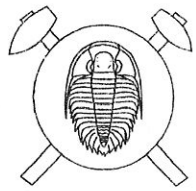
New stratigraphical results in the Paleozoic of the Drahanská vrchovina Upland (Moravia, Czech Republic)



Nové poznatky o stratigrafii paleozoika Drahanské vrchoviny (Czech summary)

(3 text–figs., 2 plates)

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Recent conodonts studies have brought some new results which modify the stratigraphical ranges of the limestones of Drahany (Basinal) and Ludmírov (Transitional) development in the Konice–Mladeč Belt (Drahanská vrchovina Upland). The lowermost boundary of the Jesenec Limestone (Drahany development) can be shifted down to the Emsian–Eifelian boundary and the base of sedimentation of the equivalents of the Macocha Formation can be shifted to the Eifelian. The uppermost occurrence of the Jesenec Limestone reaches up to the Middle–Upper Tournaisian boundary. According to these data a considerable part of volcanic activity belongs probably to the Tournaisian as well, which emphasizes the similarity between the sedimentation in the Konice–Mladeč belt and the southern part of the Šternberk–Horní Benešov Belt.

Introduction

In the period from fifties to eighties of this century basic facial developments and separate litostratigraphic units of the Devonian in Moravia had been defined. Based on new principles of the stratigraphic classification and nomenclature the results were summarized in the comprehensive review of unmetamorphosed Devonian in Moravia by Zukalová and Chlupáč (1982). In three main developments – basinal (Drahany) development, platform (Moravian Karst) development and Transitional (Ludmírov) development, formations and members were distinguished, stratotypes were chosen and boundaries were defined both based on macropaleontological and micropaleontological data. More recent data on the stratigraphy of the metamorphosed and unmetamorphosed Devonian were published by Chlupáč et al. (1986).

Recent micropaleontological research in the Konice Devonian in the Drahanská vrchovina Upland has yielded some new results which modify up to now assumed stratigraphical ranges of the carbonate facies both in the basinal and Transitional development. It has been assumed that basinal Jesenec Limestone – a term introduced by Chlupáč (1964), was deposited from the Givetian to the Frasnian and at the end of the Frasnian the carbonate sedimentation was completely substituted by pelitic facies of the Ponikev Formation. New research based mainly on the study of conodont fauna has, however, shown that the time interval corresponding to the deposition of the Jesenec Limestone was substantially longer and the basinal limestone facies range from the lower boundary of the Middle Devonian up to the Lower Carboniferous.

Middle Devonian in the Ludmírov abandoned quarry

Some evidence on the possible existence of older limestone facies was suggested already during the extensive deposit survey in the Konice–Mladeč Belt by Crha et al. (1989). The age of the oldest limestones correlated with the range of Tortodus kockelianus and Polygnathus ensensis conodont zone, however, reflected rather broad stratigraphical range of the impoverished conodont association. The new results of conodont studies in carbonates in the quarry situated E of Ludmírov (see fig. 1) shift the lower boundary of the Jesenec Limestone significantly lower.

The eastern neighbourhood of Ludmírov on the Průchodnice Hill is a typical region of the Transitional (Ludmírov) development. In the abandoned quarry situated on the western slope of the hill (see fig. 1) about 23 m of limestones that can be regarded as equvivalents of the Macocha Formation are exposed overlain by about 2 m of the Jesenec Limestone (see fig. 2, section 1). The equivalents of the Macocha Formation are grey, massive and locally recrystallized with abundant crinoid ossicles and deformed recrys-

