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# A FIELD TRIP TO THE FAMENNIAN OF THE MORAVIAN KARST (ČSSR)

by

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(11 figures)

**ABSTRACT.** - Sections in the Famennian limestones of the Brno area are described near Mokrá, Jedovnice and Líšeň. The facies and thickness of these Famennian carbonates have been largely controlled by differential synsedimentary subsidence of small blocks of the Proterozoic basement. (Abstracted by the editors).

**RESUME.** - Des coupes dans les calcaires famenniens de la région de Brno sont décrites près de Mokrá, Jedovnice et Líšeň. Le faciès et l'épaisseur de ces carbonates famenniens a été contrôlé surtout par les subsidences synsédimentaires différentes de petits blocs du socle Protérozoïque.

## INTRODUCTION

The Upper Devonian and Lower Carboniferous limestones of the Moravian Karst can be studied in some big outcrops (figs. 1 and 2). Nodular and organodetrital limestones of Famennian age occur on top of Upper Frasnian reefal limestones in the Mokrá area. The facies and thickness of these Famennian carbonates have been largely controlled by differential synsedimentary subsidence of small blocks of the Proterozoic basement producing heterochronic lithofacies in the Mokrá Quarry.

Red nodular limestones and limestone breccias with slumping can be observed in a small quarry near Jedovnice. These represent a condensed nearshore sedimentation during the Famennian on the border of a tilted block. Regressive tendencies reached their acme during the Lower Tournaisian in this area.

On the contrary, a relatively thick sequence of dark-grey, organo-detrital limestones of the same age characterizes the deposits around Líšeň.

## MOKRÁ QUARRY

This is a huge, active quarry where limestone is extracted for a cement factory. A detailed description is given by Dvořák *et al.* (1986). Three sections may be visited : the westernmost section (A), the southwestern section (B) and the northwestern section (C) (fig. 3). These display important differences in the thickness and stratigraphic ranges of the various lithofacies. Each section starts with reefal Vilémovice limestones. These are overlain by the nodular Křtiny limestones (sometimes intercalated by cephalopod-bearing limestones), and

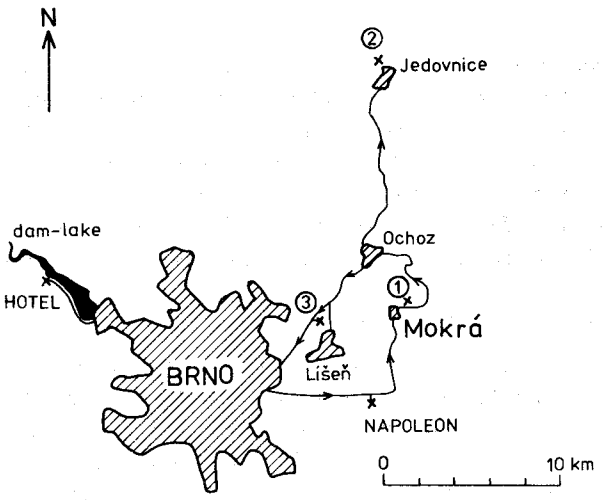


Figure 1. - Map of Brno area showing location of sections near Mokrá, Jedovnice and Líšeň.
The participants to such an excursion may be housed in a hotel West of Brno. A touristic stop is possible at the famous battlefield of Austerlitz, where the French troops under Napoleon marched against the Austrian and Russian armies in 1805.

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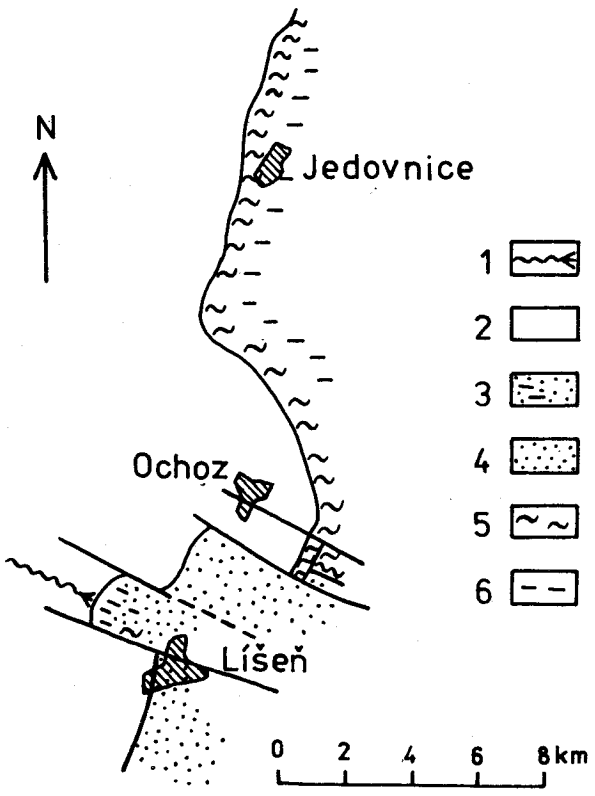


Figure 2. - Paleofacies scheme of the Moravian Karst during Upper Famennian time.
1. deltaic facies; 2. (dry) land; 3. black silty shales with intercalations of dark-grey limestones; 4. well-bedded, dark-grey organodetrital limestones; 5. condensed variegated nodular limestones; 6. dark-grey shales with rare nodules of micritic limestones.

subsequently by the organodetrital to micritic Hády-Říčka limestones. The latter are relatively thin (about 8 m) in the northwestern section, where these are intercalated in the nodular Křtiny limestones. But in the southwestern section, the organodetrital to micritic Hády-Říčka limestones are about 200 m thick ! A concise description of the sections is presented here below.

