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Barrande's Rock: The section across a giant slump structure (Lower Devonian of Central Bohemia)

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Abstract

The subject of the present study is the Barrande's Rock in the S of Prague, an excellent exposure of folded Lower Devonian limestones (Lochkov Formation). The intense folding of the Rock is an anomaly in the structure of the Prague Synclinorium. The frequency of folds is enormous, contrasting with the simple structure of the adjoining area. The fold axes plunging in a wide range 25 – 55° W to SW are mostly oblique to the axis of the Prague Synclinorium. The intense folding also involves the Kotýs Limestone which behaved competently during the Variscan folding. The relation between the folded Lochkov Formation and the overlying Slivenec Limestone (Praha Formation) suggests an erosional truncation of folds during the Lochkovian-Pragian boundary Event. The structure of the Rock can be best explained as a coherent slump structure on a giant scale, encompassing the whole Lochkov Formation (about 50 m thick). A palinspastic reconstruction of the slump body is presented and discussed in terms of the palaeogeography and palaeotectonics of the Prague Basin.

1. Introduction

The Barrande's Rock, an outstanding exposure of intensely folded Devonian limestones in the S of Prague, has been traditionally presented as an example of disharmonic folding. The Rock, bearing the memorial tablet with Barrande's name, is a part of the National Nature Monument „Barrandovské skály". This excellent series of outcrops has been a subject of many stratigraphical and palaeontological studies (for a review see Kříž 1999). On the contrary, there is still a lack of studies dealing with the Barrande's Rock in terms of structural geology. After the study on fold hinges by Počta (1908), only Kettner (1968) published a detailed drawing of the Rock showing its structural complexity. The drawing, published after the author's death, was targeted to the visitors of the 23rd International Geological Congress in Prague, and has only a brief explanatory text with the minimum of geologic information.

The peculiar character of the Barrande's Rock structure attracted attention even in the early period of the geological survey of Central Bohemia. Krejčí (1877) was the first to draw the geological section along the left bank of the Vltava River S of Prague, showing a remarkable feature: the intensely folded Lochkov Formation („étage F_1") sandwiched between simply inclined underlying and overlying formations (Fig. 1). The extremely intense folding observed on the Rock was later attributed to the incompetence of rocks to support a tectonic force, ie. the Variscan orogeny. This notion has survived even in the recent textbooks, excursion guides, etc.

The author of the present paper recently undertook a minor revision of structural features of the Lower Palaeozoic in the Prague Basin (Röhlich 2007a). At the same time the author's attention focussed on the slump structures in the Silurian-Devonian of Central Bohemia (Röhlich 2007b, 2008b). The results of these studies have shown that the Barrande's Rock is an extraordinary case within the framework of the Prague Synclinorium. A new interpretation of the Barrande's Rock structure has been proposed (Röhlich 2008a): a giant coherent slump structure, ie. a submarine slide.

The present paper deals with the structure of the Barrande's Rock in detail. The Rock deserves a systematic and authentic documentation. With regard to the extremely difficult access to the greater part of the rock

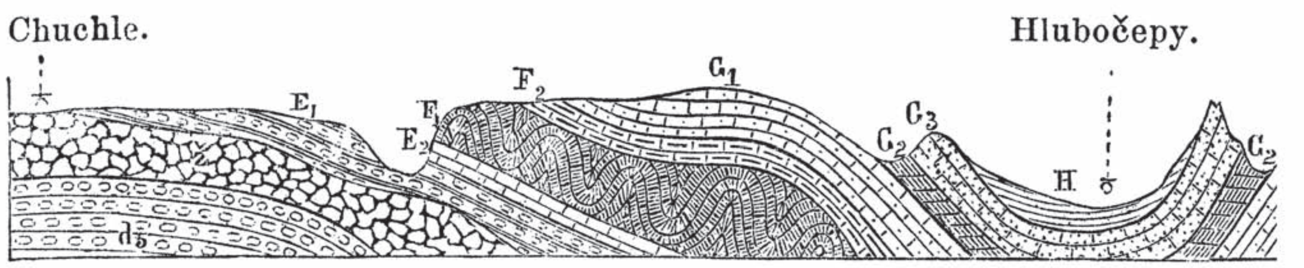

Fig. 1: Section along the left bank of the Vltava River S of Prague, after Krejčí (1877: 435). E_1–E_2 Silurian, F_1 Lochkov Formation, F_2, G_1, G_2, G_3, H Pragian to Givetian formations.

face, the photography at a distance has the crucial role. Unfortunately the trees hide some parts of the Rock. Nevertheless the opposite (E) bank of the Vltava River has yielded a good viewpoint for a photomontage which would serve as a background for the structure tracing. The voids have been filled with closer views and with the direct survey at the foot of the Rock. The survey was supported by means of a scale in 10m distances (stationing) painted on the margin of the adjoining paved road. The only purpose of this stationing (far from geodetic accuracy) is to facilitate the orientation. The present tracing (Fig. 4) covers the 170 m length of the rock face. The structurally monotonous and partly forested S part has been omitted.

Stratigraphy

Though the whole Barrande's Rock is built of the Lower Devonian Lochkov Formation, three lithologically different members have to be distinguished here. Beginning from the bottom, they are:

(1) bioclastic crinoidal limestone and/or intraformational breccia,
(2) transition between the Radotín and Kotýs limestones (Kosoř Limestone),
(3) light bioclastic Kotýs Limestone (Chlupáč 1998, p. 107, fig. 59).

