foraminifers (*Spirillina* sp., *Involutina* sp. rotaliids and others), juvenile ammonites and frequent aptichi. In the uppermost horizons occur sections resembling Calpionelles. This indicates Tithonian age of upper horizons. Some types of these limestones are formed of pellets. Typical microfacies are those with *Saccocoma* sp. („*Lombardia*“), pellet and *Saccocoma* and foraminiferal ones (with *Involutina* sp.).

On the basis of the mentioned facies (they occur in detailed studied profiles of the Kysuca Unit) in overlying Tithonian limestones and mainly frequent aptichi we can the mentioned rocks place into the Kimmeridge up to Lower Tithonian [*Lamellaptychus* gr. *B. sparsilamellosus* (Gümbel), *L. lamellosus* Park. and *Laevaptychus latobliquus* Trauth: horizon V by S. M. Gąsiorowski].

Calpionella and cherty limestones. Over the modular limestones (Kimmeridge) lie pink, light-gray, yellowish thin-bedded massive micritic marly limestones in upper part of which occur black cherts. These limestones form several independent klippens and occur also together with the above-mentioned beds. In places, they are of gray colour, thin-bedded to thick-bedded, alternating with gray marly shales.

Microscopically, these limestones are organodetrital, with micritic matrix. Organic detritus is composed of calpionelles *Calpionella alpina* Lör., *C. elliptica* Cadisch, higher *Calpionellites neocomiensis* Colom, *Stenosemellopsis hispanica* (Colom) etc. Very frequent in lower horizons is *Globochaete alpina* Lomb. Besides the mentioned, there appear radiolarians, ostracods and foraminifers. Part of the limestones is in the main formed of *Nannoconus* (*N. steinmanni* Kamptner etc.). In higher horizons there occur intraclasts of marly Calpionella limestones from lower horizons, even the Kimmeridgian limestones.

Stratigraphical range of the Calpionella and cherty limestones on the basis of *Calpionella* is Tithonian—Neocomian similarly as in the Kysuca Unit. The occurrence of the intraclasts shows a shallowing or emerging of part of the southern ridge in consequence of the Neocimmerian movements.

The Nižná Limestone. In the type area of the Nižná Subunit, i. e. between Nižná

and Medvedzie was found that the organodetrital crinoidal limestones with fragments of carbonatic rocks, placed until now on the basis of macroscopic lithological criteria to the Dogger of the Czorsztyn Unit (D. Andrusov 1938 — geological map of Orava) are in fact gravel or slightly sandy gravel limestones in places with *Orbitolinas* and their age is Barremian—Aptian—Lower Albian. They represent a special paraurgonian facies. It is necessary to mention that similar rocks were described by D. Andrusov (1945) from blocks in the Burdigalian conglomerates in the vicinity of Predmier (Považie area). Thickness about 10 m.

East of the elevation point 608.1 at the base of the Nižná Limestone, there appear breccias formed of fragments of the Tithonian-Neocomian limestones of the Nižná Subunit, fragments of black cherts, limestones and yellowish shales (Lias) cemented by the organodetrital limestone. The occurrence of these breccias could be explained by interruption of sedimentation after the Neocomian, prior to the Barremian in connection with shallowing of the southern ridge, reflected also in a transition to the paraurgonian shallow-water facies. In places probably originated erosional phenomena and the mentioned breccias. In other places, contact of the Nižná Limestone with the Neocomian is along the irregular plane, however, mostly tectonical.

Macroscopically, the Nižná Limestone is gray, green-gray, in places yellowish, medium- to coarse-grained organodetrital gravel limestone, locally with cherts, in places with fragments of carbonatic rocks. Part of the organic material may be identified as fragments of crinoids and corals.

Microscopically, these rocks are mostly gravel, sometimes slightly sandy, with foraminifers. To the oldest horizons belong the types of biosparitic character, in other places, higher occurs micritic marly mass. In places was seen a growing of the calcite and crustification texture. The gravels are formed of fragments of organisms and rocks. From among organisms are shells of lamellibranchs, brachiopods and gastropods on which one can see traces after strong drilling action of minute algae, fragments of crinoidal articles, spines of echini, corals and algae: *Dasycladaceae*, *Acicularia* and *Solenopora* [*Archaeolithothamnium belgicum* (Foslie), *Archaeolithothamnium* sp., *Pseudolithothamnium* sp. etc.]. We can see also gravels formed of these rocks: *Nannoceras* limestones, *Calpionella* limestones with *Saccocoma*, radiolarian limestones, radiolarites and sponge limestones. In part of the described limestones appear well reworked psammitic quartz grains of medium size. In the basal mass in various horizons of the Nižná Limestones occur frequent foraminifers [*Miliolidae*, *Valvulineria*, several agglutinantia, *Lituolidae*, *Textularia* sp., *Spirillina* sp., *Pseudolituonella* sp., *Hedbergella* sp., *Orbitolina* sp. — minute forms, *O. cf. conoidea* (Craş) and *O. discoidea* (Craş)]. In uppermost parts there occurs *Ticinella roberti* (Gand.).

