4. The Ludlow-Přídolí boundary interval in the Barrandian area

The International Subcommission on Silurian Stratigraphy accepted Přídolí as the uppermost Silurian Series in 1983. This proposal was ratified during the 27th International Geological Congress in Moscow (BASSETT 1985), at which the stratotype section in Požáry quarry near Praha-Řeporyje became established (fig. 3). The base of the Přídolí Series is defined by the first occurrence of the graptolite *Monograptus parultimus* JAEGER in bed No. 96.

This boundary interval was studied at three localities: Požáry quarry near Praha-Řeporyje, Kosov quarry near Beroun, and the Marble quarry near Praha-Lochkov. The Požáry quarry is the international stratotype of the lower boundary of the Přídolí Series, whereas the Kosov and Marble quarries serve as auxiliary reference sections.

The Přídolí Formation, as defined by PRANTL and PŘIBYL (1948), was named after its principal locality (Přídolí near Velká Chuchle). On the recommendation of the Subcommission on Silurian Stratigraphy, the Přídolí Formation was renamed the Požáry Formation by KŘÍŽ et al. (1986). This step was not accepted by the Czechoslovak (later Czech) Commission on Stratigraphy because of the priority of the former name.

4.1. Požáry quarry near Praha-Řeporyje

The abandoned Požáry quarries (Požár 1 and 2) are situated on the southern bank of the "Dalejské údolí" Valley about 1 km to the east of Praha-Řeporyje (see fig. 1).

The Lower Devonian massive, medium to coarse-grained, bioclastic limestones of the Lower Lochkovian were quarried for cement and lime production, glass and chemical industries, and construction materials. The limestone quarrying at Požár 1 ended in the late 1930's, and in the Požár 2 quarry by the end of the 1940's.

This locality was first described by WOLDŘICH (1919), and later by BOUČEK (1937), HORNÝ (1962), BARNETT (1972), CHLUPÁČ (1953, 1957), CHLUPÁČ et al. (1972), KŘÍŽ (1989, 1999b, KŘÍŽ et al. 1986, in CHLUPÁČ et al. 1992), and others. Geological mapping of this area was undertaken during the years 1957–1958, and 1966–1974 by I. Chlupáč and J. Kříž (see sheet Praha-jih 12-421, ed. CHÁB et al. 1988).

This stratotype section has been subjected to a thorough biostratigraphical study (see paper by KŘÍŽ et al. 1986). A sedimentological study was carried out by KUKAL (in KŘÍŽ et al. 1986).

The base of the Přídolí Series does not correlate with that of the Přídolí Formation. The original bed numbering has been utilized in the present study. Samples were taken from limestone beds 86, 87 (two samples), 89e, 94, 96, 98, 99c, 100, 102 and 104.

Geological setting

The entire sequence of the Kopanina and Požáry formations (Upper Silurian), and the main part of Lochkov Formation (Lower Devonian), are exposed at this site.

The Požár 1 quarry area is protected by law No. 40/1956 as a Natural National Monument.

The Kopanina Formation is exposed in the access road cut into the quarry and in a nearby tunnel. The lower part of the formation is dominated by tuffaceous and calcareous shales with micritic limestone lenses. The upper part of this formation (the trilobite Prionopeltis archiaci Zone) is com-

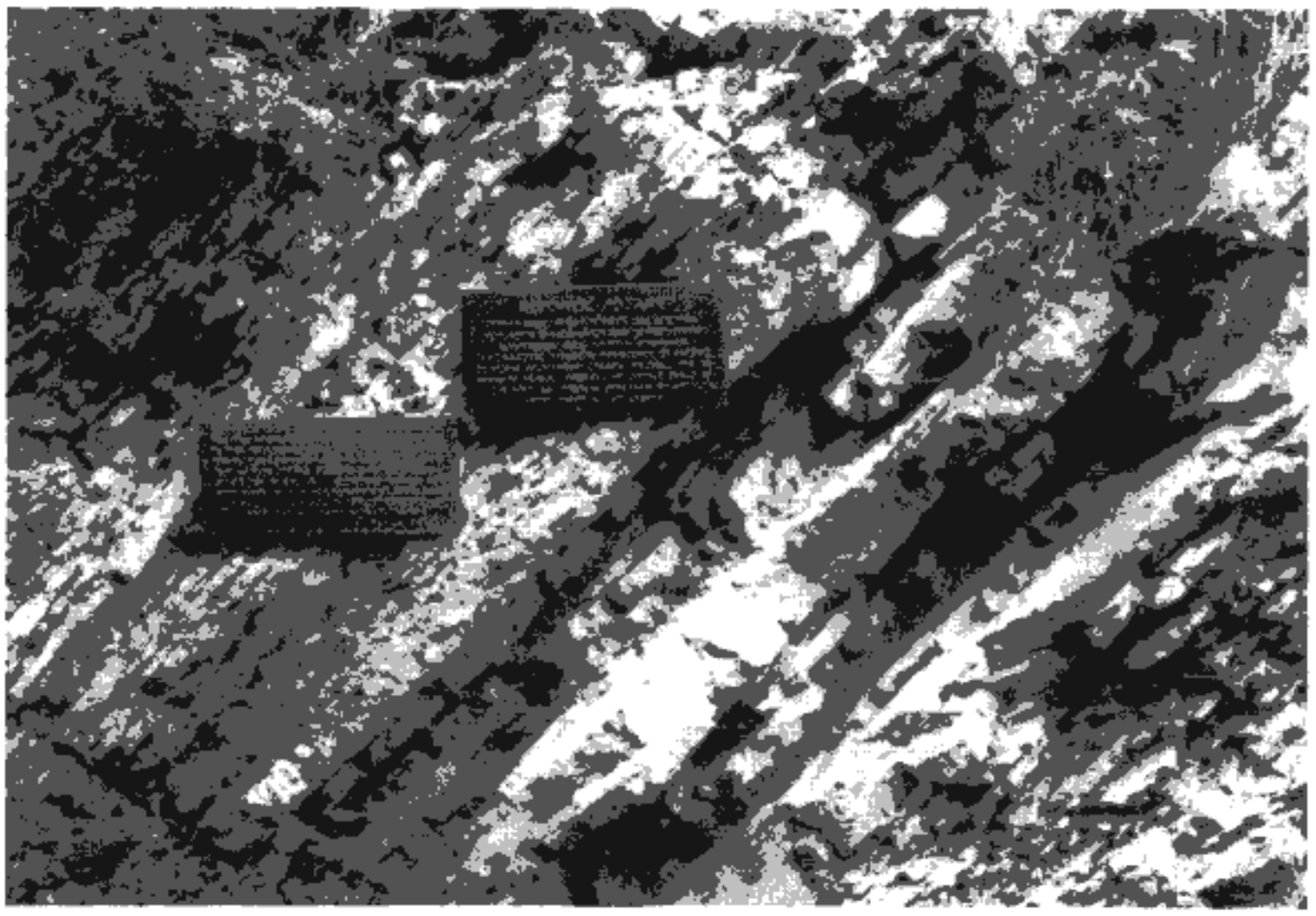

Figure 3. International basal boundary stratotype of the uppermost series of the Silurian System – Přídolí in the Požáry quarry near Praha-Řeporyje.