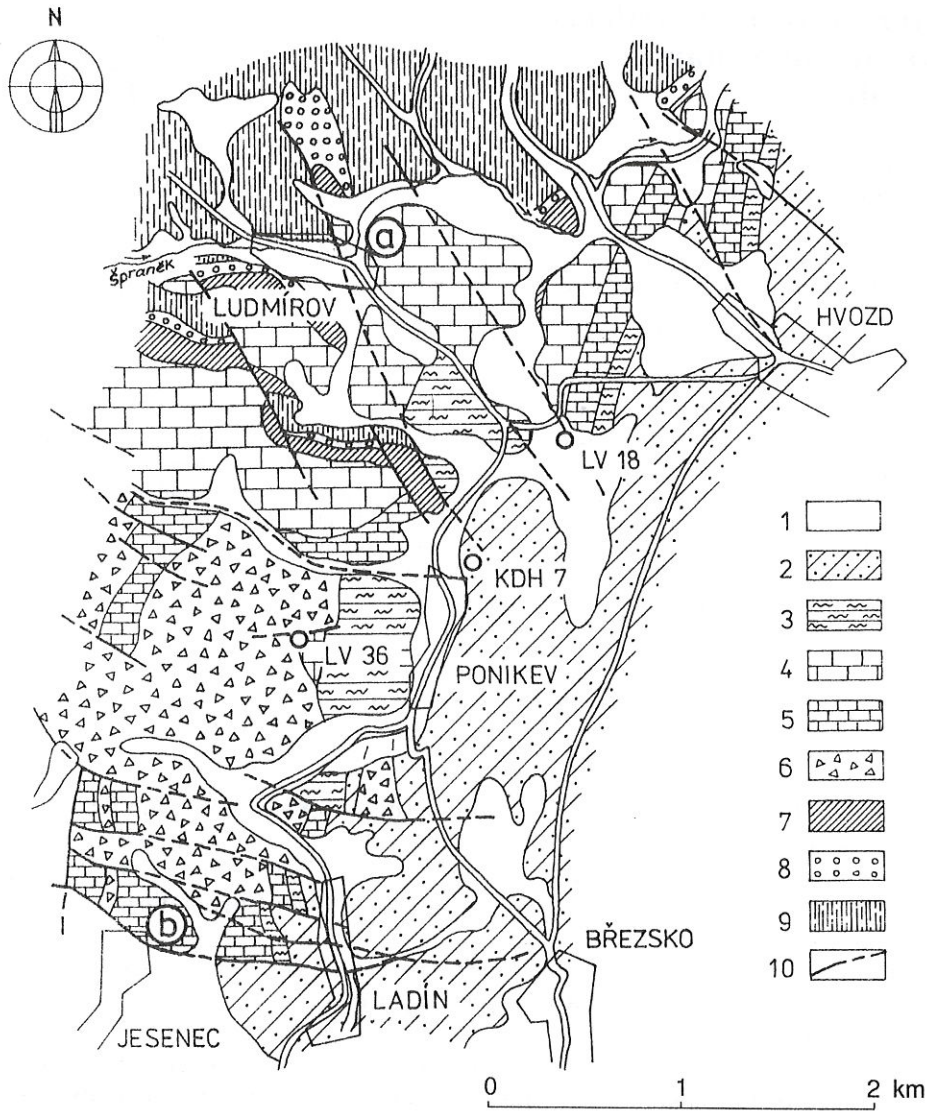


Fig. 1. Simplified geological map of the part of Konice–Mladeč Belt between Ludmírov and Jesenec. According to I. Chlupáč – J. Svoboda 1963
1 – Quaternary cover; *2* – Lower Carboniferous of the Protivanov Formation; *3* – Ponikev Formation; *4* – Carbonates of the Transitional development; *5* – Jesenec Limestone and limestones of the basinal development; *6* – Complex of volcanic rocks; *7* – Stínava–Chabičov Formation; *8* – Basal clastic formation; *9* – Kladky phyllites; *10* – faults

tallized stromatoporoids. In the lower part micritic – biomicritic limestone predominates, higher up in the section the representation of biodetrital limestone with abundant crinoid ossicles increases. The equivalents of the Macocha Formation contain rare conodont fauna and evidently represent a deeper sedimentary environment than the typical facies of the Macocha Formation in the Moravian Karst.