The total thickness of the Lochkov Fomation has been roughly estimated at 50 m (Chlupáč 1988). The lowest member of the Lochkov Formation is only incompletely exposed on the Barrande's Rock. A complete section plus ca. 2 m of the underlying Požáry Formation has been thoroughly investigated some 100 m SW of the Rock, in the forested hollow after extraction of limestone called „Černá rokle" (Chlupáč et al. 1972). The uppermost part of the Silurian Požáry Formation (Přídolí Series) is built of black calcareous shales with intercalations of micritic limestone. The Lochkov Formation begins as light grey biodetritic limestone with crinoids, cephalopods and bivalves. The grain of limestone gets finer upwards. This ca. 6 m thick member is capped with an intraformational breccia about 1 m thick. The whole sequence has a simple monoclinal structure with dip of 55–60 degrees toward NW.

The tectonic conditions are the same in the S part of the Barrande's Rock, where the tracing of its structure begins (Figs. 3 and 4, stationing 0–10 m). Here is the lowest exposed bed the intraformational breccia mentioned above. The exposed thickness of the breccia amounts to 2–3 m. The limestone matrix of the breccia contains irregularly disseminated subangular to subrounded limestone fragments, frequently slabs, up to more than 20 cm in size. The breccia, which can be interpreted as a mudflow deposit, is an indication of submarine slide testifying to the unstability of the sea bottom.

In the N part of the rock face (approximate stationing 130–140 m), in the core of an anticline, there is exposed a group of limestone beds which can be parallelized with the crinoidal limestone from the S vicinity of the Barrande's Rock. No intraformational breccia has been found here and it is probably missing even in the underlying levels.

The main part of the Lochkov Formation exposed on the Barrande's Rock belongs to the transitional facies between the Radotín and Kotýs Limestone, the so-called Kosoř Limestone. In comparison with the dark grey platy limestones and calcareous shales of the Radotín Limestone, the Kosoř Limestone has the proportion of shales lesser, the colour lighter, and the grain size larger. Dark chert concretions and discontinuous thin interbeds

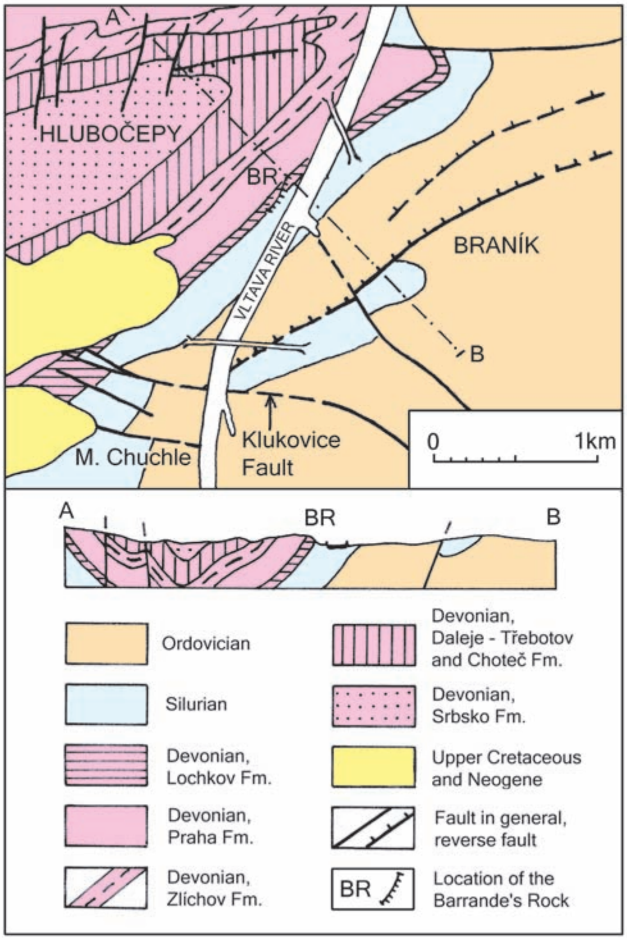

Fig. 2: Geological setting of the Barrande's Rock. Compiled from the geological map 1 : 25.000 (Cháb, J. ed. 1990) and author's survey.

are locally present in both members. The thickness of the Kosoř Limestone can be only roughly estimated at 20 m. This is due to the intense folding and to the fact that the rock face intersects the beds more or less obliquely.

The least investigated unit of the Barrande's Rock is the Kotýs Limestone. The reason is the inaccessibility of this member which is exposed only in the higher parts of the Rock. The Kotýs Limestone has been characterized as „light grey bioclastic crinoid sparry well-bedded limestone with uneven (knobby) bedding planes, separated only by very thin laminae or „films" of a darker, grey or greenish clayey substance … Cherts are usually common in the middle parts of the sequence." (Chlupáč 1998). There is no sharp boundary between the Kosoř and Kotýs limestones but their different character is well discernible at a distance. The Kotýs Limestone has less frequent bedding joints, sometimes poorly visible. Even on high quality photos some structures can be traced only tentatively. The occurrence of the Kotýs Limestone in the higher middle part of the Rock is due to the existence of a miniature synclinorium. The exposed thickness can be roughly estimated at 10 m.