The oldest horizons of the Nižná Limestone with the basal breccias and limestones have a character of biosparites are of Barremian—Aptian age (Urgonian). The youngest horizons, on the basis of *Ticinella* sp., correspond to the Albian, the main mass is of Aptian age.

In surrounding of the above-mentioned beds in the tectonic contact lies a flysch sequence with intercalations of exotic conglomerates. Until now these beds were placed to the Upper Cretaceous of the Klippen Belt. Outcrops of the flysch beds are well seen at the beginning of the valley towards Zemianska Dedina village and in the field roads. We see alternation of bedded gray-brown, fresh blue-gray sandstones, graywackes, sometimes coarse-grained polymict sandstones. There occur beds of a flysch, graded bedded conglomerates, in places of olistolitic character. Pebbles are well reworked, in olistolitic conglomerates unsorted. Very frequent is crystalline and exotic material; in limestone material pebbles of the Czorsztyn Unit, have not been found. Between the sandstone beds are intercalations of marly, in places silty shales of brown-gray colour. Unfortunately until now were found only indeterminable agglutinantia. In one of beds

of the exotic conglomerates north-north-west of the elevation point 596.3 on the left side of a slope, at the beginning of the valley towards Zemianska Dedina, were found large Orbitolinas [*O. plana* d'Arch.] — the typical Cenomanian species]. Besides it, there appear Orbitolina sandstones to sandy limestones in the northern part of this conglomerate layer.

The Orbitolina sandstone is a coarse-grained sandstone with a marly cement. Some quartz grains are well reworked, others are sharp-angled reaching up to 5 mm in diameter. These fragments of rocks were found: quartzites, limestones, melaphyries, and other basical eruptives. Orbitolinas: *Orbitolina* sp. and *O. cf. conoidea* Gras have coarse-agglutinated walls with medium-grained psammitic material (sharp-angled quartz grains, rarely zircon). Uneven size of agglutinating material possibly shows that they lived in different environments, i. e. they represent thannatocoenosis. There occur irregular fragments of Lithothamnium and crinoids.

Data by K. Borza (1966) and A. Began, K. Borza, J. Salaj and O. Samuel (1965) on the occurrence of the Cenomanian conglomerates with *Orbitolina cf. conoidea* near Zemianska Dedina are referred to the above conglomerates. In the work by J. Salaj and O. Samuel (1966, p. 82) they were placed to the Pieniny Unit incorrectly. Besides this, the mentioned authors to the Pieniny Unit placed the occurrences of the Rudina Member and Green Globotruncana Marls of the Kysuca Unit occurring in the tectonic window from below the Nižná Subunit near the mill of Zemianska Dedina.

On the whole, the above-mentioned flysch beds with intercalations of conglomerates represent probably the whole Middle Cretaceous of the Nižná Subunit. They need, however, the further studies, also from the reason, that on the north they are connected with macroscopically and lithologically similar sequences of the Santonian—Campanian. The boundary until now is conventional.

South of Medvedzie in an artificial outcrop in the tectonic contact with the Red Globotruncana Marls and siltstones of the Campanian—Maastrichtian on the north and Central Carpathian Palaeogene on the south, there occur the flysch beds formed of polymict sandstones alternating with gray sandy marls, marly and silty shales with two layers of clay shales of red and yellow colours with rich Lower and Middle Santonian microfauna. On the mentioned tectonic contact with the Campanian—Maastrichtian appear thick veins of the secondary calcite, in which were found fragments of the Nižná Limestone. This shows connections to the Nižná Subunit. The flysch beds are tectonically separated. These beds represent the youngest member of the Nižná Subunit.

Conclusions

The Nižná Subunit originated at the beginning in a shallower environment as the Kysuca Unit (Lias), in the Dogger and Malm has rather identical character with the Kysuca Unit. In the Cretaceous, the sedimentary area becomes shallower in consequence of Neocomian synorogenic movements. At the end of Neocomian (probably Barremian) sedimentation was even interrupted (breccias at the base of the Nižná Limestone). Cretaceous sedimentation has on the whole a shallow-water character, typical for the area of the southern ridge in the Pieniny geosyncline. Clastic material in the Middle Cretaceous beds comes from the Pieniny cordillera (exotic cordillera) emerged part of the southern ridge. Sequences of the Nižná Subunit lie tectonically over the Kysuca Unit.

