Application of microfacies analysis in the Lower Devonian of the Barrandian, central Bohemia

Použití mikrofaciální analýzy v barrandienském spodním devonu (Czech summary)

(3 text-figs., 4 plates)

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Microfacies analysis using the Standard Microfacies (SMF) Types (Wilson 1975, Flügel 1982) was made on the Lower Devonian (Lochkovian, Pragian, Zlíchovian) carbonates in the two localities in the Barrandian area: the Radotín Valley and the Čeřinka quarry. The research resulted into the definition of 8 microfacies types, not fully corresponding to the SMF Types: A - packstone with abundant bioclasts, B - biomicrite, C - microbioclastic calcisiltite, D - packstone with calcisiltite matrix, E - coarse bioclastic limestone or lithoclastic breccia, H - nonfossiliferous micrite, I - laminite with peloids, J - spiculite. The microfacies criteria are used for determining the sedimentary environment and its development through the Lower Devonian is reconstructed.

Key words: Devonian, limestones, sedimentology, microfacies, Barrandian area, Bohemia.

Introduction

The studied areas are situated in the Silurian-Devonian syncline of the Barrandian area in central Bohemia, between the cities of Prague and Beroun (Fig. 1). For the microfacies study we choose the sequence from the Lochkovian to the Zlíchovian in the two sites: the Radotín Valley at Prague and the Čeřinka quarry near Bubovice.

The localities in the Radotín Valley lie on the southwestern margin of Prague. The studied outcrops were in the three quarries situated on the both sides of the valley: Hvížďalka on the southern, Špička and Cikánka on the northern side. The first two quarries are exploited by nearby cement plant, the third is used for the decorative stone, „Slivenec Marble“, which has been taken there since the Middle Ages.

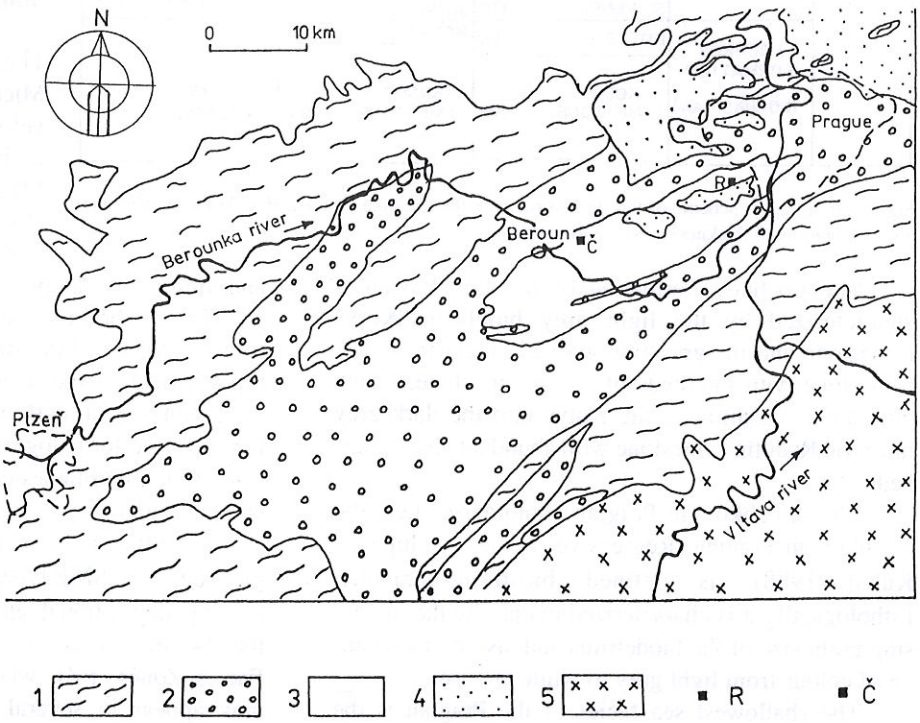

Fig. 1. Position of the studied localities within the Barrandian Area
1 - Proterozoic; *2* - Cambrian and Ordovician; *3* - Silurian and Devonian; *4* - Upper Cretaceous; *5* - granitoids; R - quarries in the Radotín Valley; Č - Čeřinka quarry

The Čeřinka quarry is located in the central part of the Barrandian Paleozoic basin, near the villages Bubovice and Kozolupy.

In the Radotín Valley the lowest beds of the Devonian are ranged with the Přídolí Formation of the Přídolian age, made up of grey biomicritic to bioclastic limestone with interbeds of calcareous shales (Horný 1962, Kříž in Chlupáč et al. 1992). In Čeřinka, the Silurian is not exposed, as in the basal strata, believed to be Silurian, the Devonian trilobite *Warburgella rugulosa* was found.

The development of the Lower Devonian varies within the outcrops on the opposite sides of the Radotín Valley as well as in Čeřinka. The detailed sequences are described in Fig. 2. Generally, in the Radotín Valley the presence of micritic facies is much higher than in Čeřinka, the amount of micritic facies in Radotín increases towards the southeast.

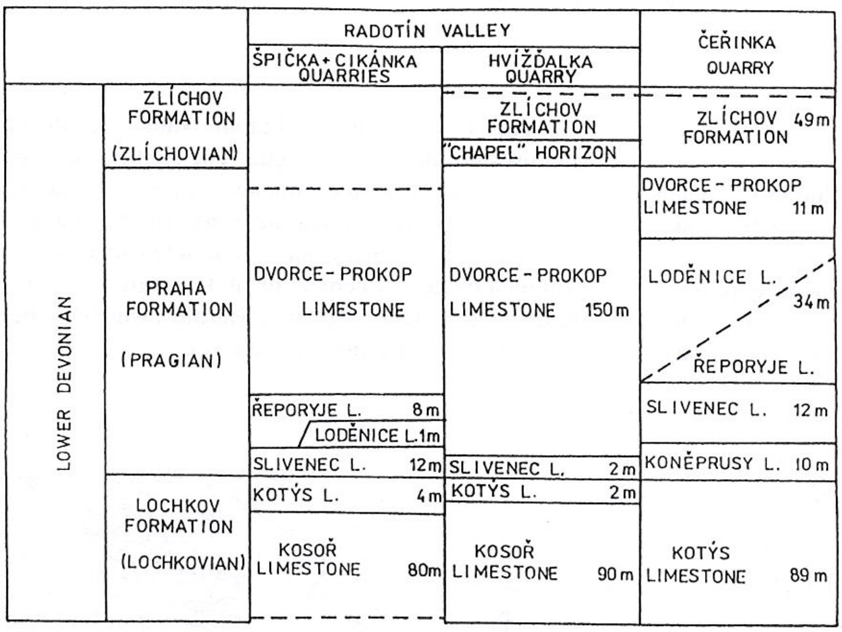

Fig. 2. Stratigraphic scheme of the studied rocks in the Cikánka, Špička, Hvížďalka and Čeřinka quarries, with total thicknesses where measurable

The Lochkov Formation of the Lochkovian is characterized by the light grey bioclastic Kotýs Limestone and the grey fine-grained bioclastic Kosoř Limestone with interbeds of calcareous shale, which presents a transition of the Kotýs into the dark grey micritric Radotín Limestone with abundant shale interbeds.