The Lochkov Formation is overlaid with the Slivenec Limestone (pinkish crinoidal limestone, 6–8 m thick) forming the lowest part of the Praha Formation (ca. 170 m thick). The Slivenec Limestone is exposed beyond the Barrande's Rock, in a forested limestone quarry (Fig. 3). The relation between the Lochkov and Praha Formations is the crucial point of the Barrande's Rock problem. The apparent discrepancy (unconformity?) between the intensely folded Lochkov Formation and the monoclinal Praha Formation has become still more conspicuous by the occurrence of the Kotýs Limestone. The boundary between the Lochkov and Praha formations is neither exposed on the Rock nor in the adjoining forested quarry. However, the outcrops of the Kosoř and Slivenec limestones are so close to each other that there is no place for the Kotýs Limestone, at least 10 m thick. It is most probable that the Kotýs Limestone was locally removed by submarine erosion before the Praha Formation sedimented. The field observations give no reason for a tectonic solution of the discrepancy. Nevertheless, the research of the contact by means of a trial pit or trench is highly desirable. The verification of the erosional truncation would be the ultimate proof of the origin of the Rock structure by a submarine slide.

Description of the structure

As already mentioned, the Barrande's Rock cuts the folds more or less obliquely. This is partly due to the moderate convexity of the rock face, changing its azimuth from ca. 35° on the S to ca. 20° at the N end. Besides this, the fold axes, altogether plunging into the Rock, change their plunge direction from ca. 240° (S) to ca. 290° (N). As a result, the N part of the Rock is much closer to a cross section than the S part, where the strike of beds is almost parallel to the foot of the rock face.

The S part of the Rock (stationing 0–20 m at the foot) exposes monoclinal strata dipping 50–60° to NW

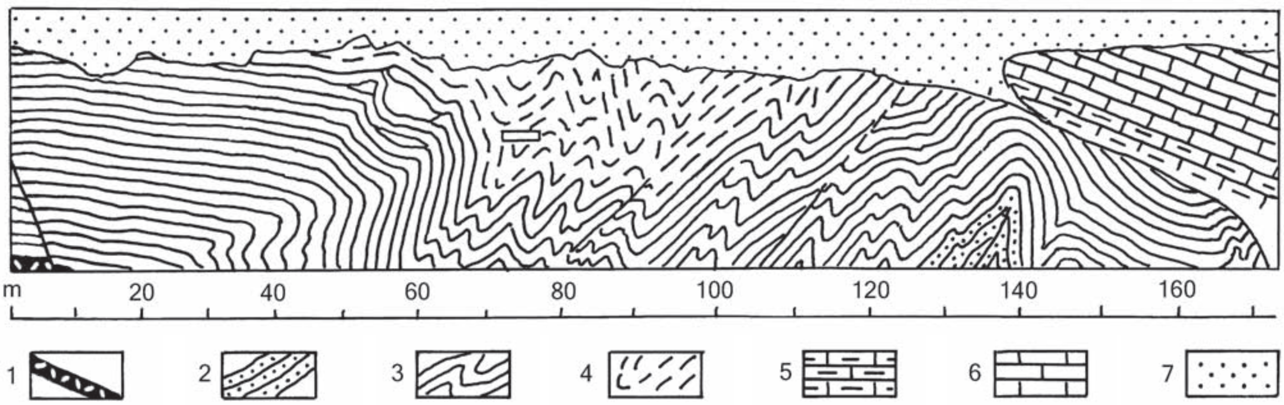

Fig. 3: Geological sketch of the Barrande's Rock and the corner of the adjoining forested quarry. **1–4**: Lochkov Formation: **1**: intraformational limestone breccia, **2**: crinoidal limestone, **3**: Kosoř Limestone, **4**: Kotýs Limestone; **5–6**: Praha Formation: **5**: Slivenec Limestone, **6**: Dvorce-Prokop Limestone; **7**: slope with scrub and trees. The gap in outcrops between the Kosoř and Slivenec limestones is hidden behind the slope bend (from 140 to 160 m stationing).

(strike N 30–40° E). The next sector (20–60 m) shows a big, moderately overturned anticline whose axis measured at the road plunges 25–30° WSW (240–250°). Then follows the most intensely folded part of the Rock (60–120 m) where the Kosoř Limestone is overlaid with the Kotýs Limestone. This is due to the miniature synclinorium having the Kotýs Limestone preserved in its core. The plunging inclined folds are mostly moderately overturned within the Kosoř Limestone. The fold axes (measured only in the Kosoř Limestone) plunge 35–55° in the directions from 240 to 270 degrees. The vergence is NNW to N. The frequency of folds in this sector amounts to 13 fold waves (13 anticlines and 13 synclines) within 60 m of the section in the Kosoř Limestone. In the Kotýs Limestone, 20–30 m above the foot of the Rock, only 7complete fold waves (7 anticlines and 8 synclines) have been distinguished in the same interval. This fact is due to the disharmonic character of folding and will be analyzed later.

The northern sector of the rock face (120–170 m) shows a lesser frequency of folds: 6 fold waves per 50 m at the foot. This part is dominated by the anticline exposing the lower limestone member (crinoidal limestone) in the core. The anticline (stationing 130–140 m) is the last one having the N vergence. The minor anticline axis at 131 m stationing plunges 45° toward WNW (290°). The N end of the rock face shows a typical disharmonic folding without any distinct vergence.