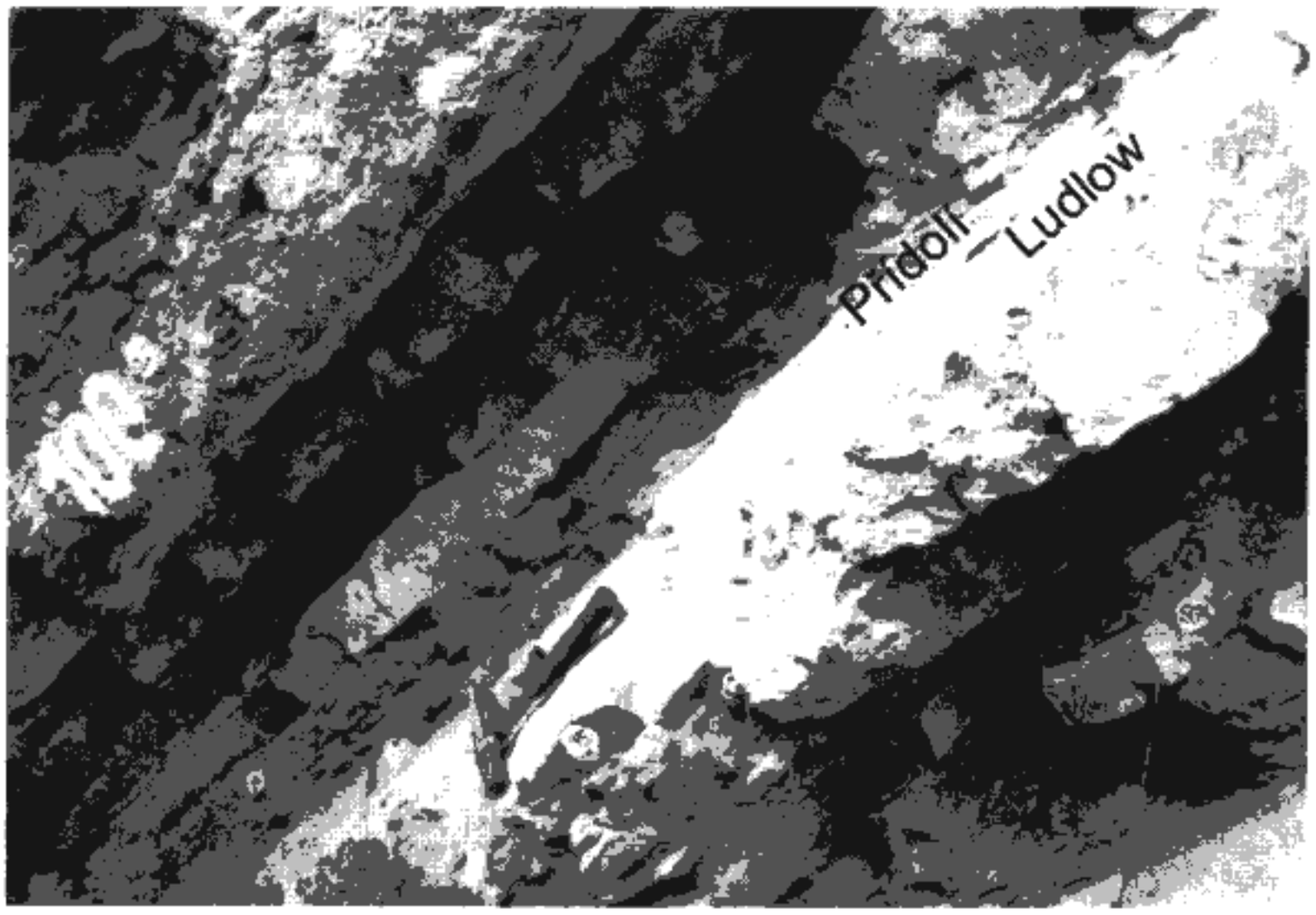

Figure 4. The Ludlow-Přídolí boundary interval in the Požáry quarry section.

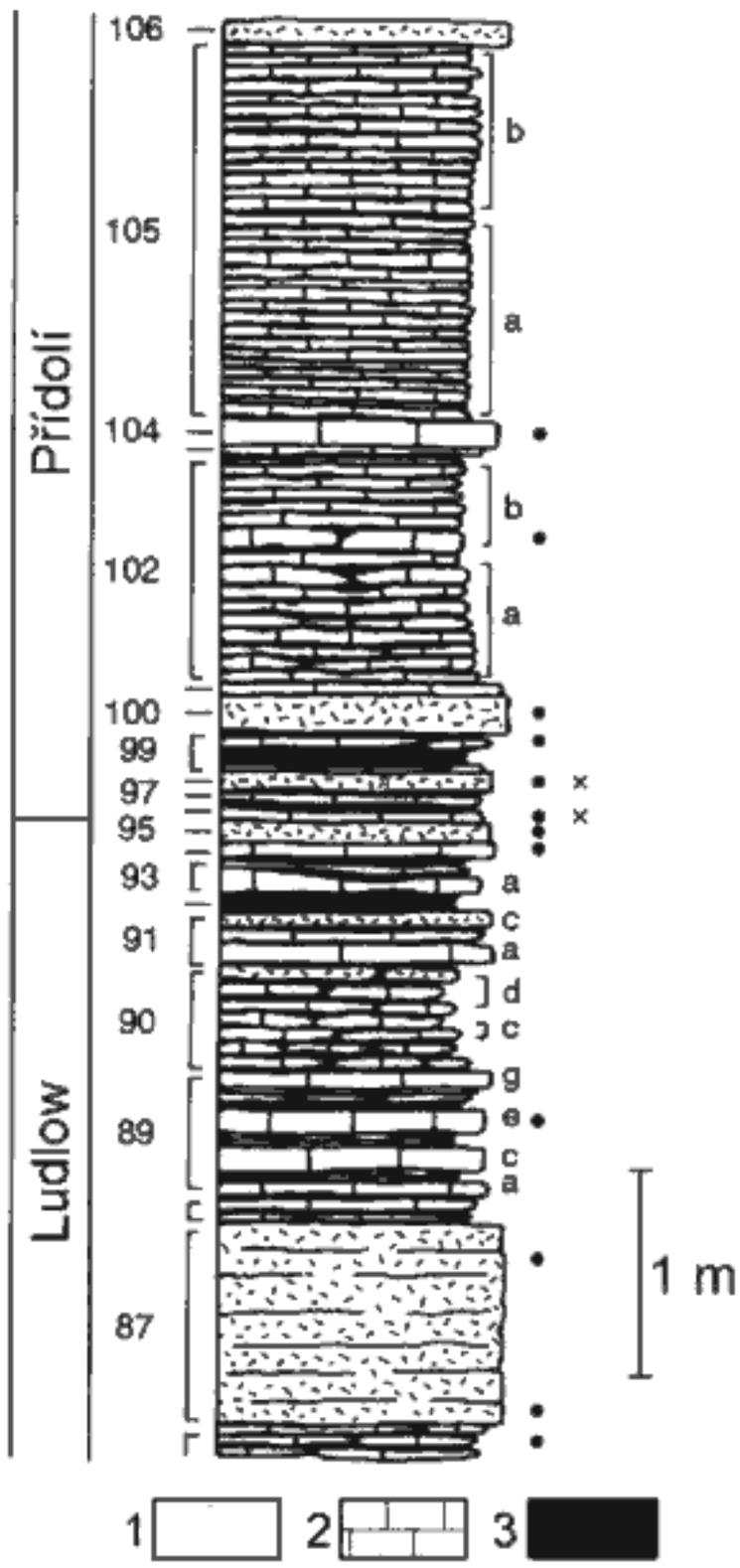

Figure 5. Lithological section of the Ludlow-Přídolí boundary in the Požáry quarry (after Kříž et al. 1986 – modified).
1 – bioclastic limestones, 2 – micritic and biomicritic limestones, 3 – calcareous shales; • – sample taken for thin-section, × – sample taken for geochemical analysis.

posed of platy, grey to dark grey, micritic to biomicritic limestones interbeded with shale. This sequence is terminated by a 1 metre thick bed of bioclastic limestone with abundant cephalopods (bed No. 87).

The base of the Přídolí Formation corresponds to bed 88 above the tunnel. It is represented by dark grey and black, platy, micritic to biomicritic limestones interbedded with calcareous shales. Laminites are also present. The upper part of the formation consists of grey bioclastic limestones with cephalopods and brachiopods, and with crinoids *Scyphocrinites* sp. in the uppermost part.

For a detailed description of the Ludlow-Přídolí boundary interval see Kříž et al. (1986).