The Jesenec Limestone is grey to dark grey, well bedded with thin shale laminae. The samples from their lower part (samples 91/45 and 91/10) contain not very abundant conodont fauna. Specimens are dark grey to black, relatively badly preserved often plastically tectonically deformed. The representatives of the genus *Icriodus* are due to the deformation mostly not closer identifiable. The association is represented by following taxa:
Icriodus rectirostratus Bultynck
Icriodus sp.
Polygnathus angusticostatus Wittekindt
Polygnathus costatus costatus Klapper
Polygnathus costatus partitus Klapper – Ziegler – Maschkova
Polygnathus costatus patulus Klapper
Polygnathus costatus costatus Klapper
Polygnathus aff. *trigonicus* Bischoff et Ziegler

The association is characterized by the presence of specimens from the group *Polygnathus costatus* rather untypical, representing transitional forms between different subspecies. On the one hand long slender specimens with the platform outline characteristic for *Po. costatus partitus* (similar forms are described by Lane – Mueller – Ziegler 1979), on the other hand forms similar to specimens described by Bultynck (1985) as *Po. patulus* – *Po. costatus* are present.

The stratigraphic evaluation of the above mentioned fauna suggests the range of Po.

patulus – Po. costatus Zone. The occurrence of the *Polygnathus costatus costatus* in the Polygnathus partitus Zone (former upper Po. patulus Zone) in the Barrandian is described by Klapper (1978). The broader stratigraphical range of *Po. costatus costatus* was recorded e. g. in the Tadzhikistan (lower Tortodus australis – Po. costatus Zone, Bardashev – Ziegler 1985) or in the Eifel (T. kockelianus – Po. costatus Zone, Weddige 1977). The species *Polygnathus angusticostatus* was found within the range from the uppermost Po. partitus to T. kockelianus Zone (Bultynck 1985) and in the Eifel even up to the Po. ensensis Zone (Weddige 1977). Thus the species is known from the uppermost Emsian up to the end of the Eifelian. The occurrence of *Polygnathus* aff. *trigonicus* is restricted to the Polygnathus costatus – Tortodus australis Zone interval (Bultynck 1985, Klapper – Johnson 1980). The range of *Icriodus rectirostratus* which is characteristic of the Upper Emsian – Lower Couvinian Co 1 in Belgium (Bultynck 1985) and of the Upper Emsian – Lower Eifelian in Germany is known from the Polygnathus laticostatus to the Polygnathus partitus Zone (Weddige – Requadt 1985). The whole assemblage in the lower part of the Jesenec Limestone in the Ludmírov Quarry thus seems to indicate Lower Eifelian age of the Polygnathus partitus Zone/Polygnathus costatus Zone boundary interval.

A very impoverished conodont association was obtained also from the equivalents of the Macocha Formation in the Ludmírov Quarry. The sample from its upper part yielded badly preserved specimens of the genus Polygnathus. The only identified species *Polygnathus angusticostatus* ranges from the uppermost Polygnathus partitus Zone to the lower part of the Polygnathus ensensis Zone – i.e. it indicates the Eifelian age. This result accords well with some recent studies of corals and stromatoporoids (Hladil 1993) and shifts also the base of carbonates of the Transitional development substantially lower.

A similar conodont fauna indicating the Eifelian age was obtained from the Ponikev LV 36 and Březsko LV 8 boreholes. In the Ponikev LV 36 borehole it is represented by *Polygnathus serotinus* Telford, *Polygnathus angusticostatus* and *Polygnathus linguiformis* Hinde *alpha morphotype* at the depth of 54–57 m. The last mentioned species has been distinguished also in the Březsko LV 8 borehole.

Based on the above mentioned data it is possible to place the onset of carbonate sedimentation of the Jesenec Limestone in the Drahanská vrchovina Upland into the Po. costatus Zone in the Lower Eifelian or at need even stratigraphically lower. This carbonate sedimentation was laterally replaced by more basinal pelites of the Stínava–Chabičov Formation. An abundant macrofauna of the same age (Emsian/Eifelian boundary to Lower Eifelian) from the shales of the Stínava–Chabičov Formation in the vicinity of Ludmírov (Chlupáč 1960) may explain well this lateral replacement of both the units. In this respect there may exist some similarity to the Šternberk–Horní Benešov belt where limestone intercalations at the Emsian/Eifelian boundary (Dvořák et al. 1982) may also indicate a possible lateral replacement of the Stínava–Chabičov Formation. The discovery of the Eifelian conodont fauna in the equivalents of the Macocha Formation of the Transitional (Ludmírov) development the base of which has been so far correlated with Lower Givetian represents another new result.