The structure of the Barrande's Rock has been generally classified as disharmonic folding. The reasons of it are of two kinds: the direct observation of folds on the Rock, and the contrast between the intricate folding of the Lochkov Formation and the simple monoclinal structure of the adjoining formations, viz. of the overlying Praha Formation. The mentioned reasons belong to two different levels of investigation and have to be discussed separately.

Disharmonic folding within the rock

The most conspicuous folds are observed in the Kosoř Limestone along the foot of the rock face, in its middle part (stationing 60–120 m). The folds are mostly acute, transitional between open and tight folds, and inclined; in part, they are moderately overturned. The disharmony is developed mainly in the fold hinges and is due to the presence of shale intercalations „squeezed out“ between the limestone beds. The anticline formed of the lower member, the crinoidal limestone (130–140 m), is only a

Fig. 4: Detailed geology of the Barrande's Rock. Drawn on the background of a photomontage taken from a viewpoint on the opposite (E) bank of the Vltava River. Scale is variable due to the perspective.

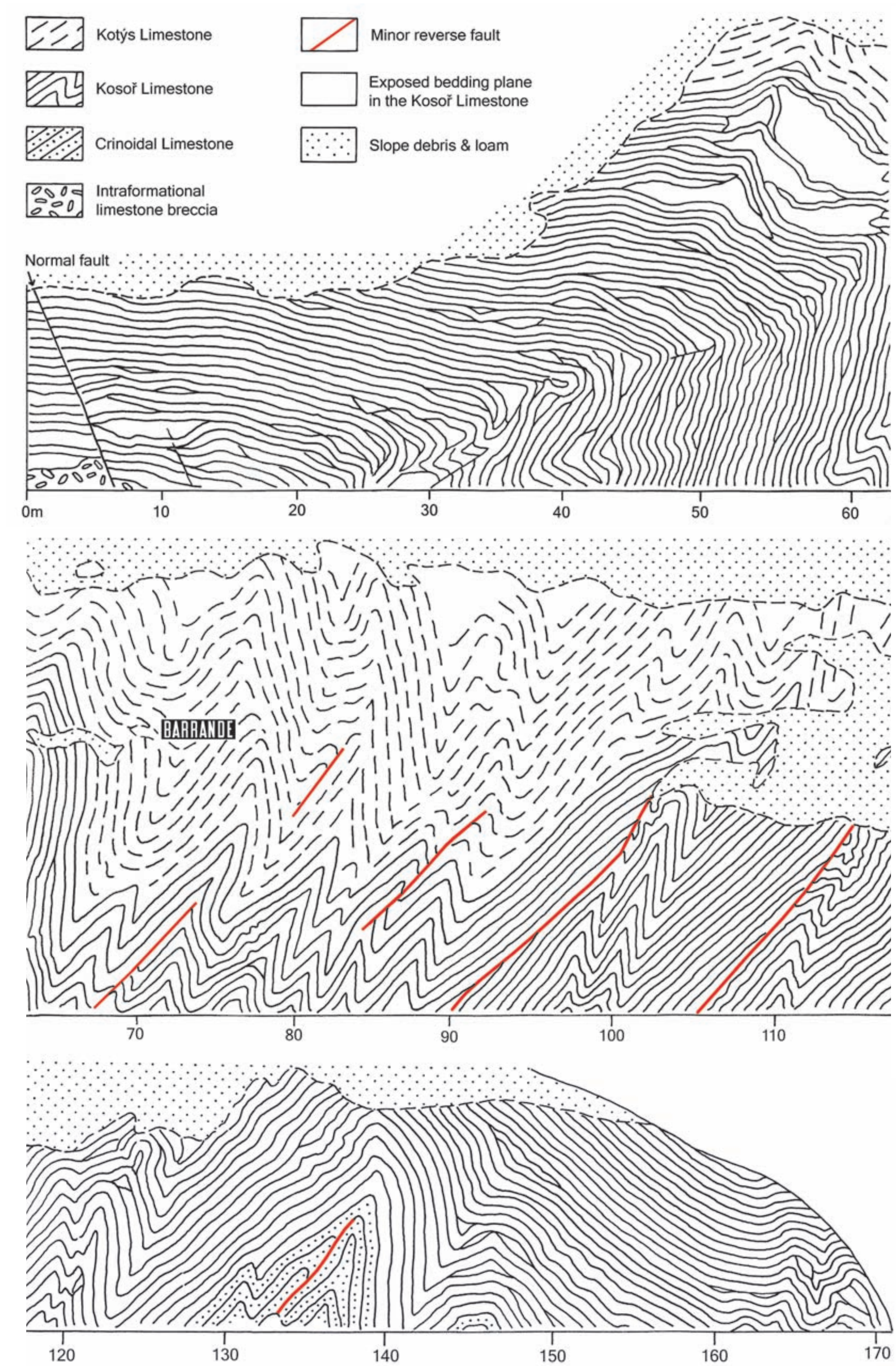
Kotýs Limestone
Kosoř Limestone
Crinoidal Limestone
Intraformational limestone breccia
Minor reverse fault
Exposed bedding plane in the Kosoř Limestone
Slope debris & loam
Normal fault
BARRANDE
0m
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170

Fig. 5: Central part of the Barrande's Rock (stationing 65–105 m). A miniature synclinorium in the Kotýs Limestone and the underlying Kosoř Limestone. View from the E bank of the Vltava River.

little more open and its relation to the Kosoř Limestone is harmonic.