The massive, light-grey to pink, coarse-grained bioclastic Kotýs Limestone of the Lochkov Formation (Lochkovian, Lower Devonian) is exposed in the Požár 1 quarry. Cherts are present mainly in the upper part of this formation. The Silurian-Devonian boundary is discussed in Chapter 5.3. The Lochkovian-Pragian boundary is located in the gallery between the Požár 1 and 2 quarries. The Praha Formation is represented by the light-grey to reddish, crinoidal Slivenec Limestone. In the upper part of the formation, this limestone passes into the reddish, micritic, nodular Loděnice and Řeporyje Limestones, and the grey nodular Dvorce-Prokop Limestone.

Bioclasts

The biosparitic limestones of the Upper Ludlow contain mainly fragments of crinoids, trilobites, brachiopods, bivalves, and cephalopods. Ostracods and phosphate bioclasts (conodonts, inarticulate brachiopods) are less abundant. Fragments of gastropod shells, corals, and sponge spicules occur very rarely. The proportion of bioclasts is usually more than 80 %. They are often micritized, and their mean

size varies between 0.2 and 1.3 mm, with maximum sizes of a few centimetres.

The bioclastic content of the micritic and biomicritic limestones is smaller (up to 50 %). It is comprised of trilobites, cephalopods, crinoids, brachiopods and ostracods, acritarchs, sponge spicules, and some corals. The sizes of these bioclasts vary between 0.16 and 0.6 mm, with maximum grain sizes from 5 to 7 mm.

Micritic and biomicritic limestones predominate in the lower part of the Přídolí Formation. The amount of bioclasts is usually less than 20 %. They are comprised of ostracods, trilobites, brachiopods, and crinoids with sizes between 0.1 to 1.0 mm. These bioclasts are not micritized.

The layers of the coarse-grained bioclastic limestones are of secondary importance. Crinoids, brachiopods, and trilobites are prevalent among bioclastic fragments, while corals, bryozoans, and ostracods are less abundant. The proportion of bioclasts varies between 80 and 90 %, and their sizes range from 0.32 to 1.6 mm. The bioclasts are often micritized.

Microfacies analysis

Although SMF 5 should belong to FB 4, only the limestone of bed 87 displays the characteristic features of FB 4. Other occurrences of SMF 5 are only thin layers within biomicritic limestones and shales (pl. 1 – fig. 1). Limestones that can be classified as transitional between biomicrites and biosparites, with a greater or lesser micrite content (packstones), contain abundant benthos (crinoids, brachiopods, bivalves) with sizes up to a few centimetres. The biomicritic limestones that dominate this section commonly contain layers or laminae of biosparitic limestones. The proportion of bioclasts in these biomicritic limestones is smaller (up to 50 %) than in those generally classified as SMF 5.

Boundary bed 96 is composed of a biomicritic limestone (wackestone) which belongs to SMF 9 (with a greater proportion of bioclasts in its lower part). Its bioclastic content is about 30 %. Several laminae of coarser-grained bioclastic limestone are present. The amount of bioclasts with a mean size of 0.3 mm is less than 70 %. This type of limestone can be classified as SMF 5. The poorly sorted, biosparitic limestone gradually passes into a biomicritic limestone with a higher proportion of micritic matrix and only minor bioclastic content. Micrite is often recrystallized to microsparite. This limestone can be classified as laminite.

The overlying sequence of the Přídolí Formation is composed mainly of fossiliferous micritic to laminated, biomicritic limestones (Folk's types B and C, mudstone to wackestone) interbedded with calcareous shales that correspond to SMF 3 (pl. 1 – fig. 4). The proportion of silt-sized bioclasts goes up to 20 %. This microfacies belongs to FB 3.

Several layers of biosparitic limestones (beds 98 and 100) are present in this section. Bed 100 is similar to 87. By contrast, the limestone in bed 98 contains about 90 % of micritic matrix in the form of micritized bioclasts (see 1 – figs. 2 and 3). Syntaxial sparite content is about 10 %. This limestone can be classified as SMF 11, deposited in FB 4 to 5, above the wave-base. There are neither geopetal structures nor gradation, and thus it cannot be interpreted as reworked SMF 5.

4.2. Kosov quarry near Beroun

The Kosov quarry is situated about 1.5 km SW from the center of Jarov village near Beroun, on the NW slope of Kosov Hill (also Dlouhá Hora, 451 m above sea level, see fig. 1).

Since the nineteenth century there have been many

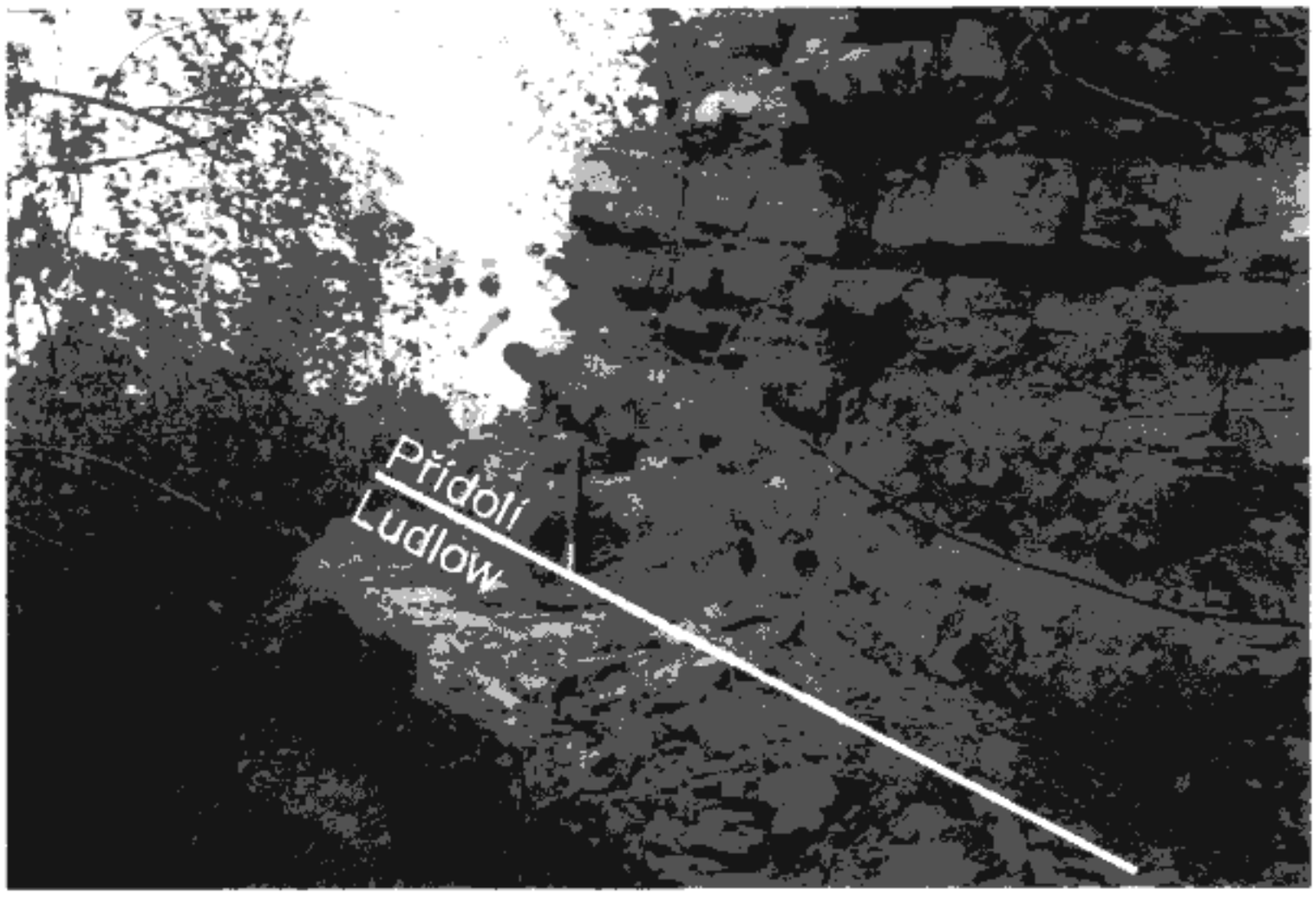

Figure 6. The Ludlow-Přídolí boundary interval in the Kosov quarry section.

small quarries at this locality, where raw materials for lime production were extracted.