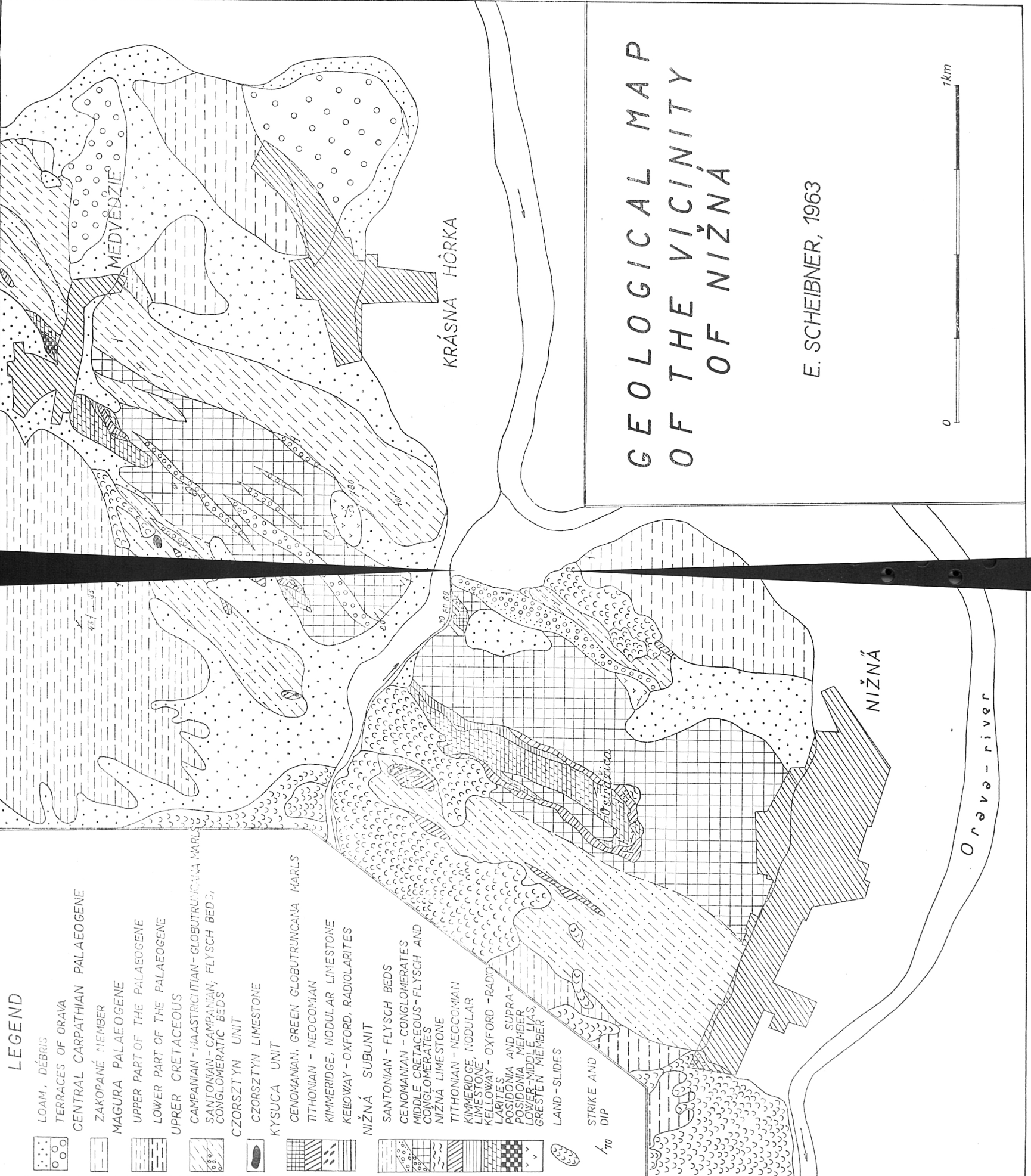
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Review by D. Andrusov.

LEGEND

- LOAM, DÉBRIS
- TERRACES OF ORAVA
- CENTRAL CARPATHIAN PALAEOGENE
- ZAKOPANÉ MEMBER
- MAGURA PALAEOGENE
- UPPER PART OF THE PALAEOGENE
- LOWER PART OF THE PALAEOGENE
- UPPER CRETACEOUS
- CAMPANIAN - MAASTRICHTIAN - GLOBUTRUNCANA MARLS
- SANTONIAN - CAMPANIAN, FLYSCH BEDS, CONGLOMERATIC BEDS
- CZORSZTYN UNIT
- CZORSZTYN LIMESTONE
- KYSUCA UNIT
- CENOMANIAN, GREEN GLOBUTRUNCANA MARLS
- TITHONIAN - NEOCOMIAN
- KIMMERIDGE, NODULAR LIMESTONE
- KELOWAY - OXFORD, RADIOLARITES
- NIŽNÁ SUBUNIT
- SANTONIAN - FLYSCH BEDS
- CENOMANIAN - CONGLOMERATES
- MIDDLE CRETACEOUS - FLYSCH AND CONGLOMERATES
- NIŽNÁ LIMESTONE
- TITHONIAN - NEOCOMIAN
- KIMMERIDGE, NODULAR LIMESTONE
- KELOWAY - OXFORD - RADIOLARITES
- POSIDONIA AND SUPRA-POSIDONIA MEMBER
- LOWER-MIDDLE LIAS, GRESEN MEMBER
- LAND - SLIDES
- STRIKE AND DIP



GEOLOGICAL MAP OF THE VICINITY OF NIŽNÁ

E. SCHEIBNER, 1963