The Lochkovian-Pragian boundary, i.e. the Lochkovian-Pragian Regressive Event (Chlupáč - Kukal 1988), is defined biostratigraphically. Lithologically it is characterized mainly by the increasing grain size of the biodetritus and also by the change of colour from light grey to white or rose.

The shallowest sea facies of the Pragian is the white biodetrital Koněprusy Limestone with high content of $CaCO_3$. The similar character, except for the colour, has the rose Slivenec Limestone. The superposed Řeporyje Limestone is biomicritic, red, nodular. Multicoloured appearance is typical of the Loděnice Limestone, with other features similar to the Řeporyje Limestone. In Čeřinka the Loděnice Limestone contains large quantity of laminites, which is rather atypical. The transition of the Řeporyje and Loděnice Limestones in Čeřinka is both vertical and horizontal.

The upper part of the Pragian is formed by the grey micritic, nodular or platy Dvorce-Prokop Limestone, where nodular and platy layers alter in rhythms of decimetre order.

The Pragian-Zlíchovian boundary is displayed by the Basal Zlíchovian Event, the immediate beginning of biodetrital sedimentation (Chlupáč - Kukal 1988). The basal part of the Zlíchov Formation, called the „Chapel Coral Horizon", appears in Radotín only. It is coarse biodetrital limestone and even breccia of coral, crinoid and stromatoporoid fragments. The upper parts of the Zlíchov Formation consist mainly of grey biomicrite to biosparite, indicating deeper and more quiet environment.

The study excluded the uppermost parts of the Zlíchov Formation with the transition into the Daleje Shale of the Dalejan, as they were not exposed in any of the four quarries.

Standard Microfacies Types

The concept of Standard Microfacies (SMF) Types was developed on Upper Triassic reef carbonates in the Alpine Mediterranean region by Flügel (1972) and expanded by Wilson (1975), who studied Paleozoic and Mesozoic examples (see Flügel 1982).

The method is based on combination of the microfacies types of limestone of various ages into major types reflecting the depositional and paleoecological conditions in a certain sedimentary environment. Precondition for recognizing SMF Type is the description of the microfacies criteria using Dunham classification system.

With the aid of sedimentological and paleontological data, the SMF types present a good basis for discussing depositional environments. Wilson assigned the 24 SMF Types to 9 Standard Facies Belts (or Facies Zones, FZ), whereby individual SMF Types may appear in several of them (see Wilson 1975, Flügel 1982).

Table 1. Comparison of described microfacies types with Standard Microfacies Types (after E. Flügel 1982)

MF Type	SMF Type (Flügel 1982)
A: Biomicrite with abundant bioclasts (packstone). Geopetal fillings, umbrella effects	5: Grainstone-packstone or floatstone with bioclasts derived from reef dwellers and reef builders. Geopetal fillings, umbrella effects
A1: Type A with chaotic fabrics, better sorted	5
B1: Biomicrite (wackestone) with well-preserved bioclasts	8: Wackestone with whole organisms which are rooted in micrite. Well-preserved inafauna and epifauna
B2: Biomicrite (mudstone or wackestone), bioclasts homogenized through bioturbation	9: Bioclastic wackestone or bioclastic micrite. Fragments of diverse organisms, texturally homogenized through bioturbation. Bioclasts may be micritized
C: Microbioclastic calcisiltite (grainstone), often with graded bedding	2: Microbioclastic calcisiltite. Small bioclasts and peloids in very fine-grained grainstone, mm riple cross-bedding common
D: Bioclastic limestone (packstone) with calcisiltite matrix	2 5 9
E: Biomicrite-biosparite (wackestone-packstone) with chaotic fabrics, worked-out bioclasts, intraclasts, micritic fissure fillings	5 4: Microbreccia or bioclastic-lithoclastic packstone. Worn grains, often graded. Polymict or monomict in origin. Also quartz cherts
H: Micrite and dismicrite (mudstone) without fauna, finely bedded	23: Unlaminated, homogeneous unfossiliferous pure micrite
I: Laminite with peloids. Oscilation of pelmicrite and pelsparite layers	19: Loferite, laminated mudstone - wackestone, grading occassionally into pelsparite with fenestral fabrics
J1: Spiculite. High content of spicules (over 50 %)	1: Spiculite. Clayey mudstone or wackestone rich in organic substance or siliceous spiculitic calcisiltite
J2: Biomicrite-biosparite with up to 50 % of spicules, poorly washed micrite changes with high concentration of spicules	1 9

The authors defined 8 microfacies types which did not fully coincide with the SMF Types of Wilson and Flügel. This is caused by the differences between the studied Old Paleozoic carbonates and the younger ones used for the definition of the SMF Types on one hand and, on the second, by the necessity of more precise scale to distinguish the differences in comparatively small area.

Microfacies types

The description of defined microfacies types together with the macroscopic description of the samples, based on Folk and Dunham classification systems, and relation to the SMF Types (with Flügel's definition of a certain type) and Facies Zones (FZ), follows:

Type A

Macroscopically light grey to rose coarse bioclastic limestone.

Biomicritic limestone with abundant bioclasts (size up to 1.5 cm, 30 % of the rock; packstone), mainly crinoids, trilobites and brachiopods. Geopetal filling and umbrella effects. This type is most similar to SMF 5, but the original environment was deeper (smaller content of reef-building organisms). SMF 5: Grainstone - packstone or floatstone with bioclasts derived from reef dwellers and reef builders. Geopetal filling and umbrella effects from infiltered finer sediment.

Type A is abundant mainly in the Lochkov Formation (Kotýs Limestone) and in the Slivenec Limestone. It indicates the origin in Facies Zones 3 (deeper shelf margin) or 4 (foreslope).

Subtype A1

The same character as the Type A but with chaotic fabrics (mixed bioclasts with different dolomite generations, their inhomogeneous distribution), better sorting (less micrite, more bioclasts - about 50 %) and more damaged bioclasts (size 0.5-2 mm), which indicates subaquatic slides.