This area has been studied by BOUČEK (1941), HORNÝ (1955a, c, 1960), BOUČEK and PŘIBYL (1955), KUKAL (1955a), HAVLÍČEK et al. (1958), WALLISER (1964), JAEGER (in KŘÍŽ et al. 1986), KŘÍŽ et al. (1986), and KŘÍŽ (1992). HORNÝ (in CHLUPÁČ et al. 1987) mapped this area on the scale of 1 : 25 000 (sheet Králův Dvůr 12-413).

The Kopanina-Přídolí formation boundary cannot be correlated with that of the Ludlow-Přídolí Series. The boundary beds are exposed in several sections. The section considered here is situated on the northern front wall in the eastern part of the quarry (section No. 778, KŘÍŽ 1992). The original bed numbers are no longer legible, and thus the section had to be renumbered.

Geological setting

The sequence of the Silurian rocks exposed in this quarry begins with the Motol Formation (Wenlock Series, Middle Sheinwoodian) and reaches to the middle part of the Přídolí Formation (Přídolí Series).

The Motol Formation exposed in the quarry begins with a graptolite Cyrtograptus rigidus Biozone. It is composed mainly of laminated calcareous shales with layers of tuffaceous material and limestone concretions as large as 75 cm in diameter. The concretions are of an early diagenetic origin (ŠRÁMEK 1974, 1976). Intrusive basalts (with thicknesses up to 30 m) occur throughout almost the entire sequence (TUREK 1983), and their contact metamorphosis with the surrounding rocks is clearly visible. Pyroclastic agglomerates and tuffaceous limestones are also present. According to KŘÍŽ (in CHLUPÁČ et al. 1992), an associated bed of endostratic breccia, about 1.5 m thick, with fragments of tuffs, tuffaceous and bioclastic limestones, and limestone concretions, represents a gravity chute connected to the initial activity of the Kosov volcanic center, situated at the junction of the Tobolka and Tachlovice Faults. The Motol Formation corresponds to the Cyrtograptus rigidus and Testograptus testis graptolite Biozones. Aside from graptolites there are abundant remains of algae, cephalopods, and bivalves (especially the genus *Butovicella*). The so-called "graptolite comets" are interesting fossils in which the rhabdosomes of graptolites became bent around objects, such as cephalopod shells, by current activity. TUREK (1983) studied these "comets" and reconstructed a corresponding paleocurrent direction from WSW towards ENE.

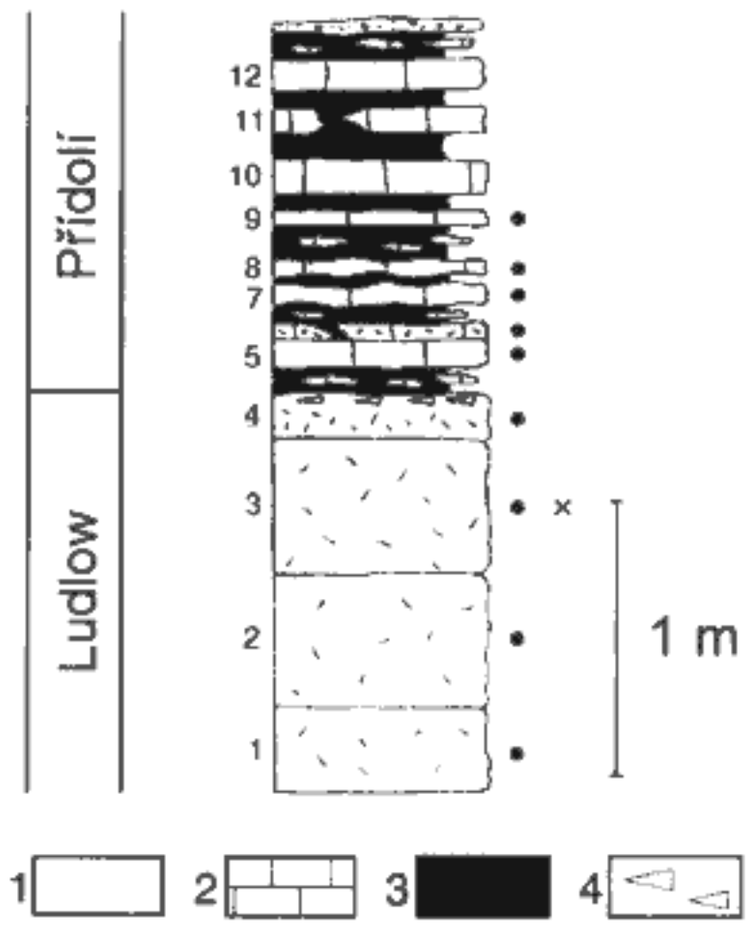

Figure 7. Lithological section of the Ludlow-Přídolí boundary in the Kosov quarry.
1 – bioclastic limestones, 2 – micritic and biomicritic limestones, 3 – calcareous shales, 4 – cephalopods; • – sample taken for thin-section, × – sample taken for geochemical analysis.

The overlying Kopanina Formation (Ludlow Series) has been studied in detail by many authors. A petrological study of this formation was carried out by KUKAL (1955a). The Kopanina Formation is composed of massive cephalopod and brachiopod limestones, dark platy micritic and biomicritic limestones, calcareous shales, tuffaceous limestones, and calcareous tuffs. Volcaniclastic material is abundant in the lower parts of the formation. The thickly-bedded limestones often display lamination, in which light-coloured laminae containing fine-grained detritus alternate with dark-coloured micritic laminae. The dark-coloured laminae are thicker than the light-coloured ones (KUKAL 1955a). The entire sequence of the Kopanina Formation is rich in calcareous concretions of early diagenetic origin. Their occurrence is mainly concentrated in the Encrinuraspis beaumonti Biohorizon (KUKAL 1955a). Massive cephalopod limestones of the Prionopeltis archiaci Biozone probably originated in a high-energy environment, as they consist of a mixture of coarse-grained detritus with a negligible proportion of fine material (micrite).

The overlying Přídolí Formation (Přídolí Series) is represented here only by its lower and middle parts. The boundaries between the Kopanina and Přídolí formations, and the Ludlow and Přídolí Series, are isochronous and are exposed in several sections. The Přídolí Formation is developed as dark platy micritic to biomicritic and bioclastic limestones, interbedded with calcareous shale.

The Ludlow-Přídolí boundary is well exposed and has been studied in detail by KŘÍŽ et al. (1986) and KŘÍŽ (1992).

In the section presently under consideration (see KŘÍŽ 1992 – section No. 778) the upper part of the Kopanina Formation is developed as light grey, coarse-grained, bioclastic limestones with abundant brachiopods, cephalopods, trilobites, and rugose corals. The cephalopods on the bedding surfaces of the uppermost bed of the Kopanina limestones are oriented in the NNE-SSW direction (wider end to the NNE), which accords with the results published by PETRÁNEK and KOMÁRKOVÁ (1953). These limestones belong to the Prionopeltis archiaci Biozone.

The lower parts of the Přídolí Formation (Monograptus parultimus Biozone) are composed of dark, platy, biomic-

ritic to bioclastic limestones with calcareous shales. Lamination is common in these limestones. Light-coloured laminae formed from the deposition of coarse-grained detritus, probably owing to changes in current conditions. Similar features were described by KUKAL (1955a) in the Kopanina limestones.