Famennian and Tournaisian in the Jesenec abandoned quarry

The studies of the youngest part of the Jesenec Limestone were concentrated to the broader vicinity of Jesenec. At the stratotype locality – the abandoned quarry at SE margin of the village (Chlupáč – Zukalová 1982) a most complete sequence of the youngest limestone facies can be traced. There are micritic and biomicritic often laminated grey limestones in the lower part of the sequence. Higher up the limestones are more biomicritic and biodetrital dark grey with brecciated interbeds and frequent phosphorites. Their original stratigraphical classification to the Frasnian was based partly on the study of stromatoporoid fauna partly on the study of conodont fauna (Dvořák – Freyer 1966).

The first data on a possible younger age of the Jesenec limestone were indicated during the extensive survey of cement deposits by Crha et al. (1989). Even though the conodont fauna indicated the Famennian and Tournaisian age some doubts on a correct stratigraphical assignement remained because of the differencies with previous results. In order to solve this discrepancies the stratotype section in Jesenec was resampled and restudied. On the one hand a relatively rich conodont association confirms the previous assumption of Crha et al. (1989) on the other hand the study has also confirmed the presence of reworked Frasnian conodonts as well as stromatoporoids.

Two parallel sections were sampled in the upper and lower floor of the abandoned quarry (fig. 2 – section 2 and 3, see also Zukalová –

Chlupáč 1982). In the Famennian sequence in the lower part of the section a very rich associations with the predominance of mesopelagic genus *Palmatolepis* predominate. The first sample 89/28 in the upper floor contains the following taxa:

Palmatolepis glabra acuta Helms
Palmatolepis glabra distorta Branson et Mehl
Palamatolepis glabra lepta Ziegler et Huddle
Palmatolepis glabra pectinata Ziegler
Palmatolepis glabra prima Ziegler et Huddle
Palmatolepis helmsi Ziegler
Palmatolepis marginifera curvata Dreesen
Palmatolepis marginifera marginifera Helms
Palmatolepis minuta schlezia Helms
Palmatolepis perlobata cf. *grossi* Ziegler
Polygnathus glaber glaber Ulrich et Bassler
Polygnathus glaber medius Helms et Wolska
Polygnathus granulosus Branson et Mehl
Polygnathus nodocostatus nodocostatus Branson et Mehl
Polygnathus triphylatus Ziegler

This association corresponds to the uppermost Palmatolepis marginifera Zone defined by Sandberg and Ziegler (1984) in the lower part of the Upper Famennian. In the parallel section in the lower floor of the quarry (fig. 2 – section 3) another conodont assemblage dominated by palmatolepids and abundant *Bispathodus stabilis* Branson et Mehl that indicate pelagic to hemipelagic facies has been recorded from the sample 91/8. The following taxa were determined:

Bispathodus costatus E.R. Branson
Bispathodus stabilis Branson et Mehl
Palmatolepis gracilis gracilis Branson et Mehl
Palmatolepis gracilis sigmoidalis Ziegler
Palmatolepis perlobata postera Ziegler
Palmatolepis perlobata schwindewolfi Mueller
Polygnathus extralobatus Schaefer
Pseudopolygnathus brevipennatus Ziegler

The mentioned association indicates upper middle Palmatolepis expansa to lower upper Palmatolepis expansa Zone.

The overlying Tournaisian sequence is mostly formed by biomicritic to biodetrital limestones (see fig. 2) with abundant phosphorites. Relatively rich conodont associations often strongly deformed by pressure were recorded from different levels of both parallel sections (see fig. 2). The lower Tournaisian has not been distinguished so far and it is either condensed or a tectonical shortening along the dislocation in the N face of the quarry took place.