Subtype A1 corresponds to SMF 5 with the same consequences as described for the Type A. It was found in the Kotýs and Slivenec Limestones.

Type B

All rocks of the Type B belong to one of the two subtypes below.

Subtype B1

Macroscopically rose or grey micritic to fine bioclastic limestone.

Biomicritic limestone with well-preserved or whole bioclasts, mainly tentaculites and trilobites (size 0.1-0.8 mm, 10-25 % of the rock, wackestone).

Because of the preservation of bioclasts, this subtype corresponds to SMF 8 (Wackestone with whole organisms which are rooted in micrite. Only a few bioclasts. Well-preserved infauna and epifauna).

Subtype B1 occurs in the boundary layers between the Slivenec and Řeporyje Limestones and in the upper part of the Zlíchov Formation. It indicates Facies Zones 2 (open sea shelf) and 3 (deeper shelf margin).

Subtype B2

Macroscopically grey platy to nodular micritic limestone.

Biomicritic limestone with lesser content of bioclasts (about 10 %, mudstone-wackestone, size of bioclasts: 0.05-0.3 mm). Accumulations of very fine micrite form nodules. Bioclasts are homogenized through bioturbation.

This subtype clearly corresponds to SMF 9 (Bioclastic wackestone or bioclastic micrite). Fragments of diverse organisms which have been homogenized through bioturbation. Bioclasts may be micritized.

Subtype B2 is typical of the Dvorce-Prokop Limestone, occurs also in the Zlíchov Formation. It indicates Facies Zone 2 (open sea shelf).

Type C

Macroscopically grey fine-grained calcisiltite.

Microbioclastic calcisiltite. Very fine bioclasts and quartz grains in calcisiltite matrix. The rock contains about 10 % of bioclasts (size 0.05-1 mm, grainstone). The grain size of matrix is not homogeneous, which may appear as a graded bedding.

This type is close to SMF 2 (Microbioclastic calcisiltite. Small bioclasts and peloids in very fine-grained grainstone or packstone, mm ripple cross-bedding common).

Type C occurs in the uppermost Dvorce-Prokop Limestone and in the limestones of the Zlíchov Formation. It indicates Facies Zones 2 (open sea shelf) and 3 (deeper shelf margin).

Type D

Macroscopically red or multicoloured nodular biomicritic limestone.

Calcisiltite with comparatively large bioclasts (bioclastic limestone with calcisiltite matrix). Size of bioclasts: 0.2-3 mm, content in the rock: 30 % (packstone). Most of the features, except for the matrix and smaller abundance of the largest bioclasts, are similar to Type A. Some parts may be homogenized through bioturbation.

The character of the whole rock corresponds to SMF 5 and SMF 9, the matrix is similar to SMF 2 (all these SMF Types have been described together with preceding microfacies types).

Type D is typical of the Řeporyje and Loděnice Limestones. It indicates Facies Zone 3 (deeper shelf margin).

Type E

Macroscopically dark to light grey fine to coarse bioclastic limestone, often with nodular bed surfaces.

Biomicritic to biosparitic limestone (wackestone-packstone) with indicies of subaquatic slides: chaotic fabrics with reworked bioclasts, intraclasts of biomicritic limestone and micritic fissure fillings without fossils. Content of bioclasts: 0 % in fissure fillings, 10-60 % in the rest of the rock, size: 0.5-0.8 mm. Size of intraclasts: about 7 mm.

The character of the rock is similar to SMF 5 but of the remarkably deeper-water origin. Intraclasts are responsible for the similarity with lihoclastic breccia, described in SMF 4 (Microbreccia or bioclastic-lithoclastic packstone. Worn grains, often graded. Polymict or monomict in origin. Also quartz, cherts and carbonate detritus).

Type E is typical of the Kosoř Limestone, in Čeřinka it occurs also in the lower parts of the Zlíchov Formation. It indicates Facies Zones 2 (open sea shelf) and 3 (deeper shelf margin).

Type H

Micritic and dismicritic limestone without fauna, finely bedded (mudstone). This type is close to SMF 23 (unlaminated, homogeneous unfossiliferous micrite, sometimes crystals of evaporitic minerals).

It was locally found in the Slivenec Limestone, only in the Čeřinka quarry.

Type H is a specific type without fauna, forming very fine beds. The micritic and dismicritic limestones originate according to Flügel (1982) in deep-water or lake environment. In this case it forms the macroscopically visible structure. It reminds open structure filled with micrite instead of sparite. It is possible that micrite has originated by activities of thick bacterial mats or by leaching. However, the origin of this microfacies type is not clear enough, i.a. post-sedimentary origin in the fresh water environment should be also considered. In such a case, of course, this type of rock could not be classified as the primary microfacies type.

It is possible that fissure fillings described at the Type E are of similar origin as the limestone of the Type H, only on smaller scale.

Type I

Laminated limestone with peloids (size up to 0,5 mm, content of peloids 40-50 % in the sediment). Pelmicritic and pelsparitic layers alternate.

The presence of peloids classes this type with SMF 19 (loferite, laminated mudstone-wackestone, transiting occasionally into pelsparite with fenestral fabrics, often ostracod-peloid assemblage, sporadic foraminifera, gastropods and algae).

This type was found in the Slivenec Limestone in Čeřinka.

Type I is another specific type - laminated biomicrite with peloids and ostracods, most similar to SMF 19.

Both MF Types (H and I) belong to the Facies Zone 8 which represents a very shallow environment of shelf.

Type J

This type represents spiculitic forms of sediment. Depending on the amount of spicules, Subtypes J1 and J2 are defined. Both subtypes occur in the Kotýs Limestone in the Čeřinka quarry only.

Subtype J1

Typical spiculite, the content of spicules over 50 % (size 0.02-0.5 mm). Spicules are very often crushed. Originally biomicritic limestone, highly silicified.

Due to the amount of spicules, this subtype represents SMF 1 (spiculite, dark clayey mudstone or wackestone rich in organic substance, or siliceous spiculitic calcisiltite, spicules usually oriented, generally siliceous monaxons, commonly replaced by calcite).

Wilson (1975) describes SMF 1 as a typical deep-water sediment. Although according to him a majority of spiculites are basinal sediments, there is a possibility of their shallow-water sedimentation (Kukal 1986). The planktonic and nectonic biota should prevail in this facies but in the studied samples especially the benthic forms (crinoids) are present. It suggests that these limestones have originated in the shallower environment than in the basin.

Type J1 was found in the upper part of the Kotýs Limestone and it changes upwards into the following Subtype J2.