Bioclasts

Crinoids and brachiopods dominate the bioclastic facies of the uppermost Ludlow (beds 1 to 3), while rugose corals and trilobites are also relatively abundant. Cephalopods, bivalves, gastropods, bryozoans, phyllocarids, graptolites, and sponge spicules are present only in smaller amounts. Recrystallized crinoid stems are usually only of microscopic size. Sponge spicules are often calcified. The proportion of bioclasts ranges from 50 to 80 %. Their size varies from tenths of millimetres to a few centimetres.

The "micritic" facies of the uppermost Ludlow is developed only at the top of the section (bed 4). Bioclasts are comprised mainly of fragments of cephalopod shells and crinoid stems. Cephalopod shells are oriented in NNE-SSW direction (their tops to NNE). Brachiopods, ostracods, sponge spicules, and acritarchs are rare. The proportion of bioclasts ranges between 5 and 15 %, with their maximum concentration on the upper bedding plane where abundant cephalopod shells occur. The size of bioclasts varies from the tenths of millimetres to few centimetres.

The Přídolí Formation is comparatively poor in bioclasts, which consist mainly of fragments of crinoids and brachiopod shells, partly of cephalopods, trilobites, bivalves, and rarely of corals, sponge spicules, and acritarchs. The mean size of the bioclasts reaches a few millimetres, larger fragments occurring sporadically. The proportion of bioclasts is usually below 20 % (maximum 50 %). In the laminae of the coarse-grained bioclastic limestones the bioclast proportion rises to 90 %.

Microfacies analysis

The Kopanina Formation in the Kosov quarry is classified as SMF 12 (beds 1–3) and SMF 3 (bed 4). This part of the section (a Prionopeltis archiaci Biozone) is developed as light grey, medium-grained to coarse-grained, biosparitic limestones with abundant crinoids, brachiopods, and rugose corals. Bioclasts are well rounded and sorted in grain size fractions of 0.3–1.3 mm and 1.3–2.2 mm. There is a maximum of 1% of micrite. This type of limestone is classified as grainstone or sorted biosparitic limestone with rounded bioclasts – Folk's type H (pl. 2–fig. 1).

The rounding and sorting of bioclasts, and the lack of micrite and specific fauna indicate a shallow-water environment with a flat bottom above the wave-base. Wave activity washed away any micritic matrix, and reworked and rounded organic remains. Crinoid biostromes with associated brachiopod fauna served as a source of bioclastic material. This environment corresponds to FB 5 (margins of organic build-ups). The limestone with cephalopods in bed 4 corresponds to SMF 3, though its lateral extent is not clear. It possibly represents only a local occurrence of this microfacies; a broad-scale transition between FB 5 and FB 3 need not be present.

The overlying Přídolí Formation (a Monograptus parultimus Biozone) is developed in this interval as SMF 9, which belongs to the FB 2 (marine shelf below the wave-base, depth of several tens of metres). The proportion of bioclasts in these biomicritic and fossiliferous micritic limestones (mudstone to packstone) is 20–50 %, with diameters ranging between 0.1 and 1.3 mm. In one case (bed 8) the bioclastic content is up to 5 %, and the particle sizes range from 0.05 to 0.1 mm. The proportion of micrite ranges from 40 to 80 %.

Platy biomicritic limestones usually show macroscopic or microscopic lamination (in beds 5 and 9). Light-coloured bioclastic laminae with minor proportions of micrite (to 10 %) can be interpreted as resulting from the minor input of coarse-grained detritus or as larger flows that deposited material at the toe of the platform. These limestones may be classified as SMF 5 which, due to redeposition, approach FB 2 typical of SMF 9. This could explain the origin of bed 6, developed as SMF 5, whose deposition probably ocurred as a relatively intense input of bioclasts.

4.3. Lochkov – Marble quarry

The Marble quarry is situated about 0.5 km ESE from an elevation point of 341 m and about 1 km WSW of Lochkov village at the SE margin of Barrandian synclinorium (see fig. 1).

This quarry is not active at present. Dark, bioclastic limestones (called "Lochkov marble"), with abundant orthocone cephalopods of the uppermost Kopanina Formation, were quarried there from the 19th century until the 1940's. The limestones of the Přídolí Formation were used for paving Prague's sidewalks. This locality has been known since the nineteenth century, when Joachim Barrande collected specimens from its cephalopod-rich fauna.

This area has been studied mainly by PŘIBYL (1940), who was the first to propose a Přídolí graptolite zonation here. The biostratigraphy of the quarry section was later studied again by PŘIBYL (1943, 1983), and in a very detailed manner by KŘÍŽ et al. (1986). This area has been mapped on a scale of 1 : 5 000 by SVOBODA and PRANTL (1950), and KŘÍŽ from 1966 to 1967 (in KŘÍŽ 1999b). Mapping on a scale of 1 : 25 000 was carried out by CHÁB et al. (1988; sheet Prague-south, 12-421).

The boundary interval at the second level was studied by KŘÍŽ et al. (1986), which is at the present time hardly accessible. The local geological situation of the Přídolí Formation is not clear due to the presence of a radial fault, the plane of which is covered by calcite. Along this fault, blocks of platy limestones with shales have been displaced into the massive bioclastic limestones of the Kopanina For-

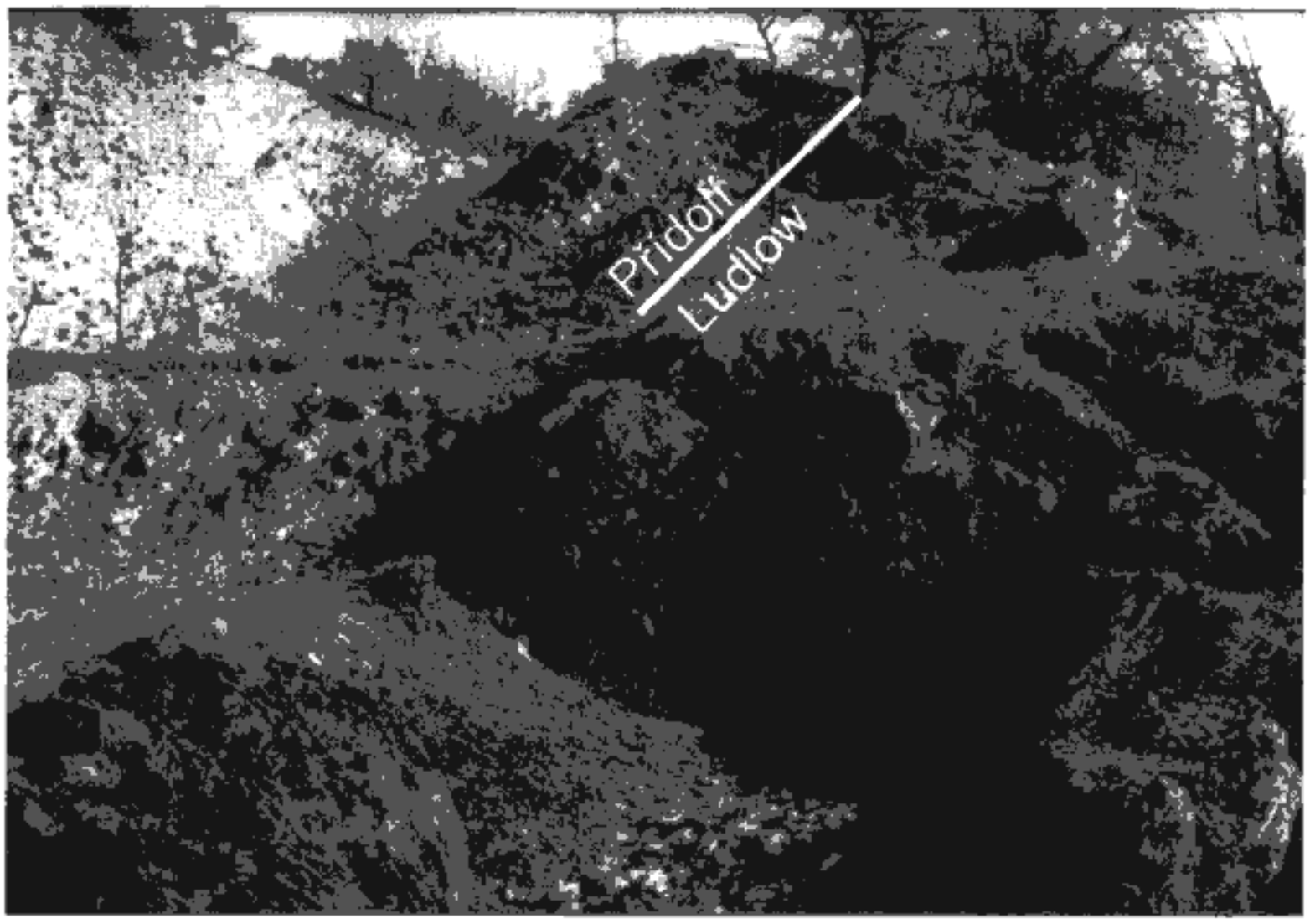

Figure 8. Ludlow-Přídolí boundary interval in the Marble quarry section.