**WESTERNMOST SECTION (A)** (fig. 4)

The sequence starts with the thick (Upper Frasnian-Lowermost Famennian) reefal Vilémovice limestones. In the uppermost portion these contain stromatoporoids, corals, foraminifera and conodonts. The upward transition into the nodular Křtiny limestones is situated in the upper part of the *Palmatolepis crepida* zone (Lower Famennian). Two metres above this boundary, a conodont assemblage of the *Palmatolepis marginifera* zone occurs. Halfway the nodular Křtiny limestones, some lenses of crinoidal limestones (encrinites) occur (containing conodonts of the *P. marginifera* zone). Some 50 m to the South 20 cm thick lenses of black limestones have been observed, containing a rich cephalopod assemblage with *Platyclymenia (Platyclymenia)* ex. gr. *intracostata* and *Sporadoceras*

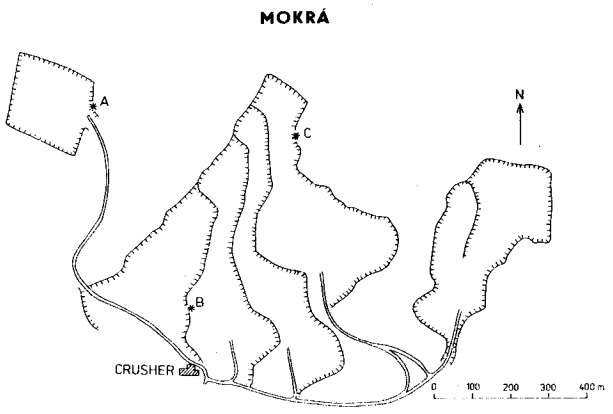


Figure 3. - Scheme of the Mokrá Quarry, indicating positions of the sections in the westernmost (A), southwestern (B) and northwestern (C) parts of the quarry.

sp. (det. : J. Kullmann, Tübingen) and conodonts of the *Scaphignathus velifer* zone.

In the upper portion of this outcrop a slow, upward transition can be observed between the nodular Křtiny Limestones and the well-bedded, dark-grey organodetrital Hády-Říčka Limestones. The latter contain conodonts of the *Bispathodus costatus* zone (Upper Famennian).

**SOUTHWESTERN SECTION (B)**

This section resembles the westernmost one. However, the lithological boundary between the reefal Vilémovice limestones and the nodular Křtiny limestones is found in the *Palmatolepis marginifera* zone, and not in the *Palmatolepis crepida* zone !
The boundary between the nodular Křtiny limestones and the dark-grey, well bedded organodetrital Hády-Říčka limestones is relatively sharp and coincides with the boundary between the *P. marginifera* and *Scaphignathus velifer* zones. Note that the thickness of the Křtiny limestones in this section is about 5 m, whereas this is only 3 m in the westernmost outcrop. The thickness of the Hády-Říčka limestones is about 200 m. These contain rich assemblages of foraminifers and coodonts belonging to the *S. velifer, Polygnathus styriacus* and *Bispathodus costatus* zones. A comparable sequence is observed in the Líšeň (Lesní lom) Quarry. But there, the nodular limestones start already in the *P. triangularis* zone.

**NORTHWESTERN SECTION (C)** (fig. 5)

In the northwestern part of the highest quarry floor a detailed section of Famennian to Tournaisian limestones can be studied. The reefal Vilémovice limestones are overlain by brown, oolitic ironstones and limestones (0.5 m thick), which form the base of the Křtiny limestones. The overlying cephalopod-bearing, grey biomicritic limestone layer has yielded conodonts of the uppermost *Palmatolepis crepida* zone. The