Subtype J2

Biomicritic to biosparitic limestone with the content of spicules up to 50 %. Layers of pure micrite transit into the micrite where spicules are predominantly concentrated. Fragments of crinoids and trilobites are common.

Substitution of SMF 1 for SMF 9 is very frequent in this subtype.

Subtype J2 is characterized by transition between SMF 1 and SMF 9 which substitute each other. Spiculitic parts alternate with micritic parts with prolific fauna, originated in the environment favourable for its life, it means in oxidizing environment. Alternating of SMF 1 and SMF 9 does not mean a considerable change in the depth but rather change of the current activity and oscillation of the oxidizing and reducing environment. The existence of the diagenetic reducing environment is also documented by macroscopic pyrite. On the basis of the given facts it is possible to class this sediment among the Facies Zone 2 (open sea shelf).

Microfacies types and sedimentary environment

The relation of Microfacies Types and Facies Zones (Fig. 3) shows that all studied rocks originated in the environment of a continental shelf. The shallowest facies in Čeřinka is the Koněprusy Limestone, in the Radotín Valley the Slivenec Limestone and the limestone of the „Chapel Coral Horizon“ with the dominating Type A (including the Subtype A1). These facies originated probably on the boundary between Facies Zones (FZ) 4 - foreslope, and 3 - deeper shelf margin. The Kotýs Limestone originated in similar but slightly deeper environment.

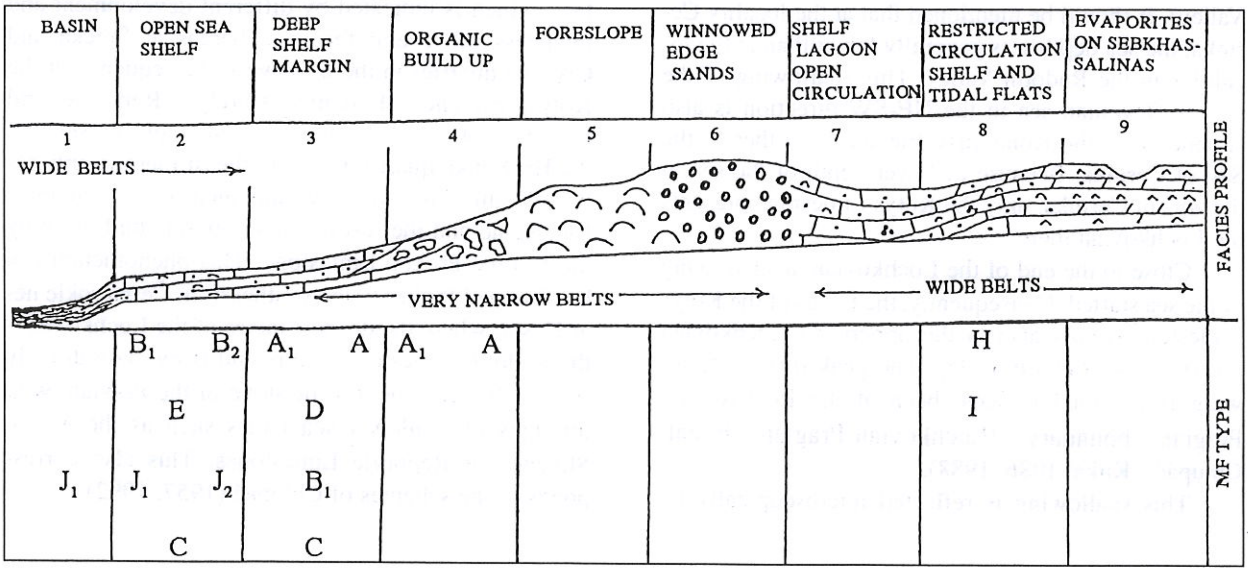

Fig. 3. Microfacies types associated with Standard Facies Zones (Belts) after J. L. Wilson (1975)

Remarkably deeper facies are the Loděnice and Řeporyje Limestones with the dominating Type D, originating in FZ 2 and/or 3. The similar depth of origin can be expected for the calcisiltites of the lower part of the Zlíchov Formation. The deeper facies is the Dvorce-Prokop Limestone, characterized by the Type B2, and the limestone of the upper part of the Zlíchov Formation with the Type B1. They are being put into FZ 2 - open sea shelf.

The deepest facies are spiculites of the Kotýs Limestone from the Čeřinka quarry with the Types J1 and J2 and the Kosoř Limestone (without uppermost layers of the Kotýs type) with the Type E. Mainly the relation of the Type E to the SMF Types caused difficulties. This type is similar to SMF 5 and SMF 4, which appear in FZ 3 and 4 but because of its occurence in the Kosoř Limestone it is necessary to place it into FZ 2, i.e. to the deepest parts of the shelf. Therefore it must be stated that the comparison of the Type E to the mentioned SMF Types is based only on their relative similarity. The difficulties are caused mainly by reworking of the sediment and other effects of subaquatic slides. This research gave no data which would allow the comparison of the depth of origin of these two types of rocks. According to the foregoing works based mainly on macroscopic features and paleontology (i.a. Chlupáč et al., 1992) we can expect that the environment where the Kosoř Limestone originated in the Radotín Valley wa s deeper than that of the spiculites in the Kotýs Limestone in the Čeřinka quarry. However the microfacies study does not prove this assumption.

Reconstruction of the Lower Devonian sedimentary environment

Relatively deep environment of the Upper Silurian also existed during almost the whole Lochkovian (represented by facies of the Kosoř Limestone in the Radotín Valley). It should be mentioned that at the locality Čeřinka, the sea depth was generally lower than at the localities in the Radotín Valley. This shallowing of the Lower Devonian sea in the NE-SW direction is also supported by the Koněprusy Elevation, farther to the SW of Čeřinka. Because of lower depth of the sea in the area of Čeřinka, only the Kotýs Limestone presents the Lochkovian there.

Close to the end of the Lochkovian, a shallowing of the sea started. Consequently, the facies of the Kotýs Limestone occurs also in the uppermost Lochkovian layers in the Radotín Valley. The peak of the shallowing is assumed to have been at the Lochkovian-Pragian boundary (Lochkovian-Pragian Event; Chlupáč - Kukal 1986, 1988).

This shallowing is reflected microscopically by abrupt change from the Microfacies Type J or E (the Kotýs Limestone) to the Type A (the Koněprusy and Slivenec Limestones). Chlupáč and Kukal (1988) consider this change as a regressive event of global importance.