mation. The Ludlow-Přídolí boundary described by Kříž et al. (1986) is not accessible at present, and therefore a section exposed on the first level was chosen for study. This section is also cut by a fault, though its lower part and the Ludlow-Přídolí boundary has remained undamaged. This section was renumbered for the present study.

Geological setting

The boundaries of Kopanina and Přídolí formations, and that of the Ludlow-Přídolí Series, are exposed in this quarry.

The Kopanina Formation starts on the second level as a sequence of dark grey calcareous shales with lenses of dark grey bioclastic limestones. The overlying massive beds of grey to dark grey bioclastic limestones with cephalopods attain thicknesses of up to 4 m. According to Kříž (1992), the uppermost beds of this sequence correspond to the horizon with the trilobite *Ananaspis fecunda* (BARR.), which in the Lochkov-Cephalopod quarry occurs below the cephalopod layers. The exposed thickness of the Kopanina Formation in the Marble quarry is about 5 metres.

The base of the Přídolí Formation sharply differs from the uppermost part of Kopanina Formation. The Přídolí Formation is developed as grey to black, laminated, biomicritic to micritic limestones, alternating with dark-grey calcareous shales. The exposed thickness of the Přídolí Formation is about 15 metres.

The biostratigraphical research of each bed was limited to macrofossils. Index fossils of the Ludlow Series, corresponding to Prionopeltis archiaci Zone, were found in beds X and X/8. They contain mainly brachiopods *Bleshidium krizianum* HAVLÍČEK et ŠTORCH and cephalopods *Kosovoceras sandbergeri* (BARR.) and *K. nodosum* (BARR.). In the overlying bed 8 the graptolite *Monograptus parultimus* JAEGER was found. The trilobite *Prionopeltis striata* (BARR.) occurs in the interbed 8/9. This trilobite genus is considered to be an index fossil of the Přídolí Series. The Ludlow-Přídolí boundary is set at the base of bed 8.

The Přídolí Formation sequence continues on the first level of the quarry. The formation is composed of laminated limestones alternating with calcareous shales. These laminites contain bivalves of the *Dualina-Cardiolinka-Praecardium* community described by Kříž (1999a). In the uppermost parts of this sequence crinoid stems *Scyphocrinites elegans* ZENKER are abundant.

"Bioclastic" and "micritic" facies occur within the Kopanina Formation in the boundary interval. A bed of black to dark grey biomicritic limestone, about 90 cm thick (bed 5), is developed within the sequence of grey to dark grey bioclastic limestones (see fig. 9). In contrast to the "bioclastic" facies, bed 5 is typified by a low content and specific types of bioclasts.

Bioclasts

The bioclasts of "bioclastic" facies of the uppermost Kopanina Formation are comprised of abundant cephalopods and bivalves, and partly by crinoids, brachiopods, ostracods, and trilobites. Calcified sponge spicules, acritarchs, gastropods, and phosphatic shells (inarticulate brachiopods) are rare. Graptolites, phyllocarids, and the worm *Spirorbis* sp. occur only sporadically. Crinoid stems are often recrystallized as syntaxial sparite. The proportion of bioclasts reaches up to 80 %. The bioclasts are usually micritized, and attain sizes above 0.3 mm.

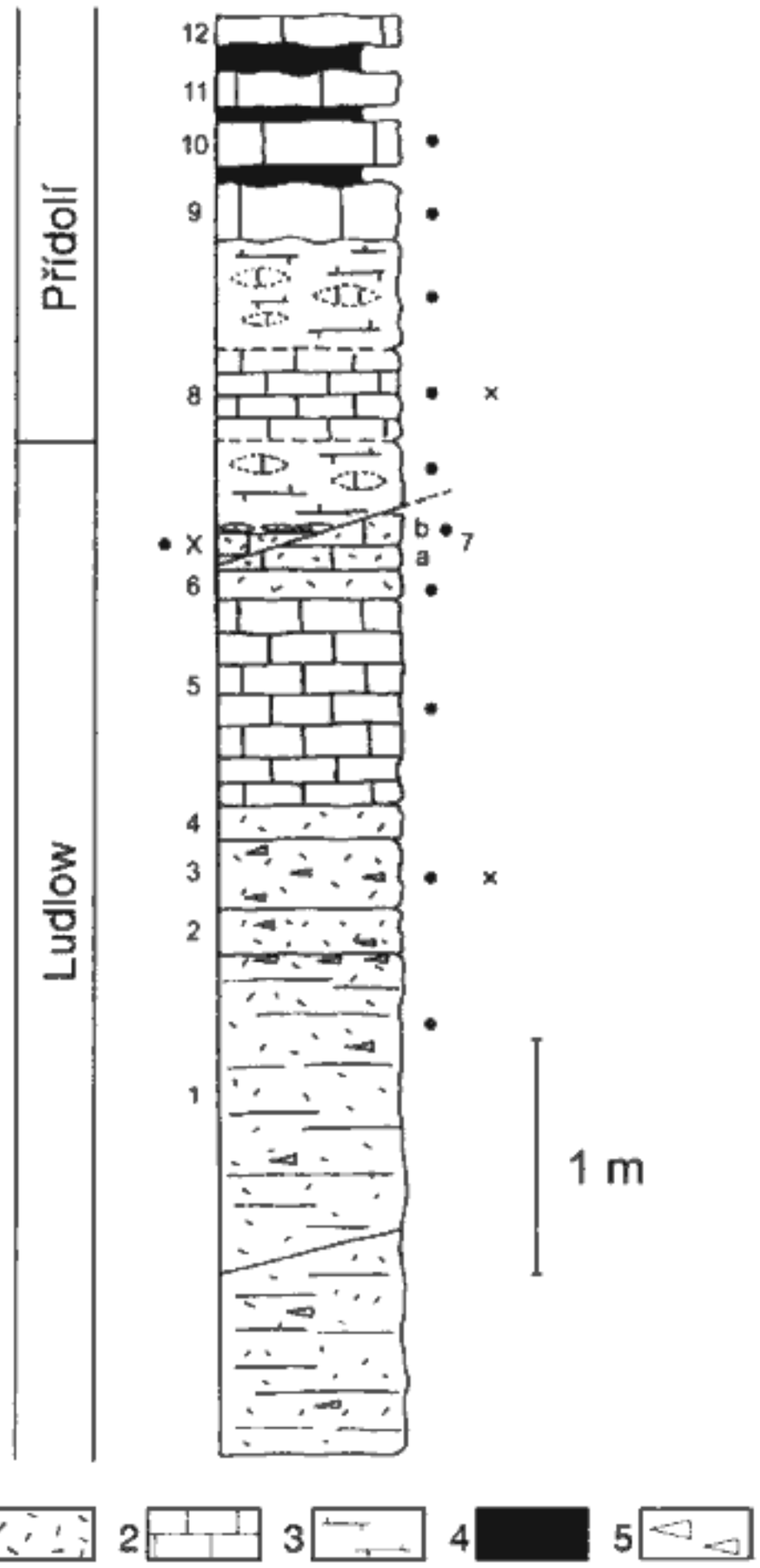

Figure 9. Lithological section of the Ludlow-Přídolí boundary in the Marble quarry.
1 – bioclastic limestones, 2 – micritic and biomicritic limestones, 3 – strong dolomitization, 4 – calcareous shales, 5 – cephalopods; • – sample taken for thin-section, × – sample taken for geochemical analysis.