The Kotýs Limestone, whose structure can be studied only at a distance, shows moderate differences in structure in comparison with the Kosoř Limestone. Some differences are evidently due to to the coarser grain, less distinct bedding, and the lack of shale interbeds. One difference, the lesser frequency of folds, has been mentioned above. Correspondent to this, the folds are mostly rounded and more frequently open than tight. The vergences are less distinct, somewhere missing. The disharmony is visible both on the boundary with the Kosoř Limestone and within the Kotýs Limestone; it is accompanied with apparent thickening and/or thinning of beds. The bedding joints, sometimes traceable only tentatively, locally disappear entirely, viz. near the upper margin of the rock face. The intense folding of the Kotýs Limestone is a real surprise. Such folding never has been observed in this rock unit being relatively competent in comparison with the Radotín and Kosoř limestones. On the Barrande's Rock, the structure of the Kotýs Limestone is best conceivable on the assumption that the sediment was not lithified in the time of deformation.

An integral part of the fold structure are minor reverse faults uniformly dipping S or SW (their strike could not be measured). As a rule, they are partly identical with bedding planes on one side; on the other side, the displacement cuts the beds. They are usually placed in the S flanks of anticlines and the drag indicates the thrusting from S to N. Several faults of this type have been traced in the middle section of the Rock. In author's opinion, the faults in question are not symptoms of a brittle behavior. They can be attributed to the displacement along bedding planes during the folding and to a propagation of the displacement beyond.

A special dislocation can be observed within the anticline of the crinoidal limestones (stationing 135 m, Figs. 8 and 9). The fault dipping 60° SW has displaced the hang-

Fig. 6: Detail of an acute syncline in the lowest Kotýs Limestone (area ca. 4 × 4 m centered 10 m above stationing 85 m). View from the E side of the railway.

ing part of the SW flank upwards and has duplicated a part of the beds (reverse fault). Strangely enough, the fault does not continue over the crest of the anticline. This discrepancy can be best explained on the assumption that the fault came into existence prior to the anticline. The palinspastic section constructed on this assumption (Fig. 9B) corresponds to one type of slump structures described in the Neoproterozoic of Central Bohemia (Röhlich 1964: 100). The described structure testifies to the existence of an earlier generation of slump structures within the Lochkov Formation, probably coinciding with the intraformational breccia on the S margin of the Barrande's Rock.

Orientation of fold axes

Fold axes (hinge lines) can be measured only in a few sites of the Barrande's Rock: along the foot of the rock face, where the lower bedding planes are exposed in the hinges of anticlines (7 sites). Syncline axes are only rarely measurable (2 sites). The error in measurement up to10 degrees has to be admitted; this is due to the small extent of the exposures of hinge lines. Tab. 1 gives a review of all measurements arranged according to their location, from S to N. The projection of fold axes into a stereogram (Fig. 10)

Fig. 7: Disharmonically folded Kosoř Limestone at the N end of the Barrande's Rock.

is combined with their directions after transposing into horizontal plane.

The results of fold axes measurements give an important conclusion: the folding on the Barrande's Rock does not fit into the Variscan structural plan of the Prague Synclinorium, viz. into the Holyně-Hostim Syncline. The plunge directions of fold axes are within the wide range of 240 – 290 degrees, being mostly oblique to the Variscan syncline axis (240 – 250 degrees). A possible objection: it may be the case of drag folds due to the strike-slip movement. The strike-slip model, however, is not supported with any incident phenomena in the vicinity. On the contrary, the general character of deformation on the Barrande's Rock indicates a shortening and a transport directed generally from S to N. The shortening can be best explained with a coherent gravitational slump – submarine slide (Röhlich 2008a).

The submarine slide model requires a minor correction of the measured fold axes by their transposing into (sub) horizontal position. Only then the results can be aplied to the reconstruction of the slide direction. This can be achieved by means of rotation of the fold axes around the conjectural strike of simply inclined beds (Fig. 11). The latter has been taken from the measured strike and dip at the S margin of the Rock: strike 40°, dip 60° NW. The results of this operation have been inserted in the stereogram of fold axes (Fig. 10).

Palaeographic and palaeotectonic setting

The objective of this chapter is a brief characterization of the palaeogeographic and palaeotectonic conditions of the Prague Basin in the critical Early Devonian interval (Lochkovian to Pragian). The Prague Basin (Ordovician to Middle Devonian) developed as an elongated marine sedimentary depression (Havlíček 1981) on the Neoproterozoic basement folded, faulted and eroded in the Cadomian orogeny. The Basin development was controlled by synsedimentary faults rooted in the basement. The longitudinal faults played the main role but the transverse segmentation was important, too (Kříž 1991, Röhlich 2007a). In the Early Devonian, the facies distribution indicates the relatively deepest environment along the SE margin of the preserved deposits. An exception is the easternmost locality (Praha Podolí) where the reduced thickness of the Lochkov Formation (28 m) indicates a shoal. The shoal might belong to the transverse tectonic high indicated as early as in the Late Berounian (Röhlich 2006), Llandoverian (Kříž 1991) and later on, in the Early Zlíchovian (Röhlich 2007b). With regard to the prevalently longitudinal tectonic control of the Basin development, the shoal might also be connected with a hypothetical longitudinal ridge lying on the SE beyond the preserved Devonian deposits.