The shallowest environment was in the area of Čeřinka, where the Koněprusy Limestone originated. In the Radotín Valley the base of Pragian is characteristic of the sedimentation of the Slivenec Limestone. During the Pragian, the sea became deeper: sedimentation of the Slivenec, Loděnice, Řeporyje and finally Dvorce-Prokop Limestones in this order corresponds to the increasing depth of the sea. However, even the deepest Pragian sea environment was shallower than the deepest environment of the Lochkovian. Partial shallowing evidenced by the transport of shallow sea (coral reef) detritus, took place at the base of the Zlíchovian („Chapel Coral Horizon“ in the Radotín Valley).

At Čeřinka, the Zlíchov Limestone sedimented in an analogous environment as the Dvorce-Prokop Limestone but the quiet, relatively deep-water sedimentation was interrupted by an intense activity of the currents at the base of the Zlíchov Formation. This is confirmed by the Microfacies Type E found at the base of the Zlíchov Formation. During the Zlíchovian the sea depth increased again (deeper facies form the middle and upper parts of the Zlíchov Formation). The increasing sea depth in the Zlíchovian is also indicated by the presence of ichnofossil *Zoophycos*, abundant in the Čeřinka quarry. According to Chlupáč (1990) *Zoophycos* lived in the deeper environment of low energy, without wave activity and of lower oxidation.

This reconstruction corresponds to the previous relevant works, above all those of Chlupáč - Kukal (1988) and Chlupáč et al. (1992).

Local differences in the Lochkovian and Pragian sea depth can be observed in sections of the Radotín Valley. The sea depth was increasing in NW-SE direction, which is indicated by different development and thickness of several facies: Whereas at Špička and Cikánka quarries in the northwest, the sequence of the Kotýs, Slivenec, Loděnice (rarely), Řeporyje and Dvorce-Prokop Limestones is completely present, in the Hvížďalka quarry in the southeast there is only relatively thin layer of rosy equivalent of the Slivenec Limestone and the rest of the Pragian is built only by the Dvorce-Prokop Limestone. This phenomenon can be observed farther to the southeast, in Černá rokle near Kosoř, where the deepest facies of the Lochkovian - the Radotín Limestone occurs and is overlain directly by the Dvorce-Prokop Limestone of the Pragian, with no signs of shallower sea facies such as the Kotýs, Slivenec or Řeporyje Limestones. This also corresponds to the schemes of Chlupáč (1957, 1992).

Conclusion

1. The microfacies analysis using the SMF Types, made for the first time in the Barrandian area, supplemented the information obtained by other methods, mainly by biostratigraphy. Biostratigraphy, however, seems to be essential, as the change of fauna along important stratigraphic boundaries is not always connected with a major change of the microfacies criteria, which is, above all, the case of the Lochkovian-Pragian boundary and only subtile differences between the Kotýs and Koněprusy or Slivenec Limestones.

2. The newly obtained data support the following:

(a) The facies differences observed in the Radotín Valley, in NW-SE direction are interpreted as a result of increasing depth of the sedimentary environment towards the southeast.

(b) Considerable amount of spiculites and calcisiltites was found within the Kotýs Limestone sequence in Čeřinka.

(c) The red and multicoloured facies (Řeporyje and Loděnice Limestones) usually have calcisiltite matrix.

(d) Samples with mixed bioclasts (different generations of dolomite in crinoid segments) provided a picture of sedimentation of material transported from the shalower parts of shelf.

(e) Considerable similarity of microfacies of the Koněprusy and Slivenec Limestones, particularly regarding bioclasts, with the difference of larger contents of micrite in the rose Slivenec Limestone, was proved.

(f) The non-fossiliferous micrite fillings were found in the Slivenec Limestone at Čeřinka. The origin of this facies, described as the Type H, was not fully explained. The similar phenomenon, but on the smaller scale, was found in the Kosoř Limestone in the Radotín Valley.

(g) Crinoid segments filled with glauconite in the central parts were found in the lower Kotýs Limestone in Čeřinka. Presence of glauconite was proved by X-ray analysis.

3. The microfacies analysis using the SMF Types proved to be useful for understanding of the Barrandian carbonates' origin. Compared to the research in younger formations, as described by Wilson (1975) and Flügel (1982), it is necessary to pay more attention to the determinig the original fabrics, which could be partially or fully hidden behind the results of post-sedimentary processes. Except this, the difference is also in the occurence of some of the significant fossils.

However, for the more detailed research it appears to be useful to work with more detailed division of the microfacies types.

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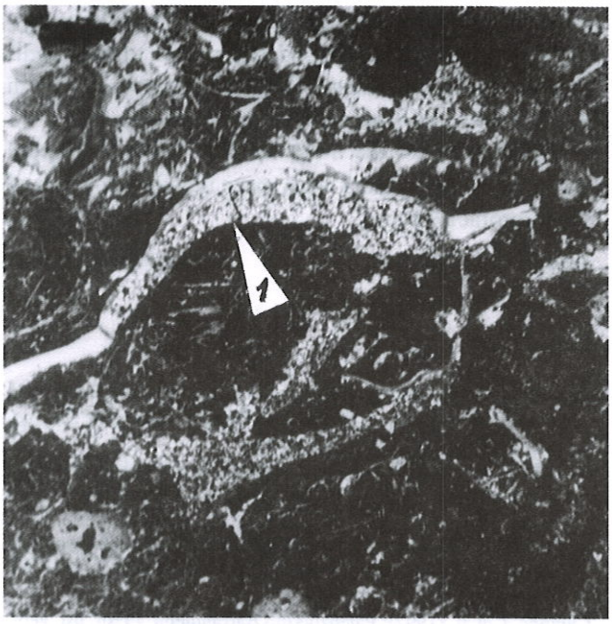
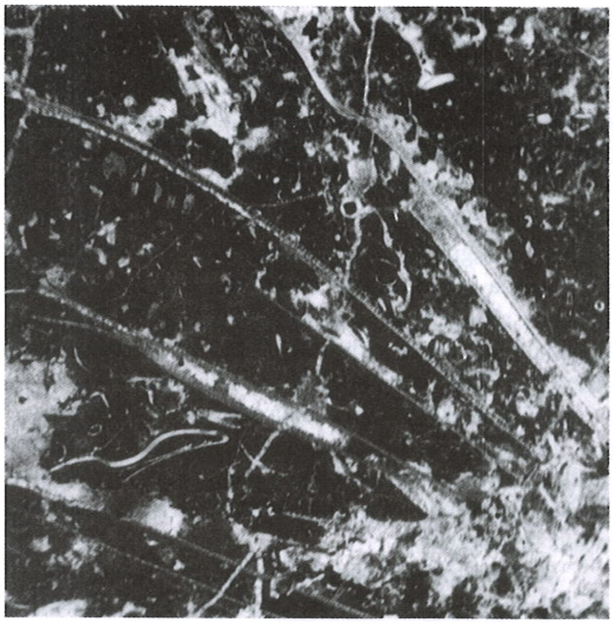
Použití mikrofaciální analýzy v barrandienském spodním devonu