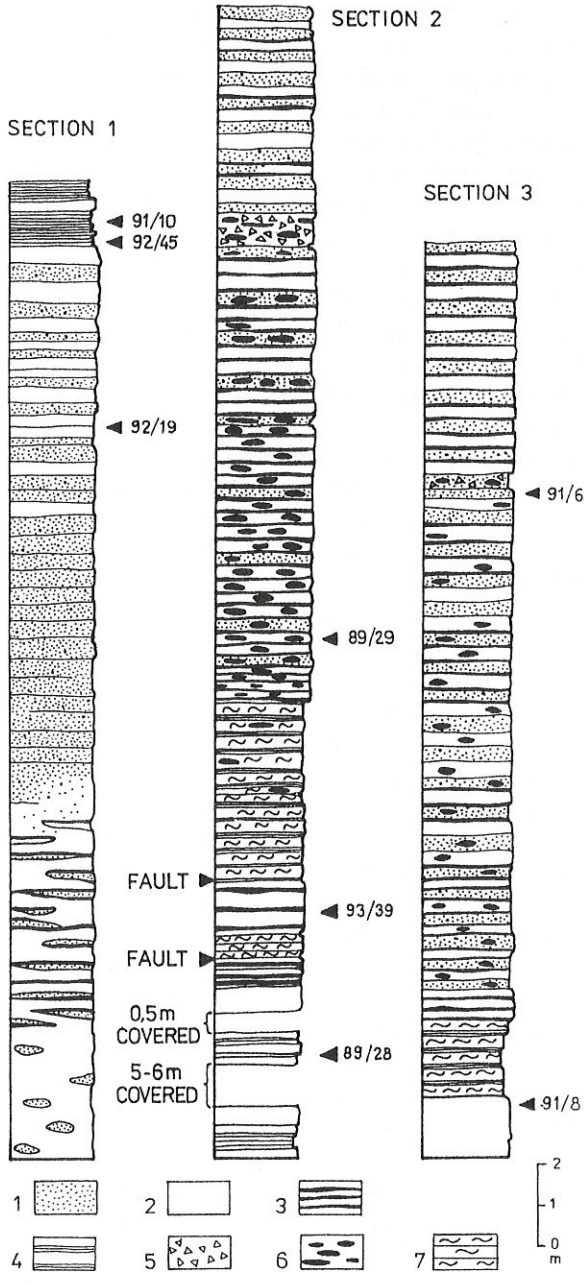
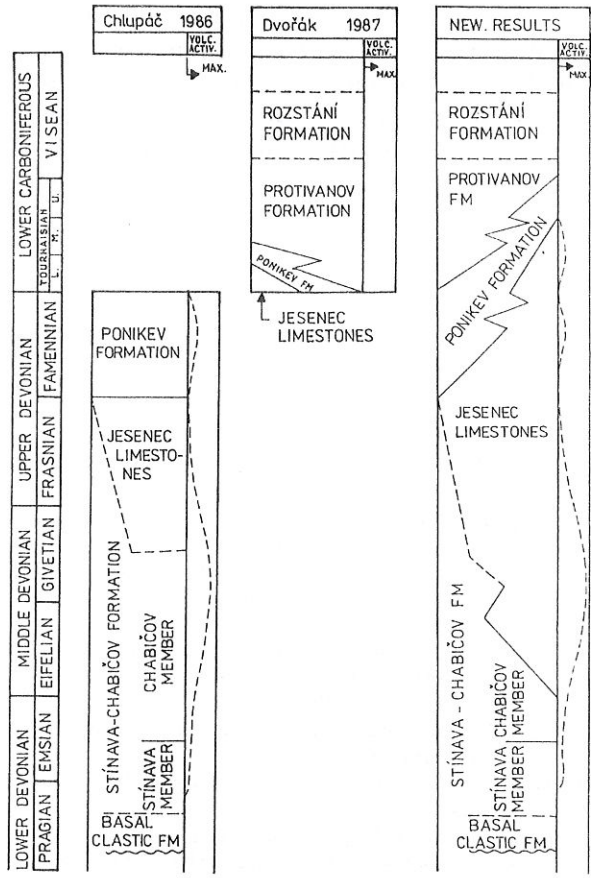


Fig. 2. Simplified graphic logs of sections (section 1 – Ludmírov quarry, section 2 – upper floor of the Jesenec quarry, section 3 – lower floor of the Jesenec quarry) with indication of samples
1 – detrital limestone; *2* – micritic limestone; *3* – laminated limestone; *4* – shale laminae; *5* – breccia; *6* – phosphorites; *7* – shear zone

The Tournaisian associations are characterized by the predominance of hemipelagic siphonodells and by the presence of reworked Givetian, Frasnian and Famennian conodont fauna. The brecciated limestone yielded also reworked Frasnian stromatoporoids (according to the determination of J. Hladil).