The occurrence of slump structures and intraformational breccias may be an indication of the closeness of synsedimentary faults – instability zones of the sea bottom. The transverse synsedimentary faults might also be involved. The closest of the transverse faults with a possible rejuvenation is the Klukovice Fault (Fig. 2). Intraformational breccias at the base of the Lochkov Formation (Barrande's Rock, Velká Chuchle) testify to the instability of the sea bottom in the Early Lochkovian (Röhlich 2008b). The Lochkovian-Pragian boundary Event (Chlupáč – Kukal 1988) is also manifested by the occurrence of intraformational breccias. The Lochkovian-Pragian boundary Event

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Fig. 8: Detail of the anticline of crinoidal limestones showing an earlier slump structure (length of the hammer handle 40 cm).

has been included in events of presumed global character. Its regressive character is documented with the extension of coarser biodetrital sediments and development of shallow water faunas. The global regressions and transgressions are generally explained by the eustatic sea-level changes. In the Prague Basin, however, some changes in the facies distribution from the Lochkovian to the Pragian testify to diastrophic movements. The onset of changes took place as early as during the Lochkovian when the deepest facies of the Radotín Limestone receded from the W part of the Basin (cp. Chlupáč 1998: 106–107). The Lochkovian-Pragian boundary Event brought a dramatic change in the development of the Koněprusy area which became an elevated transverse segment of the Prague Basin. This can be explained by synsedimentary movements along the Tobolka Fault (Röhlich 2007a).

In the Pragian the area between Hlubočepy and Solopysky became the site of the most intense deposition of the micritic Dvorce-Prokop Limestone (Chlupáč 1998: 110–111). This locally higher rate of sedimentation and the above-mentioned facies changes suggest a moderate reshaping of the Basin, in which the transverse segmentation participated, too.

Submarine slide model

The study of the Barrande's Rock structure, its position in the Prague Basin, and the information on the Basin development have resulted in the present model of submarine slide (Fig. 12).

(1) A tectonically controlled high (shoal) extended in the S and/or SE. The assumed fault scarp might correspond to a normal fault (later inverted to reverse fault) presently located 800 m SE of the Rock, and/or to the Klukovice Fault.

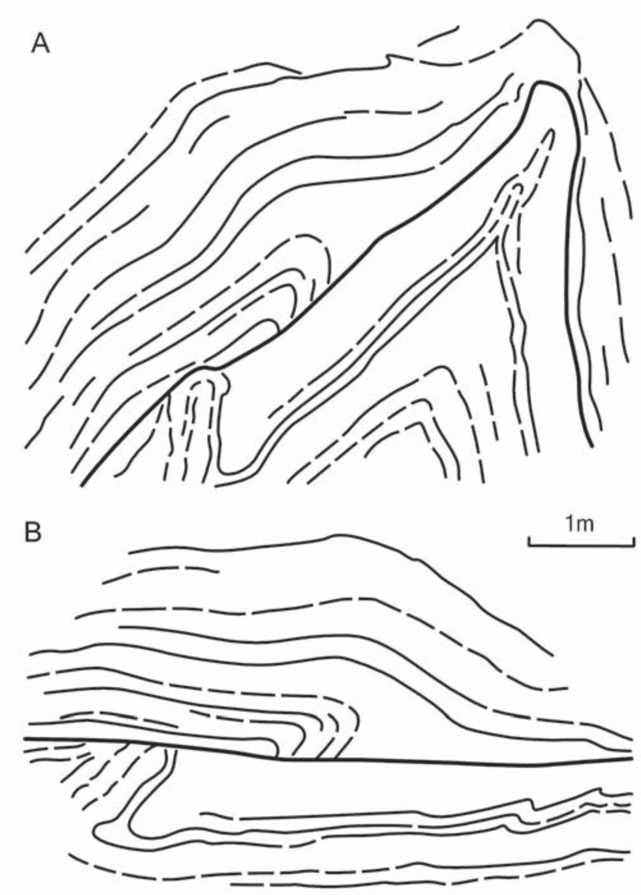

Fig. 9: Anticline in the lower part of the Lochkov Formation (stationing 130–140 m) encompassing an earlier slump structure. **A** – present state, **B** – palinspastic section predating the forming of the anticline.