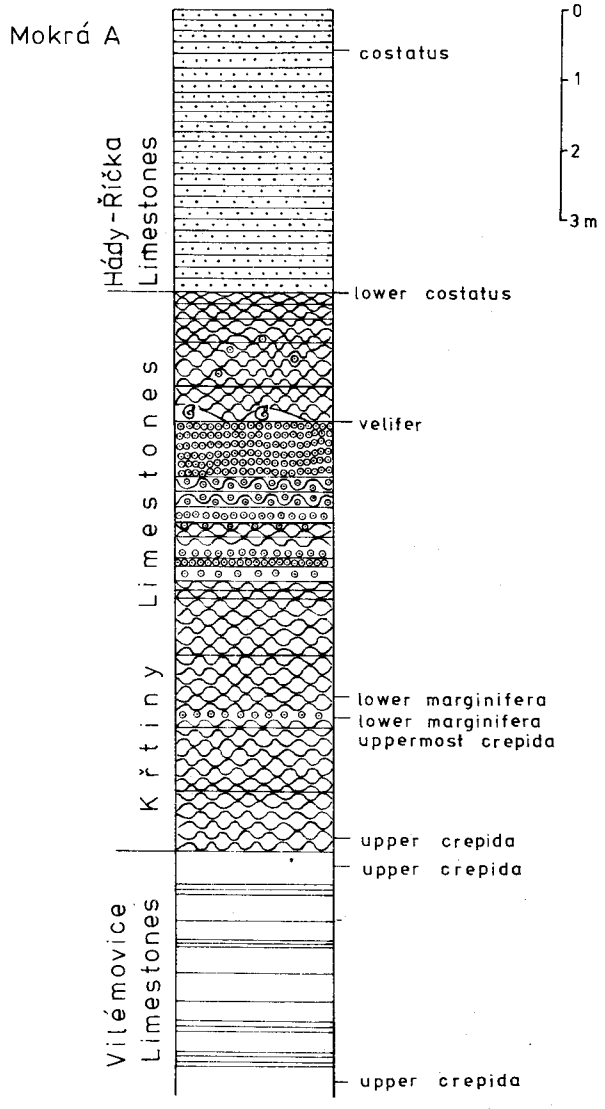


Figure 4. - Synthetic westernmost section (A) of Mokrá Quarry. For legend see fig. 5.

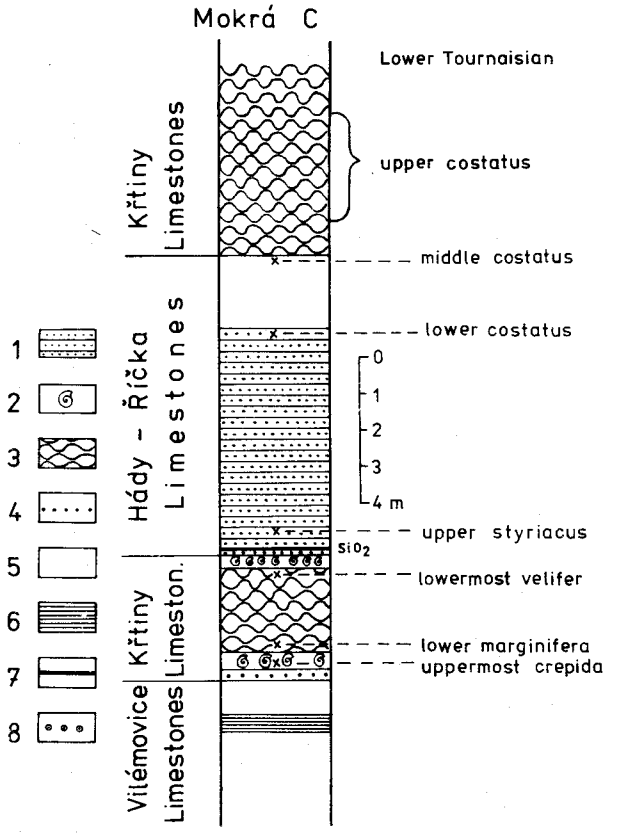


Figure 5. - Synthetic northwestern section (C) of Mokrá Quarry. Legend to figures 4 and 5.
1. rhythmic succession of grey, organodetrital limestone beds grading into micrite; 2. cephalopod-bearing, grey biomicrite; 3. grey, nodular limestone; 4. oolitic ironstones and limestones; 5. light-grey to grey, dense micrites; 6. light-grey, laminated limestone; 7. black chert; 8. crinoidal limestone.

nodular (Křtiny s.s.) limestones contain conodonts assemblages ranging from the lower *Palmatolepis marginifera* to the lowermost *Scaphignathus velifer* zones. The top of the Křtiny limestones in this section consists of a 0.35 m thich bed of cephalopod-bearing, grey biomicritic limestones. The total thickness of the Křtiny limestones in the northwestern section (3.5 m) is comparable to that observed in the westernmost section.

The overlying Hády-Říčka limestones are relatively thin (8 m) as compared to the about 200 m thick sequence in the southwestern section. These consist of a lower half (6 m) of grey, well-bedded limestones showing a graded bedding in each layer of organodetrital limestones upwards passing into micrites, and an upper portion (2 m) of grey, massive micrite. A black chert is intercalated near the base of

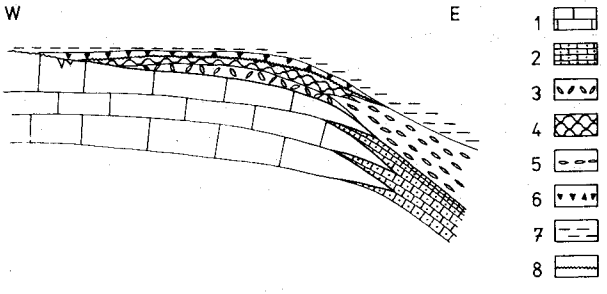


Figure 6. - Schematic reconstruction of paleofacies in the Jedovnice area (partly based on borehole data). Not to scale !
1. Frasnian reefal "Vilémovice" limestones; 2. Vintoky Member (off-reef, dark-grey, well-bedded organodetrital limestones with intercalations of black calcareous shales), Frasnian; 3. grey and red limestone breccias (caused by slumping) with stromatolites and stromatactis, Frasnian-Famennian boundary; 4. predominance of red or grey nodular limestones, Famennian to Lower Tournaisian; 5. dark-grey, nodular limestones gradually passing into calcareous black shales with nodules of micritic limestones, Famennian to Lower Tournaisian (lithofacies 3 to 5 belong to the Křtiny limestones); 6. Upper Tournaisian (?) sandy limestone breccias containing fragments of Vilémovice and Křtiny limestones, and also phosphatic nodules; 7. Lower Carboniferous shales; 8. stratigraphic gap.