The conodont associations in the first Tournaisian sample 93/39 contains:

Fig. 3. Stratigraphical scheme of the basinal development of Paleozoic in the Konice–Mladeč belt in comparision with previous data



Polygnathus inornatus Branson et Mehl
Polygnathus symmetricus E.R. Branson
Pseudopolygnathus primus Branson et Mehl
Pseudopolygnathus triangulus triangulus Voges
Siphonodella cooperi Hass
Siphonodella crenulata Cooper
Siphonodella duplicata Branson et Mehl
Siphonodella obsoleta Hass
About 7 m higher up in the section the sample 89/29 yielded a similar association:
Pseudopolygnathus sp.
Siphonodella crenulata Cooper
Siphonodella sp.

In the sample 91/6 just bellow the brecciated layer the following taxa were distinguished:

Polygnathus inornatus Branson et Mehl
Pseudopolygnathus triangulus triangulus Voges
Siphonodella cooperi Hass
Siphonodella crenulata Cooper
Siphonodella cf. *duplicata* Branson et Mehl

These associations where representatives of *Siphonodella obsoleta* and *Siphonodella cooperi* dominate can be correlated with the middle part of the Tournaisian. *Pseudopolygnathus triangulus triangulus*, the index form of the former Siphonodella – Pseudopolygnathus triangulus triangulus Zone, ranges from the uppermost Siphonodella sandbergi Zone to the lower Siphonodella crenulata Zone, and *Siphonodella crenulata* ranges from the base of the lower Siphonodella crenulata Zone to the upper Siphonodella crenulata–Siphonodella isosticha Zone.

In another section in the KDH 7 borehole, even younger Tournaisian conodont fauna represented by species *Gnathodus punctatus* Cooper and *Siphonodella quadruplicata* Branson et Mehl (in depth of 28–56 m) corresponds to the upper Siphonodella crenulata–Siphonodella isosticha Zone and indicates the late Middle Tournaisian age. In the uppermost part of the borehole *Gnathodus* cf. *cuneiformis* Mehl et Thomas was found. The typical representatives of this species occur only in the Upper Tournaisian, however, considering that only cf. determination was possible, the presence of the Upper Tournaisian carbonates in the Konice Devonian remains to be an open question.

The above mentioned data clearly suggest that the sedimentation of the Jesenec Limestone continued from the Frasnian higher up to the Famennian and Tournaisian when it was laterally replaced in deeper facies by shales with radiolarites of the Ponikev Formation (see fig. 3).

Conclusions

The new results from the Drahanská vrchovina Upland strongly support a good parallelization with the Devonian and Lower Carboniferous of the Šternberk–Horní Benešov Belt in both the sedimentary and the volcanosedimentary development. The data of conodont stratigraphy suggest, similarly as in the southern part of the Šternberk–Horní Benešov Belt, the Tournaisian age of a considerable amount of volcanites which accords well with already known geochemical and petrographical similarity (Přichystal, in press). Also in the Šternberk–Horní Benešov Belt, even though at somewhat different stratigraphical level (Givetian), the lateral replacement of the upper part of the Stínava–Chabičov Formation by the Jesenec Limestone can be traced (Chlupáč et al 1986) as well as the lateral replacement of the Ponikev Formation by Upper Frasnian up to Upper Tournaisian limestones (Zikmundová 1964, Dvořák 1987).

In the Konice Devonian a considerable stratigraphic range of basinal limestones (from the Emsian–Eifelian boundary up to the end of the Middle Tournaisian), variable lithology (micritic, biomicritic, biodetrital limestones, laminated and brecciated limestones, volcanite intercalations) and lateral replacement with both the underlying Stínava–Chabičov Formation and the overlying Ponikev Formation favour the classification of these basinal limestones as Jesenec Formation (cf. Zukalová – Chlupáč 1982).