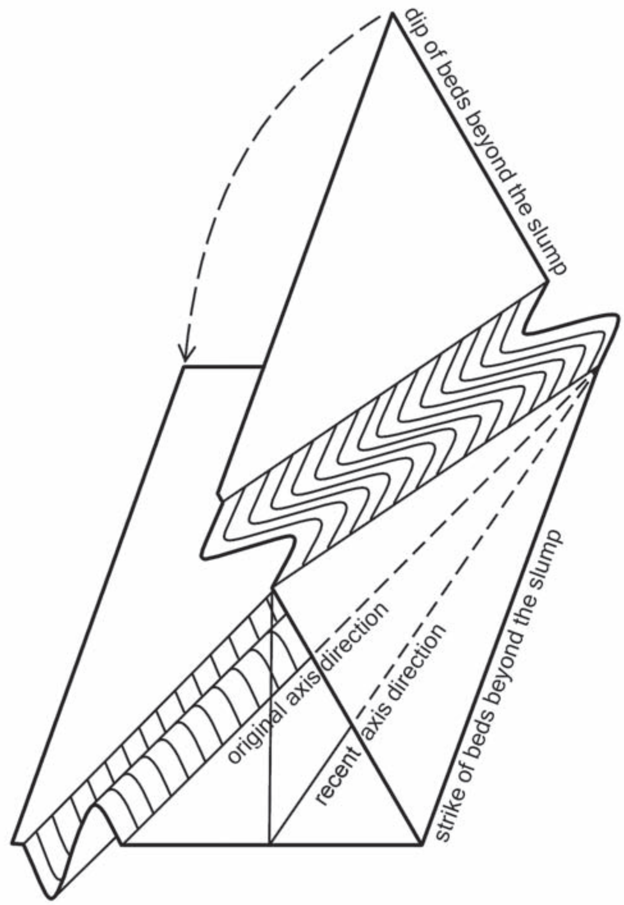

Fig. 11. Transposition of plunging slump fold axis to horizontal position by rotation along the strike of beds beyond the slump.

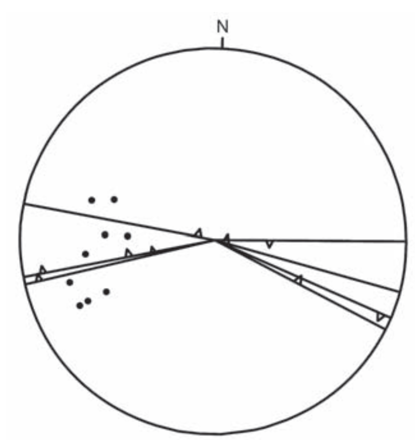

Fig. 10: Projection of fold axes (dots) into Lambert equal area net (lower hemisphere). Radial lines show directions of axes transposed to horizontal plane. Triangles are located according to the sites of measurement from 20 to 170 m of stationing (up – anticline axis, down – syncline axis).

(2) During the Lochkovian-Pragian boundary Event, the Lochkovian sediments were broken off along the fault(s) and detached from the underlying Silurian strata. The detachement (décollement) probably took place in a shale layer within the Požáry Formation.

(3) The slide was accompanied with warping and folding of the sliding set of strata. The front of the slide, subject to the greatest stress, was in the site of slope moderation or at the foot of the slope. The front of the slide passed into undisturbed strata. Consequently, the slump structure has not been disintegrated.

The present model has, of course, many uncertain parameters: the size and shape of the slump body, the length of transport, etc. The directions of measured fold axes show some variability and the gravitational transport direction is not always normal to the fold axes. Highly

Tab. 1: Review of fold axes orientation.

Stationing	Anticline (A) Syncline (S)	Plunge / direction	Transposed axis direction
27 m	A	30 / 240	253 (73)
29 m	A	25 / 250	255 (75)
62 m	A	40 / 240	255 (75)
72 m	A	35 / 240	254 (74)
88 m	A	45 / 270	277 (97)
99 m	A	55 / 270	282 (102)
112 m	S	35 / 260	267 (87)
131 m	A	45 / 290	293 (113)
166 m	S	35 / 285	290 (110)

disputable is the speed of the movement. The coherence of the slump structure rules out any catastrophic scenario; the movement could be imperceptible in terms of the human eye. The bulging of the sea bottom was immediately and permanently exposed to streams: the truncation of the slump body probably took place along with the development of its structure. This circumstance was not taken into account in the first drawn model (Röhlich 2008a).

A difficult problem to be analyzed is the evaluation of fold vergences. Most of folds in the section are close to the transition from inclined to overturned folds, with a clear vergence to N. After transposing to their conjectural (subhorizontal) position before the Variscan folding, the vergences are suppressed or even reversed (Fig. 11). Unfortunately, the exact solution of the original geometry of folds requires some unknown data, viz. the deformation by simple shear due to the Variscan folding. In resolving the question of the gravitational transport direction, the author has preferred the explicit drag phenomena on reverse faults (Fig. 4) to the ambiguous vergences of folds. The local northward slope of the sea bottom is also confirmed by the earlier slump structure observed in the lower part of the Lochkov Formation (Fig. 9).

Another point of controversy might be the consistence of the slump body during the deformation. Its thickness (minimum 40 m after the present survey) speaks in favour of the advanced stage of lithification in the lower layers. On the other hand, the style of folding suggests a highly ductile behavior. This controversy can be moderated when taking into account the hydro- and lithostatic pressure and its changes. The shallowing during the Lochkovian-Pragian boundary Event resulted in the lowering of the hydrostatic (and consequently also lithostatic) pressure. The Lochkovian (and still more the underlying Silurian) sediments accumulated a high proportion of organic matter. The decay of this matter saturated the sediments with hydrocarbons. The pressure lowering must have released a part of the dissolved hydrocarbons, especially methane. The released gas lowered the grain pressure and may have contributed to the ductile behavior of sediments (Handin 1958, Laubscher 1961, De Sitter 1964). Even in the case of higher viscosity corresponding to lithified sediments, the time available for the deformation (thousands of years at least) makes the ductile deformation of rocks by gravitational sliding conceivable.

Conclusion

The detailed survey of the Barrande's Rock structure has not only confirmed its special character, but also has revealed certain features incompatible with the tectonic style of the Prague Synclinorium:

(1) The enormous frequency of folds which cannot be in connection with any outstanding thrust or reverse fault. The adjoining area has a simple structure.