Mikrofaciální analýza využívající srovnání se standardními mikrofaciemi (SMF), definovanými Wilsonem (1975) a Flügelem (1982), byla provedena na spodnodevonských horninách (lochkov, prag, zlíchov) dvou barrandienských lokalit: v Radotínském údolí a v lomu Čeřinka u Bubovic. Bylo vymezeno 8 základních typů mikrofacií, které odpovídají SMF jen zčásti: A - hrubě bioklastický vápenec, B - biomikritový vápenec, C - mikrobioklastický kalcisiltit, D - kalcisiltit s většími klasty, E - hrubě bioklastický až brekciovitý vápenec s litoklasty a indiciemi podmořských skluzů, H - mikritový vápenec bez fauny, I - laminovaný vápenec s peloidy, J - spikulit. Na základě mikrofaciálních kritérií bylo rekonstruováno sedimentační prostředí a jeho vývoj v průběhu spodního devonu.

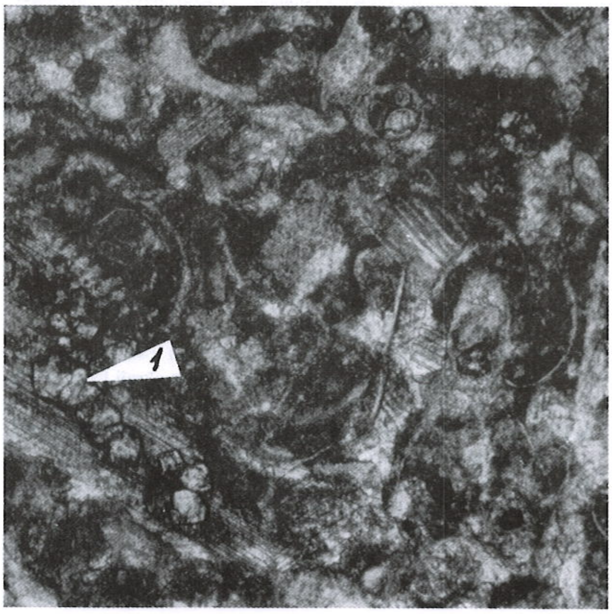
L. Velebilová - P. Šarf: Application of microfacies analysis in the Lower Devonian of the Barrandian, central Bohemia (Pl. I)



1. Type A: Bioclastic limestone with abundant bioclasts. Slivenec Limestone (Pragian), Špička quarry, light red colour
1 - trilobite with geopetal filling; Magnification: x8



2. Type A: Bioclastic limestone with prolific segments of trilobites and crinoids. Section of the part of trilobite *Scutellum formosum slivenecense*. Slivenec Limestone (Pragian), Čeřinka quarry, dark rose colour; Magnification: x8

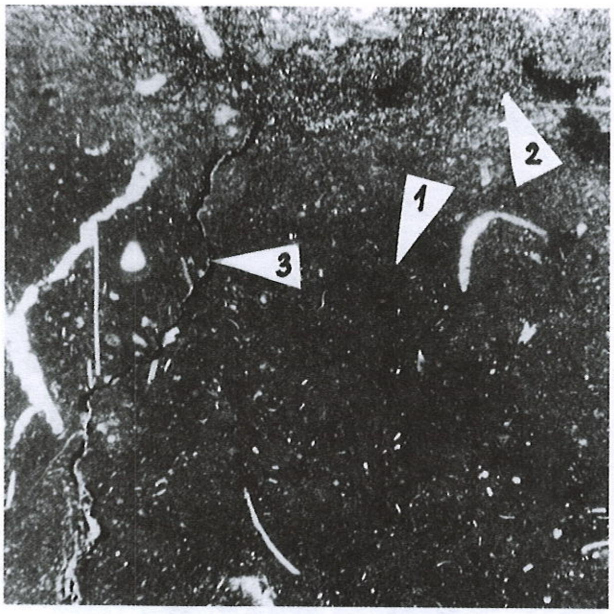


3. Subtype A1: Bioclastic limestone with chaotic fabrics, partly recrystallized bioclasts, partly dolomitized. Slivenec Limestone (Lochkovian-Pragian boundary interval), Špička quarry, light red colour
1 - dolomite; Magnification: x43

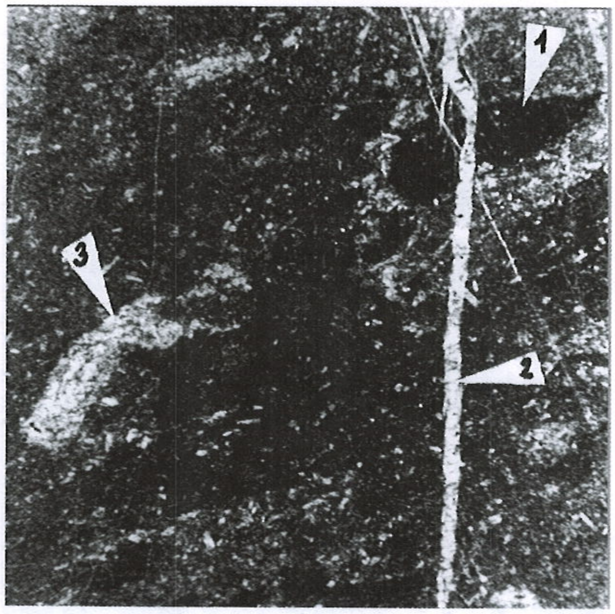
4. Type B1: Biomicritic limestone. Sections of Dacryoconarid tentaculites in micrite matrix. Chýnice Limestone (Zlíchovian), Čeřinka quarry, red colour
A - geopetal sparite filling in cross-section of tentaculite; Magnification: x43

Photo by I. Fišer

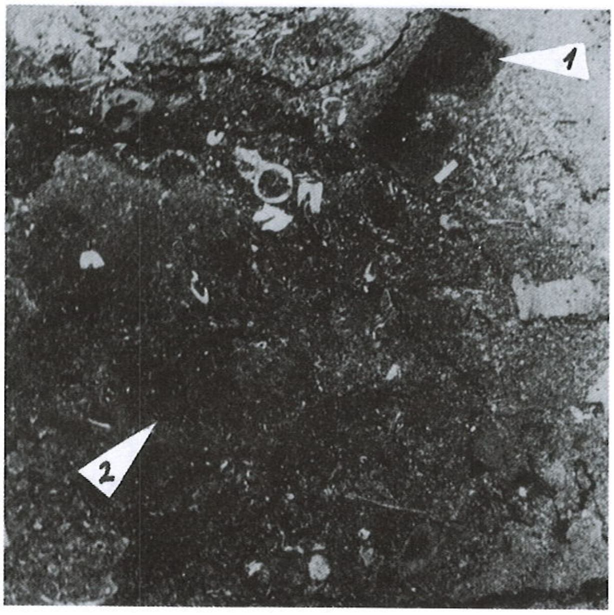
L. Velebilová - P. Šarf: Application of microfacies analysis in the Lower Devonian of the Barrandian, central Bohemia (Pl. II)