Translated by the authors

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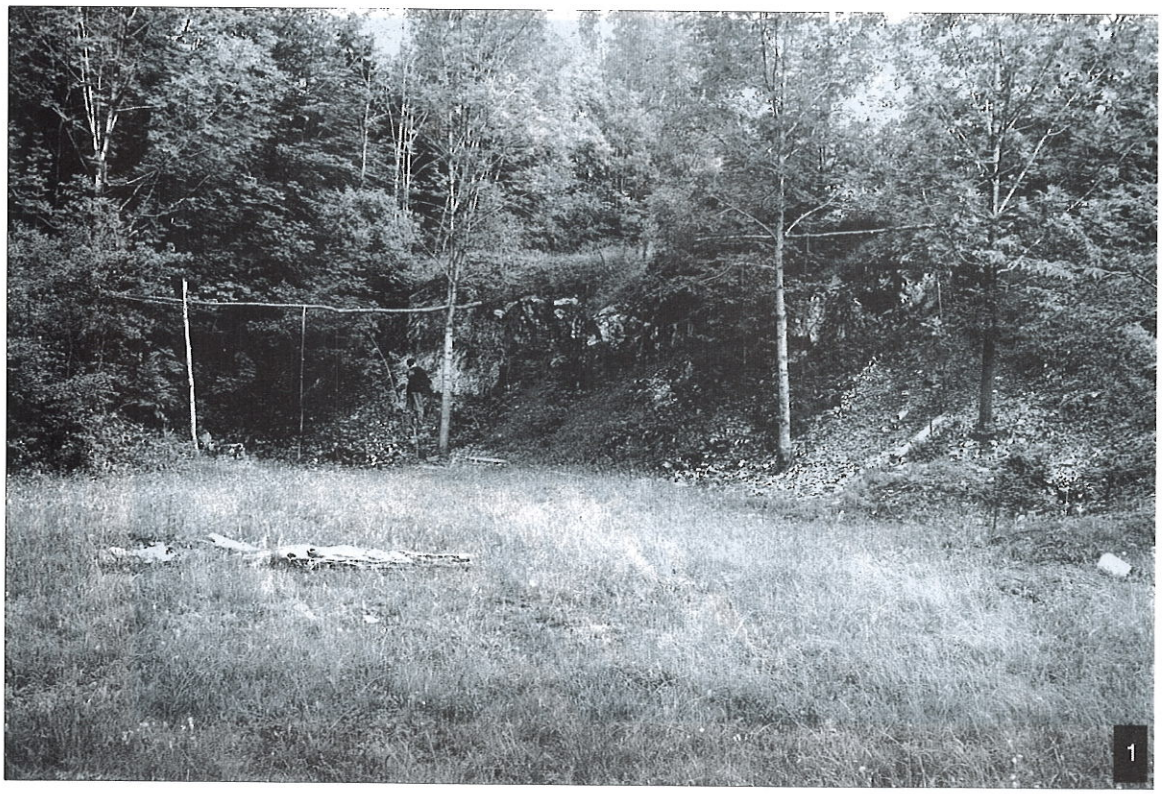
Nové poznatky o stratigrafii paleozoika Drahanské vrchoviny

Další výzkumy konodontové fauny ve faciích pánevního (drahanského) a přechodního (ludmírovského) vývoje v konicko–mladečském pruhu přinesly některé nové výsledky, které upřesňují stratigrafické rozpětí vápencových facií těchto vývojů. Spodní hranici jeseneckých vápenců (drahanský vývoj) lze posunout k bázi eifelu a do eifelu je rovněž možno posunout bázi ekvivalentů macošského souvrství přechodního vývoje. Svrchní hranici jeseneckých vápenců můžeme pak položit až k hranici středního a svrchního tournai. V návaznosti na tyto údaje náleží rovněž značná část vulkanitů patrně tournai, což zvýrazňuje podobnost vývoje devonu v konicko–mladečském pruhu s j. částí šternbersko–hornobenešovského pruhu.



The quarry at the NE margin of Jesenec – the stratotype locality of the Jesenec Limestone

1. The northern wall of the upper floor of the quarry – the part of the section which belongs to lower Upper Famennian up to Tournaisian. In comparision with the original situation (see Zukalová – Chlupáč 1982) it is almost completely overgrown by vegetation
2. The continuation of the same section situated in the western wall of the quarry – Tournaisian limestones and breccias