The "Micritic" facies (in bed 5) contains comparatively poor fauna. The proportion of bioclasts is only up to 20 %, and their sizes range between 0.1–0.6 mm. Larger fragments are rare. These bioclasts consist mainly of ostracods, acritarchs, and crinoids, rarely by fragments of brachiopods and cephalopod shells.

The Přídolí Limestone contains comparatively poor fauna consisting of graptolites, brachiopods, cephalopods, ostracods, sponge spicules, with lesser proportions of bivalves, acritarchs, and gastropods. The bioclast content varies from 20 to 30 %, and the grain size is clearly bimodal, with a finer fraction ranging between 0.1 and 1.6 mm, and a coarser fraction of 3.0 mm and larger.

Rugose corals are completely absent in the Marble quarry. The micritic and biomicritic limestones are devoid of trilobites.

Microfacies analysis

The limestones of the Upper Ludlow correspond to three SMF – 12 (bed 1), 5 (beds 3, 6, 7b, X), and 9 (bed 5).

The grey, medium- to coarse-grained, cephalopod-bearing, biosparitic limestone (SMF 12) of bed 1 is characterized by a minor micrite content. This is the same as in beds 1 to 3 in the Kosov section. Biogenic detritus is mainly composed of fragments of cephalopods and bivalve shells. Crinoid stems are usually recrystallized. Brachiopods are present in small amounts and corals are completely absent. This limestone is strongly recrystallized, which results in a smaller proportion of identifiable bioclasts (about 20 %). The micrite content is less than 1%. The bioclasts are poorly sorted and rounded, and this limestone can thus be classified as an unsorted biosparitic limestone (Folk's type F) or grainstone. The depositional environment corresponds to FB 5, especially to its deeper part where the rounding of bioclasts was not as effective as in the Kosov area. The polycyclic fragmentation of bioclasts is also possible.

The overlying sequence of the Kopanina Formation, except for bed 5, is developed as a grey limestone passing from biomicrite to biosparite (Folk's type E) or packstone, with a bioclastic content of about 80 %. The micrite proportion reaches a maximum of 10 %. The bioclasts are neither sorted nor rounded. This type of limestone is clasified as SMF 5, belonging to FB 4 (the slope of a carbonate platform), where material produced in shallow areas was redeposited. Geopetal fillings in bioclasts, mainly in cephalopod shells, are common (pl. 2 – figs. 2 and 3).

In beds 3 and 6 micrite is present as small pellets (1,6 mm in size), some of which contain enclosed bioclasts (pl. 2 – fig. 3). These pellets might be original intraclasts that were deposited in places close to where biomicritic limestones were being deposited. Most of the micritic matrix was washed out, and pure pellets or coated bioclasts represent relics of the original micritic limestones. Transport was probably short, and the pellets were deposited in the deeper part of the slope. This interpretation is supported by the same character of these pellets within large bioclasts, and by their separate occurrences. Transported pellets were deposited together with coarse-grained sediment, even in cephalopod shells where they form part of a geopetal structure. FERRETTI and KŘÍŽ (1995) described these structures as a product of a high-energy environment. Bed 5 is developed as a dark-grey to black, biomicritic (type C) limestone–wackestone, which corresponds with SMF 9. Its micrite content is about 80 %, while sparite is nearly absent. The thickness of these beds decreases laterally. The character of the sediment does not show a change of sedimentary environment as a result of sea level rise. The deposition environment corresponds to FB 4, close to the wave-base where small changes in wave activity, in combination with limited bioclastic input, can locally change the type of deposition within the FB. These local "micritic facies" could be the sources of the intraclasts and micritic pellets (see above). Micritic facies that were origi-

nally coherent could have been completely destroyed by the activity of waves or currents.

The base of the Přídolí Formation is set to bed 8. It is comprised of grey or black biomicritic limestones (wackestone), with bioclastic proportions up to 30 %, and is classified as SMF 9 (pl. 2–fig. 4) deposited in FB 2. In contrast to Požáry and Kosov, no lamination was observed within these limestone beds.

4.4. Conclusions

There are some differences in microfacies development within these sections. The development of the Ludlow-Přídolí boundary interval can be characterized in agreement with the facies distribution as described by HORNÝ (1955b) and HAVLÍČEK and ŠTORCH (1990). Such facies changes are developed mainly in the uppermost part of the Kopanina Formation (Upper Ludlow).

Table 2. Amount of bioclasts in the Ludlow-Přídolí boundary interval

		SILURIAN		
		Upper Ludlow "BcF"	Upper Ludlow "MF"	Lower Přídolí
Crinoids	K	●	•	•
	Ml	•	•	X
	Po	●	•	•
Brachiopods	K	●	•	•
	Ml	•	•	•
	Po	•	•	•
Cephalopods	K	•	•	•
	Ml	●	•	•
	Po	•	•	X
Trilobites	K	•	X	•
	Ml	•	X	X
	Po	•	•	•
Bivalves	K	•	X	•
	Ml	●	X	•
	Po	•	X	X
Ostracodes	K	X	•	X
	Ml	•	•	•
	Po	•	•	•
Sponge spicules	K	•	•	•
	Ml	•	X	•
	Po	•	•	X
Corals	K	•	X	•
	Ml	X	X	X
	Po	•	X	X
Acritarchs	K	X	•	•
	Ml	•	•	•
	Po	X	•	X
Others (gastropods, graptolites, a. o.)	K	•	X	•
	Ml	•	X	•
	Po	•	X	X

Localities: K – Kosov quarry, Ml – Marble quarry, Po – Požáry quarry. Facies: "BcF" – bioclastic facies, "MF" – micritic facies; relative content of bioclasts: ● – abundant, • – common, • – rare, X – bioclasts are not present.

The shallowest marine deposition represented in the Kosov quarry appears to have taken place at a depth of a few metres. Wave activity caused a high degree of reworking (fragmentation and rounding) of the biogenic detritus. Crinoid biostromes with associated brachiopod fauna on the SW margin of the Svatý Jan volcanic center, or the separate Kosov center as presumed by FIALA (1970), could have served as a source of bioclastic material. The isolated Kosov center was already inactive during this period of deposition. This environment supported favourable life conditions which sustained the substantial development of the benthic organisms that provided the bioclastic material.

The situation in the Marble quarry is quite different. Here, the Ludlowian limestones are rich in a micritic compound. Geopetal textures are also abundant, and fossil assemblages are more variable. Pelecypods are the most abundant among the fossils. The Marble quarry is situated far away from the Svatý Jan volcanic elevation and from the typical crinoid monocultures. The depositional environmnent of these limestones can be interpreted as a gently inclined slope on the fringe of a shallower zone with biostromal sediments. Bathymetric conditions are estimated to have been several tens of metres, possibly near the lower limits of wave activity.

The stratotype locality of Požáry shows the most complicated depositional development, particularly in the Upper Ludlow and Lower Přídolí. The irregular alternation of comparatively shallow-water limestones with biomicritic and micritic limestones, and also shales, is observed here. The maximum depth of the depositional environment of these micritic and biomicritic limestones and shales is estimated to have been several tens of metres. Nevertheless, the bioclastic limestones evince the same kind of shallow-water environment as in the Marble quarry, and were possibly deposited on a gently inclined sea floor. The Požáry locality is situated between the Svatý Jan volcanic centre (in the SW) and the much smaller Nová Ves submarine volcano (to the NE). This environment could have been influenced by inlet currents flowing between these two points of elevation. Such periodic and variable current activity could cause the development of diverse limestone compositions in comparison with localities of more regular deposition.