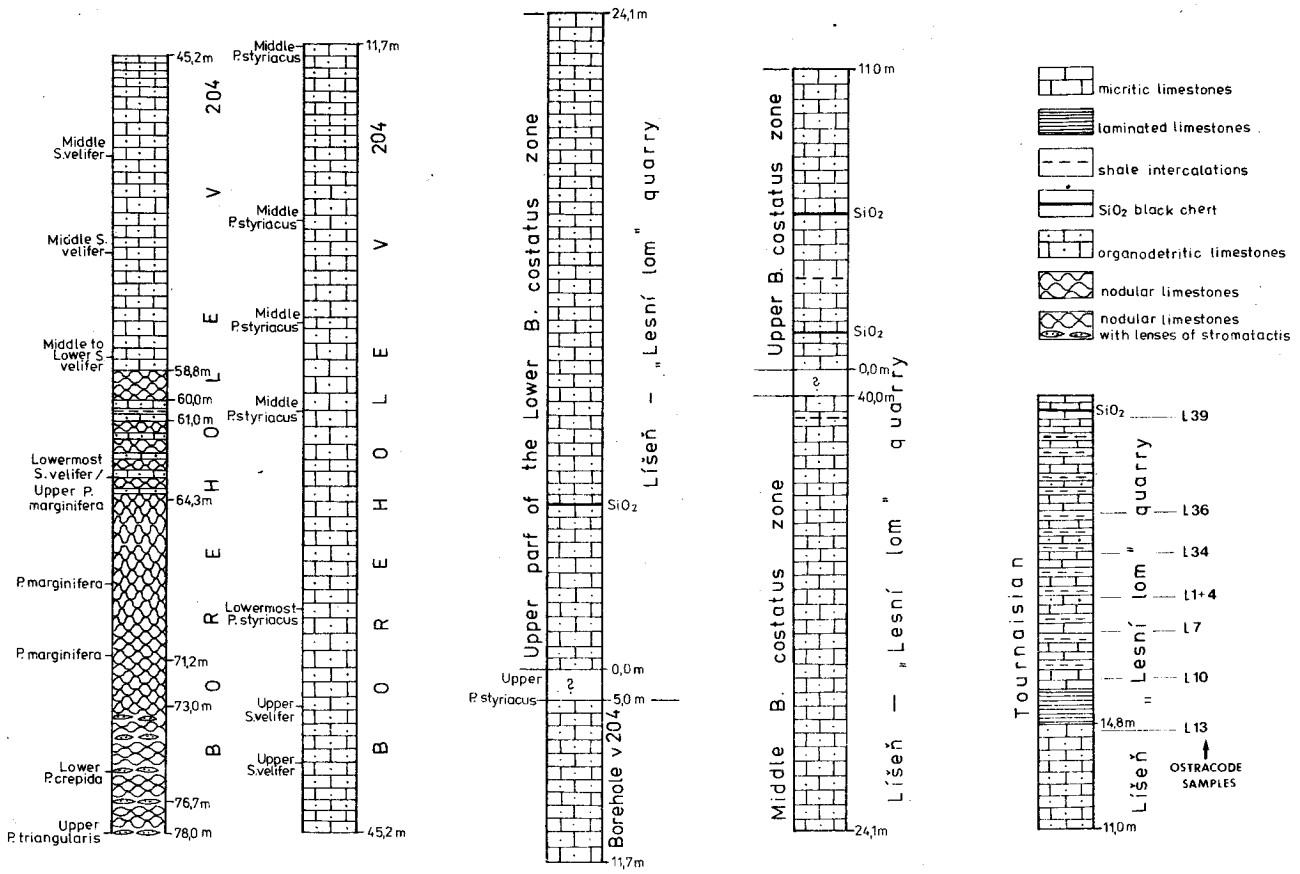


Figure 7. - Synthetic section of Líšeň Quarry (Lesní lom), completed by data from borehole V-204.

the limestones. Conodont assemblages in this interval belong to the upper *Polygnathus styriacus* to middle *Bispathodus costatus* zones. The top of the section is formed by some 10 m of nodular Křtiny limestones yielding conodonts of the upper *B. costatus* zone. This means that the terms Vilémovice, Křtiny and Hády-Říčka limestones represent different lithofacies, rather than true lithostratigraphic entities. The rapid lateral and vertical changes of these lithofacies as documented in the Mokrá quarry by conodont assemblages are related to synsedimentary faults, which can be observed at several places in this quarry.