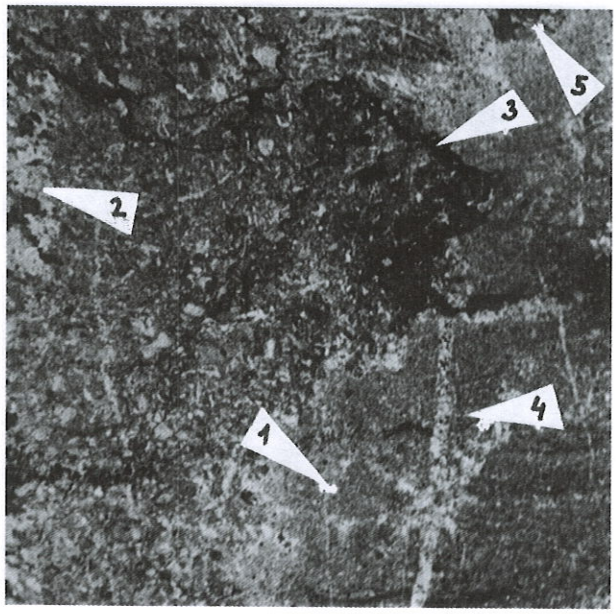
1. Type B2: Biomicritic limestone with nodular structure, partly dolomitized. Dvorce-Prokop Limestone (Pragian), Hvížďalka quarry, grey colour
1 - nodule, 2 - dolomite, 3 - microstylolite; Magnification: x8



2. Type C: Microbioclastic calcisiltite with fine graded bedding, tiny calcite dykes and intraclasts of biomicrite. Zlíchov Formation (Zlíchovian), Hvížďalka quarry, grey colour
1 - intraclast, 2 - calcite dyke, 3 - piece of coral (Tabulata); Magnification: x8



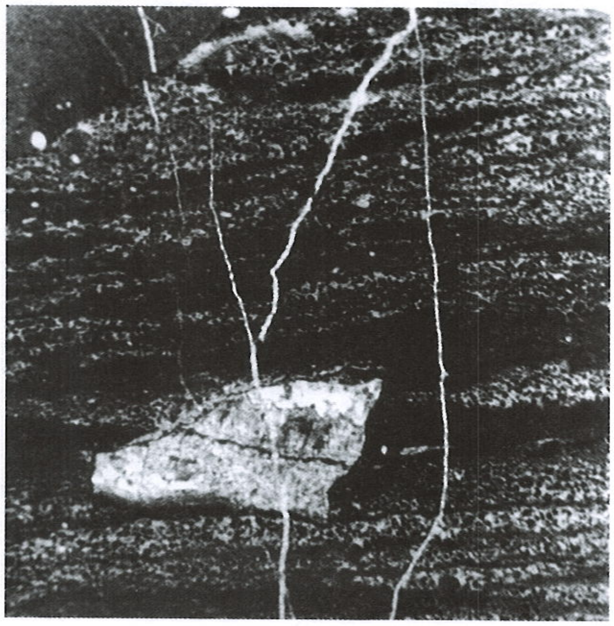
3. Type D: Nodular limestone with microbioclastic (calcisiltite) matrix. Řeporyje Limestone (Pragian), Špička quarry, red colour
1 - fragment of crinoid, 2 - nodule; Magnification: x8



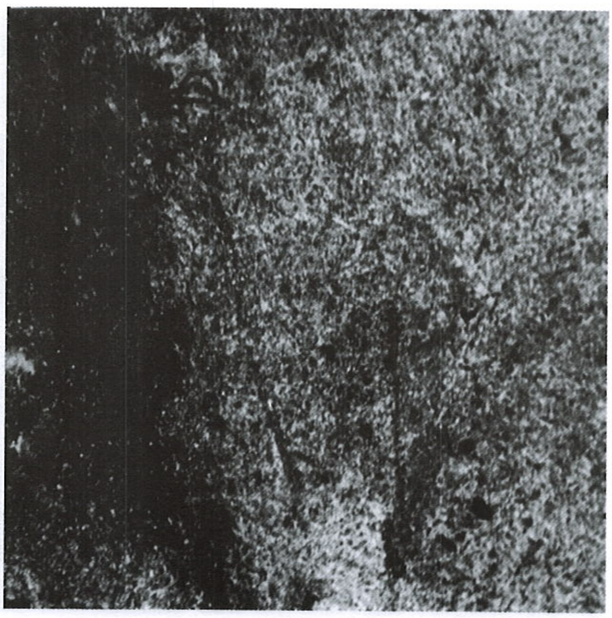
4. Type E: Bioclastic limestone with micrite - calcisiltite matrix and breccia fabrics with intraclasts of biomicrite and non-fossiliferous calcisiltite fissure filling, partly recrystallized. Kotýs Limestone (uppermost Lochkovian), Hvížďalka quarry, light grey colour
1 - filled fissure, 2 - recrystallized part, 3 - microstylolite, 4 - calcite dyke, 5 - intraclast; Magnification: x8

Photo by I. Fišer

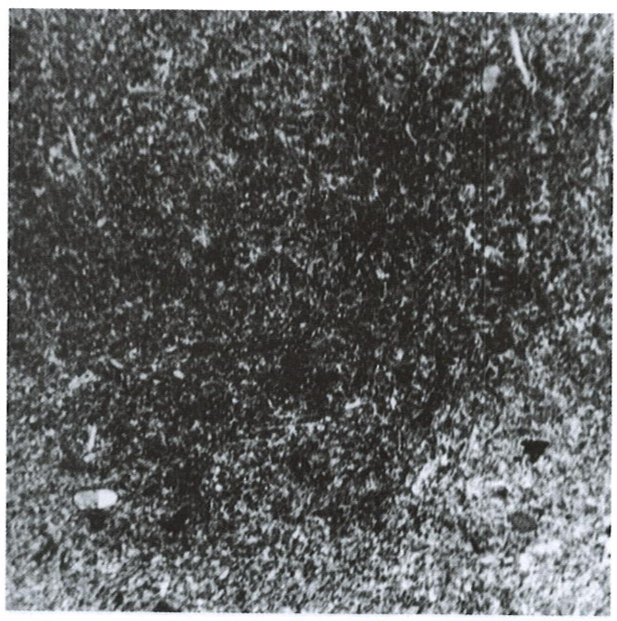
1. Type H: Finely bedded non-fossiliferous micrite filling open structure in bioclastic limestone with abundant crinoids (Type A). Slivenec Limestone (Pragian), Čeřinka quarry, rose - yellowish colour; Magnification: x8