The base of the Přídolí is characterized in the Kosov and Marble quarries by a pronounced lithological change from the underlying Kopanina Formation, which is not observable in the Požáry quarry. The lower part of this sequence is composed of platy and often laminated biomicritic limestones. Laminites do not occur within this boundary interval in the Marble quarry, though they are present in higher parts of the sequence (KŘÍŽ 1992, KŘÍŽ et al. 1986, etc.). This lamination may have resulted from the intense input of bioclastic material from shallow-water areas. This interpretation is supported by the sharp surfaces and the variety of larger bioclasts within the larger laminae. The bioclasts consist of crinoid fragments, corals, bryozoans, brachiopods, and trilobites. The absence of laminated limestones in the basal beds of Přídolí may be

explained by its greater distance from the source and the more limited input of bioclastic material, as is demonstrable in the Kosov quarry.

The sudden change in deposition at the Ludlow-Přídolí boundary is explained by CHLUPÁČ and KUKAL (1988) as representing a rapid transgressive event. Such an event is not evident in the Požáry quarry, where deposition was affected by unique and variable current conditions in the Upper Ludlow which could mask the effect of such transgressive event.

5. The Silurian-Devonian boundary interval in the Barrandian area

According to the resolution submitted to the International Union of Geological Sciences by the International Committee on the Silurian-Devonian boundary, this boundary should be set at the base of the Monograptus uniformis Zone (MCLAREN 1969). This recommendation was ratified at the 24th International Geological Congress in Montreal in 1972. The international standard (stratotype) for this boundary was established as Klonk near Suchomasty, with an auxiliary type section at Budňanská skála near Karlštejn (MCLAREN 1977). This resolution was motivated by the investigations of Ivo Chlupáč (CHLUPÁČ et al. 1972). All the biostratigraphic data that contribute to establishing and correlating the level at which *M. uniformis* first appears may be used toward the delineation of this boundary.

The main biostratigraphic criteria for the determination of the Silurian-Devonian boundary according to the current state of research (CHLUPÁČ et al. 1972, CHLUPÁČ – KUKAL 1977, PARIS et al. 1981, JEPPSON 1988, CHLUPÁČ et al. 1992, 1998, CHLUPÁČ – HLADIL 2000, CHLUPÁČ – VACEK 2003) may be summarized as follows:

1) the first occurrence of Lochkovian index graptolite *Monograptus uniformis* PŘIBYL;
2) the appearance of a trilobite assemblage including *Warburgella rugulosa* (ALTH);
3) the base of chitinozoan Angochitina chlupaci Zone;
4) the level within the conodont Icriodus woschmidti Zone, above the Ligonodina elegans detorta Subzone;
5) the upper boundary of the youngest Silurian trilobite biozone with *Tetinia minuta* (PŘIBYL and VANĚK) in pure carbonate facies.

The shallow-water development of boundary beds in which bioclastic limestones predominate is concentrated in the NW flank of the Barrandian area (area between Praha-Nová Ves and Tetín). In the area of transitional development the thick accumulation of bioclastic crinoidal or cephalopod limestones (the *Scyphocrinites* horizon) has developed into a wider boundary interval (Radotín Valley, Karlštejn, Vonoklasy). The deeper-water deposition in the SE flank of the Barrandian is characterized by platy micritic to biomicritic limestones and shale facies (Klonk, Čertovy schody).

5.1. The Praha-Radotín section

This section is situated within the Praha-Radotín settlement (see fig. 1), in a road cut about 50 m NE from the intersection of the streets "K cementárně" and "V sudech", and about 100 m SW from the paleontological locality called Antipleura Gorge (well-known since Barrande's). The sequence of the uppermost part of the Přídolí Forma-

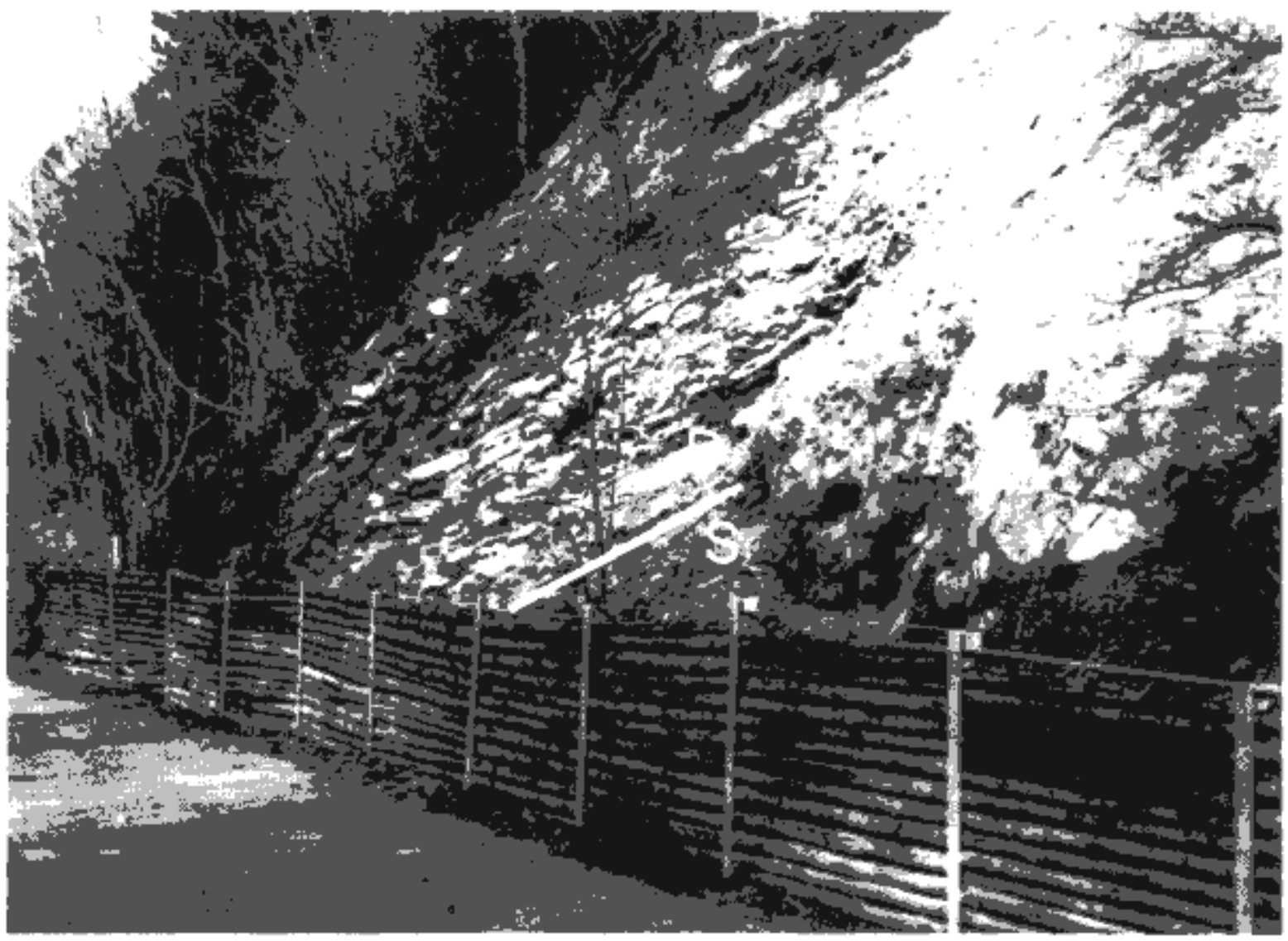

Figure 10. The section of the Silurian-Devonian boundary beds in Praha-Radotín. The Silurian-Devonian boundary is marked by white line.