## JEDOVNICE QUARRY (fig. 6)

This is a small abandoned quarry North-West of the village Jedovnice. The oldest outcropping rocks are the reefal Vilémovice limestones. These light-grey, massive limestones contain some laminated intercalations with bird's eyes structures, and very rare lenses of stromatolites. Upwards these gradually pass into grey micrites with a nodular structure, yielding conodonts of the Upper Frasnian *Palmatolepis gigas* zone. Thick-bedded to massive limestone breccias occur higher up in the sequence. Near the base these contain platy nodules (up to 8 cm in length) of grey micrites "floating" in a matrix of light-grey micritic limestones. The long axis of these nodules forms an angle of 60-80° with the bedding plane. This position of the nodules is due to slumping. The upper portion of the limestone breccias is red-coloured. Sometimes, these red-coloured layers contain red, laminated stromatolites with an undulate, loaf-like surface (observed in boreholes in the surroundings of the quarry; Dvořák *et al.*, 1976). The conodont assemblages from the top and the bottom of this interval indicate a *Palmatolepis triangularis* age. A 3 m thick sequence of purplish, nodular limestones with some clayey matrix covers the limestone breccias. These have yielded conodonts of the Lower Famennian *Palmatolepis crepida* to *Palmatolepis marginifera* zones. The original sedimentary structures have been partly destroyed by eastward slumpings (in the direction of the basin center). The youngest deposits in the Jedovnice quarry display the typical lithofacies of the Křtiny limestones. These consist of pink, nodular limestone layers (0.5 - 3 cm thick) in a dark purple, calcareous clay matrix. The limestone/matrix ratio is very variable. The conodonts from the Křtiny limestones belong to the *Palmatolepis marginifera* to *Polygnathus styriacus* zones. The period of red nodular limestone deposition was marked by abundant supply of clayey clastics which underwent a strong chemical

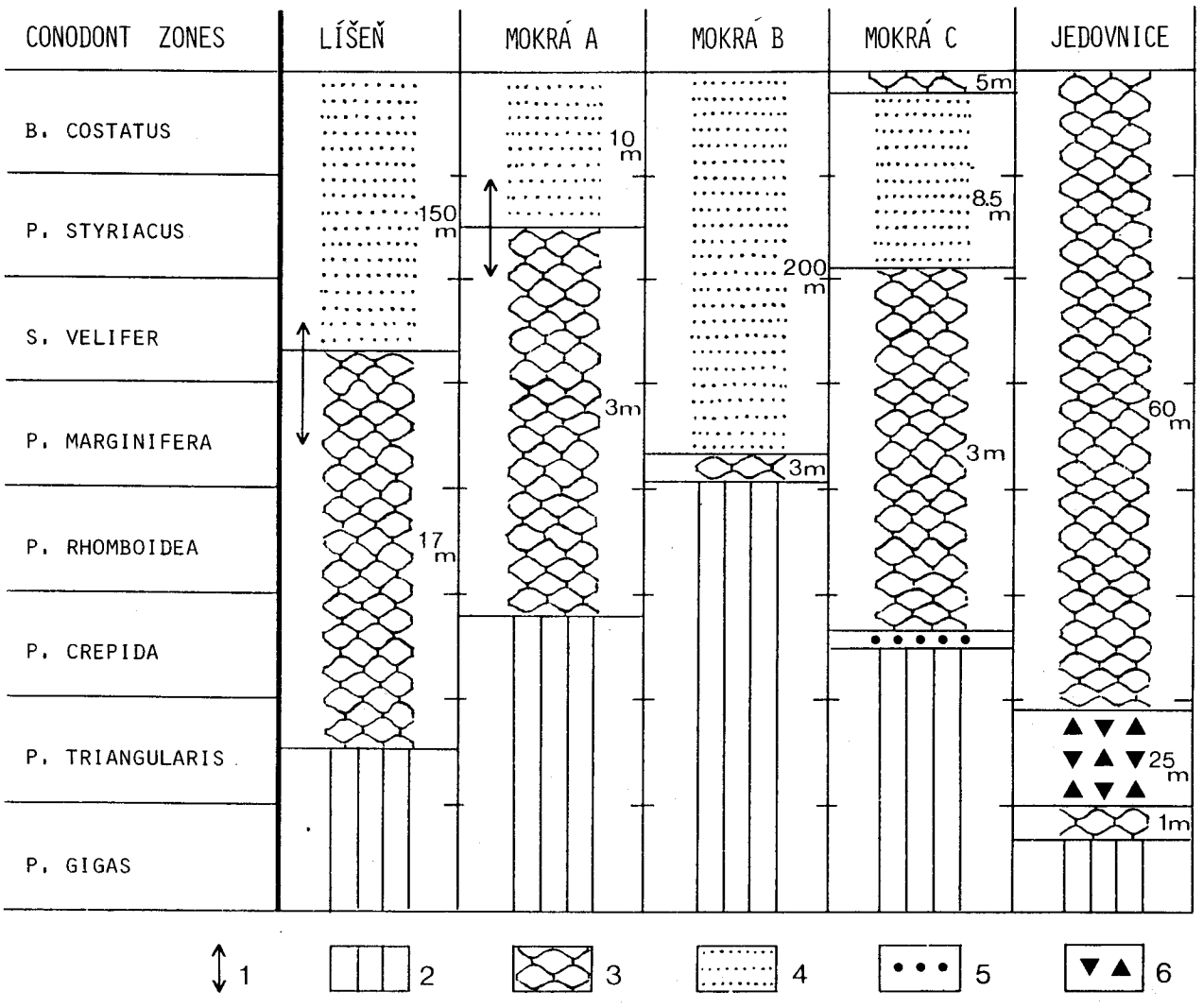


Figure 8. - Cartoon showing comparison of main lithofacies in the Moravian Karst near Brno.
1. transitional lithofacies; 2. reefal "Vilemovice" limestones; 3. nodular "Křtiny" limestones; 4. organodetrital "Hády-Říčka" limestones; 5. oolitic ironstones and limestones; 6. slump breccias.

weathering under arid conditions. These clastics were deposited in a nearshore, oxic environment.