2. Type I: Finely laminated micritic limestone with peloids (content of peloids 40-50 %, size 0.01-0.5 mm), pelmicritic and pelsparitic layers alternate. Redeposited clasts are present. Slivenec Limestone (Pragian), Čeřinka quarry, rose-brown colour; Magnification: x8

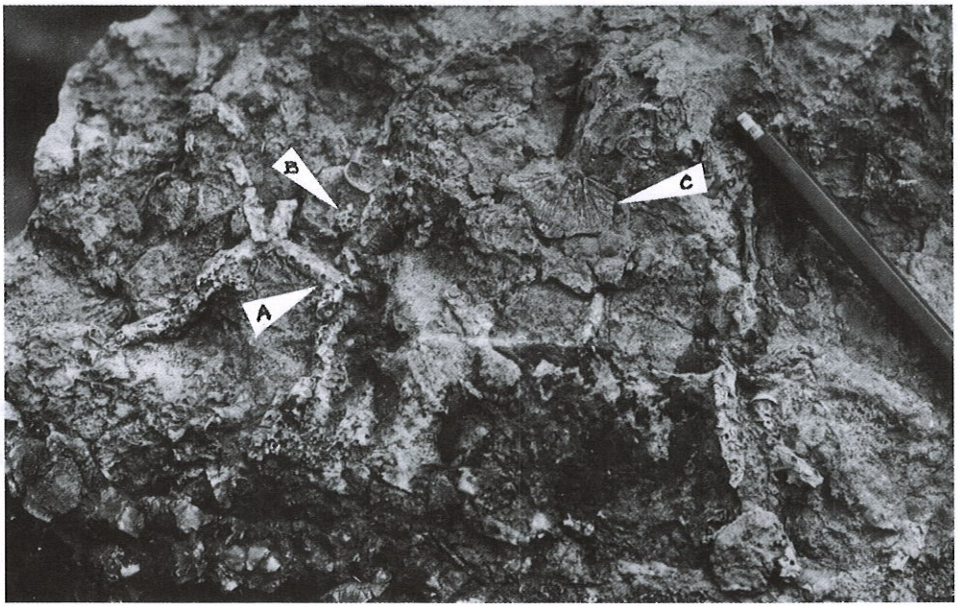


3. Type J1: Typical spiculite with micrite matrix (content of spicules 60 %), highly silicified. Kotýs Limestone (Lochkovian), Čeřinka quarry, grey colour; Magnification: x8

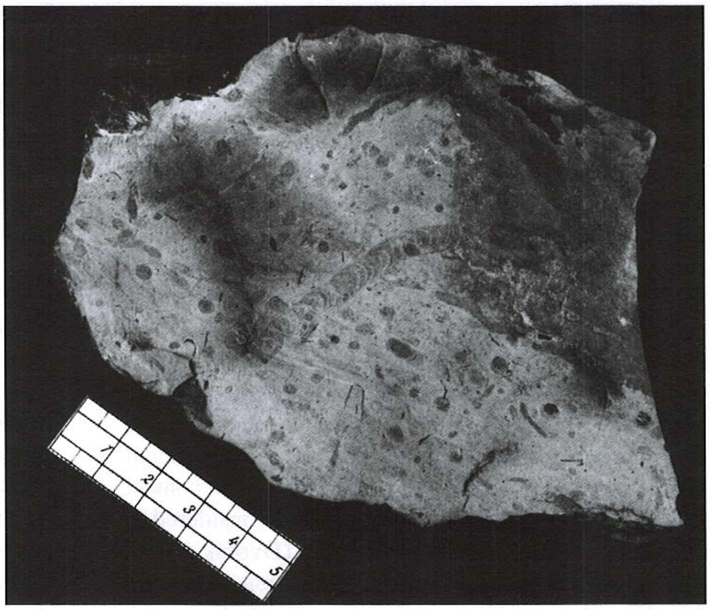


4. Type J2: Bioclastic limestone. Originally biomicritic limestone, micrite recrystallized into sparite. Kotýs Limestone (Lochkovian), Čeřinka quarry, grey colour; Magnification: x8

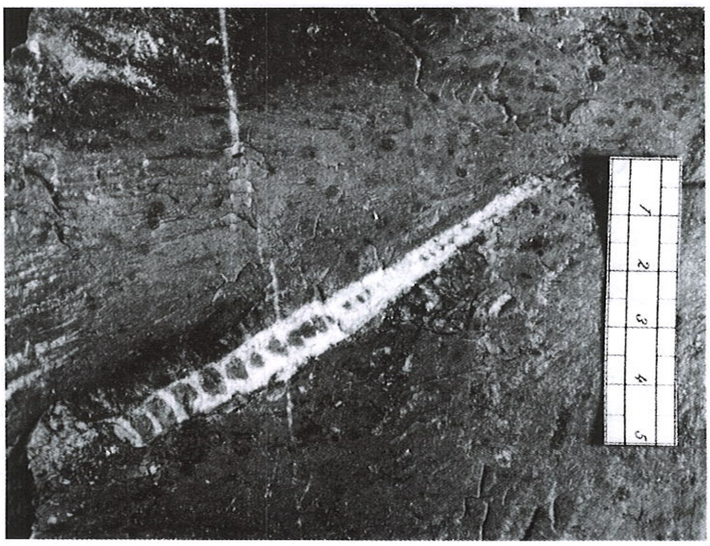
Photo by I. Fišer



1. Coral assemblage. Kotýs Limestone (Lochkovian), Čeřinka quarry, grey colour
A - *Dulipora* sp. Termier & Termier 1980, B - *Granulidictyinae* indet. Weyer 1970, C - brachiopod
Photo by L. Velebilová



2. Traces of *Zoophycos* and *Chondrites* bioturbations. Zlíchov Limestone (Zlíchovian), Čeřinka quarry, grey colour
Photo by R. Duda



3. Section of Orthoceras across the bedding. The Zlíchov Limestone (Zlíchovian), Čeřinka quarry, grey colour
Photo by R. Duda