Grey to yellowish nodular limestones in the surroundings of this quarry have yielded uppermost Famennian to Lower Tournaisian conodonts. Clay matrix is very limited here, only forming coatings on individual nodules. The uppermost portion of the nodular limestones in the Jedovnice area is only known from boreholes. It contains reworked conodont assemblages of the *Palmatolepis marginifera* zone, which have been redeposited in the Lower Carboniferous strata.

These reworked conodonts provide evidence of a continuous regression, resulting in the erosion of former (Lower to early Upper Famennian) deposition areas. This regression reached its acme during the (Middle to Late ?) Tournaisian. This is emphazised by the limestone breccias on top of the nodular limestones. These contain fragments of Frasnian and Famennian limestones which occur in a (subordinate) grey limestone matrix including abundant quartz grains, white kaolinized feldspathic grains and sometimes abundant black phosphorite concretions. These breccias may be of Upper Tournaisian age.

## LÍŠEŇ (LESNÍ LOM) (fig. 7)

Like Mokrá, this is a large, active quarry where limestone is extracted for a cement factory. The sequence consists of almost 150 m of dark-grey, well-bedded organodetrital limestones of Famennian and Tournaisian age. The lower portion of the section has been studied also in boreholes, of which V-204 is the most important.

The oldest rocks occur in the northwestern part of the quarry. These consist of Lower Famennian, grey to dark-grey, nodular micritic limestones containing conodonts of the *Palmatolepis triangularis*,

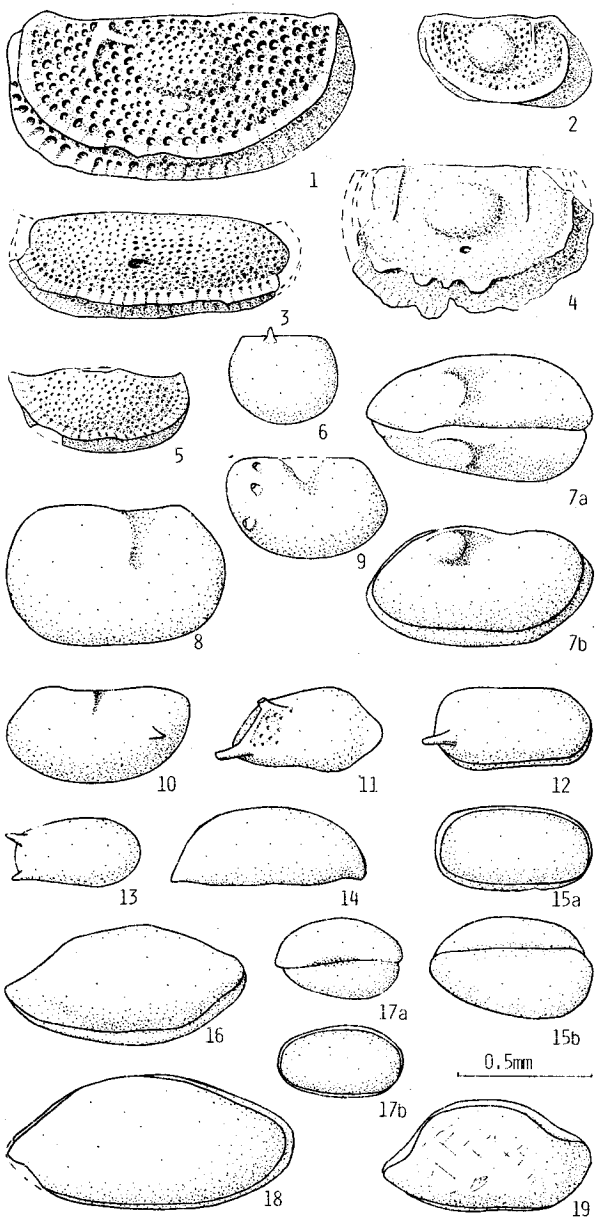


Figure 9. - Lower Tournaisian ostracodes from Líšeň Quarry, samples (in ascending order) L13, L10, L7 and L1 + 4. NHMM 1985 128. Open marine shelf assemblages.

1, 2, 4: *Amphissites* spp. 1, 2 : L1 + 4; 4 : L7.
3, 5 : *Kirkbya* spp. 3 : L13; 5 : L1 + 4.
6 : *Shishaella* sp., L13.
7, 8 : Knoxiellidae ? 7 : L1 + 4; 8 : L7.
9 : *Coryellina triceratina* Posner *in* Samoilova & Smirnova 1960, L10.
10 : *Coryellina* sp., L13.
11 : *Cribroconcha ?* sp., L13.
12 : *Orthonaria* sp., L13.
13 : *Healdia* sp., L10.
14 : *Acratia* sp., L13.
15, 17 : *Microcheilinella* spp. 15 : L13; 17 : L1 + 4.
16, 18, 19 : *Bairdia* spp. 16 : L10; 18 : L1 + 4; 19 : L7.

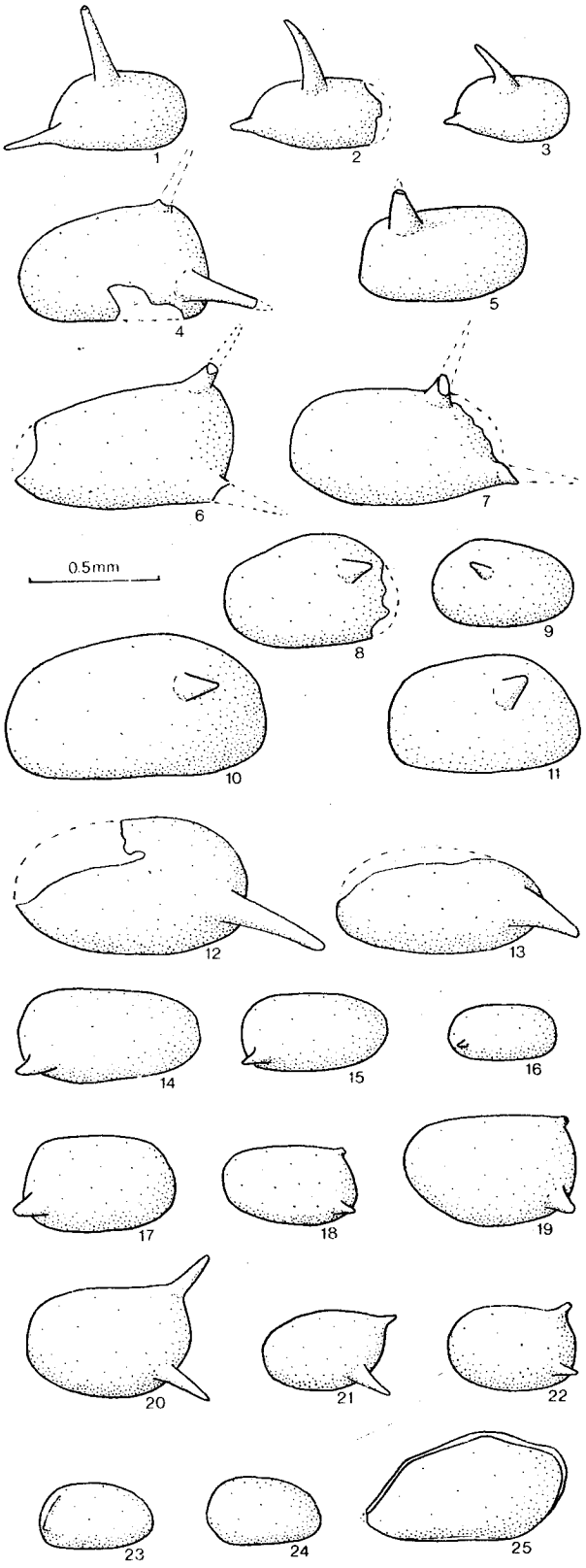


Figure 10. - Lower Tournaisian ostracodes from Líšeň Quarry, samples in ascending order) L34, L36 and L39. NHMM 1985 128. Thuringian-type assemblages.

1-3 : *Rectonaria varica* Gründel 1961. 1 : L36; 2, 3 : L34.
4-7 : *Rectonaria muelleri* Gründel 1961. 4 : L34; 5, 6 : L 36, 7 : L39.
8-11 : *Triplacera (Necrateria)* cf. *trapezoidalis* Gründel 1962. 8 : L34; 9 : L39; 10, 11 : L36.
12, 13 : Tricorninidae ?, L36.
14-22 : *Orthonaria* cf. *asymmetrica* Gründel 1972. 14-16 : L34; 17-19 : L39; 20-22 : L36.
23 : *Healdia* sp., L34.
24 : *Pseudobythocypris ?* sp., L 34.
25 : *Bairdia* sp., L36.

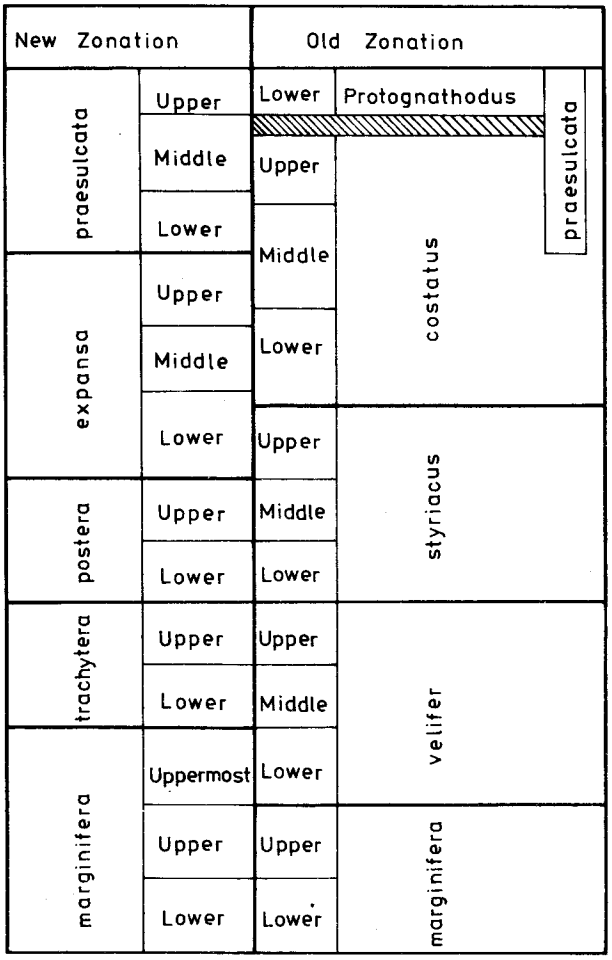


Figure 11. - Comparison between new and old conodont zonations. In this paper reference is made to the old zonation.

*P. crepida* and *P. marginifera* zones. A slow, upward transition from nodular into dark-grey, organodetrital limestones occurs during the lower *Scaphignathus velifer* zone. This roughly matches the same boundary in the southwestern section (B) of the Mokrá Quarry. However, at Mokrá the boundary between the reefal Vilémovice limestones and the overlying nodular Křtiny limestones occurs within the *P. marginifera* zone, whereas at Lišeň the nodular limestones start already (at least) in the *P. triangularis* zone ! The organodetrital limestones belonging to the *S. velifer* zone are 23.2 m thick in the V-204 borehole, whereas those belonging to the *Polygnathus styriacus* zone have a thickness exceeding 29 m.

The dark-grey, organodetrital limestones in the quarry largely belong to the *Bispathodus costatus* zone. The thickness of individual beds varies between 5 and 30 cm, thickness variations between 10 and 20 cm being the most common. Sometimes the beds show graded bedding. These consist of biodetrital, biomicritic and sometimes micritic limestones with thin intercalations of dark-grey, laminated calcareous shales (usually 2-5 cm thick, rarely up to 11 cm).

In thin sections, the limestones display an alternation of granulometrically different laminae with sharp boundaries. These laminae are not only distinguished by differences in the grain size, but also by differences in the sorting of the material. Some laminae are residual "shell beds", although these do not display any intensive wave sorting or rounding of bioclasts. The coarser-grained laminae (median grain diameter 0.2 - 0.4 mm) contain fragments of crinoid ossicles and brachiopods, whereas the finer-grained ones include remnants of ostracodes, trilobites, foraminifera and sponge spicules. The bioclasts show an intensive micritisation (grading into micrite peloids in residual calcarenites). Various amounts of clay admixture and rare quartz grains of silt size occur in the micrites. Locally, small lenses or thin intercalations are observed of dark-grey silicites with sponge spicules. The shale intercalations have yielded rare plant debris.

These organodetrital limestones suggest deposition in an environment with varying water energy. This resulted in a rhythmic sedimentation of coarse residual calcarenites and micrites with clay admixture followed by periods of non-deposition and intensive micritisation.

The upper part of the sequence can be studied in the southeastern outcrops of the quarry. There, the boundary between the Famennian and Lower Carboniferous is formed by a 1.3 m thick layer of laminated micrites without any fossils. These are overlain by very well-bedded, dark-grey to grey micrites (thickness of individual beds 2-5 cm) with numerous intercalations of calcareous shales and rare intercalations of dark-grey, biodetrital limestones and black cherts. This interval has yielded ostracodes (figs. 9 and 10), and rare conodonts and foraminifera of Lower Tournaisian age. The thickness of these strata exceeds 10 m. The ostracode assemblages in the lower half of this sequence (samples L13, L10, L7 and L1 + 4) characterize an open marine shelf environment. Those in the upper half (samples L34, L36 and L39) are predominated by spinous forms characterizing a "basinal" Thuringian paleofacies. This suggests a transgressive event during the Lower Tournaisian, which should be traced some 5 m above the laminated, nonfossiliferous micrites at the base of the Tournaisian.

In the southeastern corner of the quarry black, fine-grained organodetrital limestones occur with many black cherts. A thin intercalation of silicified shales yielded relatively well-preserved plant fragments.

## REFERENCES

DVOŘÁK, J., FRIÁKOVÁ, O., HLADIL, J., KALDOVA, J., & KUKAL, Z., 1986. Geology of Paleozoic in the vicinity of quarries of Mokrá Cement Factory (Moravian Karst). Sbor. Geol. Věd, Geologie (in print), Praha.

DVOŘÁK. J., FRIÁKOVÁ, O & LANG, L., 1976. Block structure of the Old Basement as indicated by the Facies Development of the Devonian and the Carboniferous in the Moravian Karst (Sudeticum, Moravia, ČSSR). Geologica et Palaeontologica, 10 : 153-160., Marburg/ Lahn.