(2) The fold axes plunge in a wide range of directions, prevalently oblique to the Synclinorium axis.

(3) The intense folding involves the Kotýs Limestone which should react competently to the folding stress. On the contrary, the Požáry Formation, lithologically compatible with intense folding, has simple monoclinal structure even in the close vicinity.

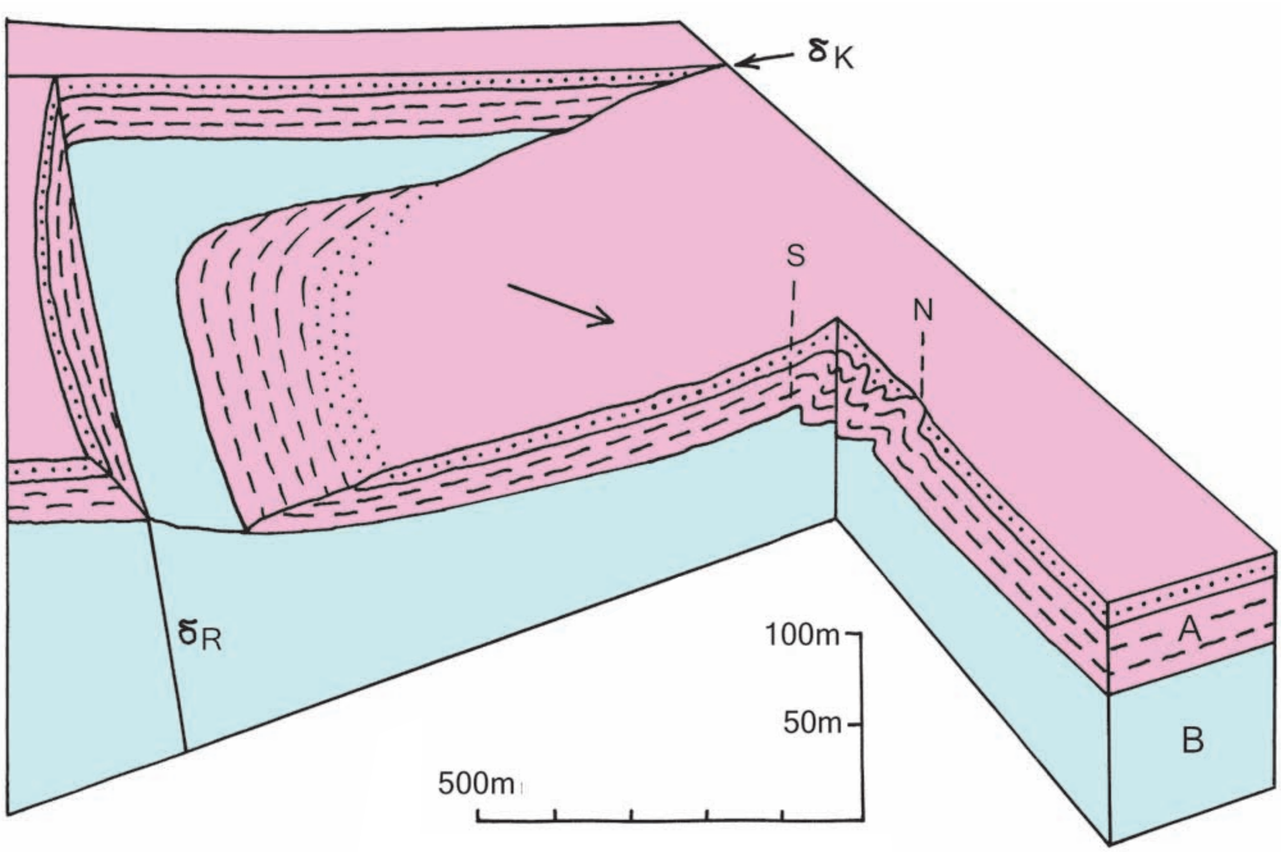

Fig. 12: Palinspastic reconstruction of the slump body exposed on the Barrande's Rock (final phase of the slump). **A** – Lochkov Formation, dotted – Kotýs Limestone; **B** – Silurian. δ – synsedimentary faults ($δ_R$ – normal strike fault, later inverted to reverse fault; $δ_K$ – Klukovice Fault). Sliding direction marked by arrow. **N**, **S** – approximate N and S end of the Barrande's Rock. Horizontal scale is variable due to the perspective.

(4) The relation between the intensely folded Lochkov Formation and the overlying Praha Formation suggests a local unconformity: truncation of the fold structure.

The above-mentioned anomalous features have led the author to the search for the mechanism responsible for the Barrande's Rock anomaly. The research of slump structures in the Silurian-Devonian (Röhlich 2008b) has suggested the most probable solution: a coherent submarine slide encompassing the whole Lochkov Formation (Röhlich 2008a). The present attempt at a submarine slide model explaining the Barrande's Rock structure has considered all relevant data and circumstances. Nevertheless, the author feels that the ultimate proof is still missing: a good exposure of the contact between the Lochkov and Praha formations within the Barrande's Rock reach. Beside the technically prompt and simple solution (trench or pit), there exists a good chance of a perfect opportunity to study the crucial section in three dimensions: two railway tunnels from Prague to Beroun have been projected almost parallel to the rock face in a close distance. This opportunity should not be missed.

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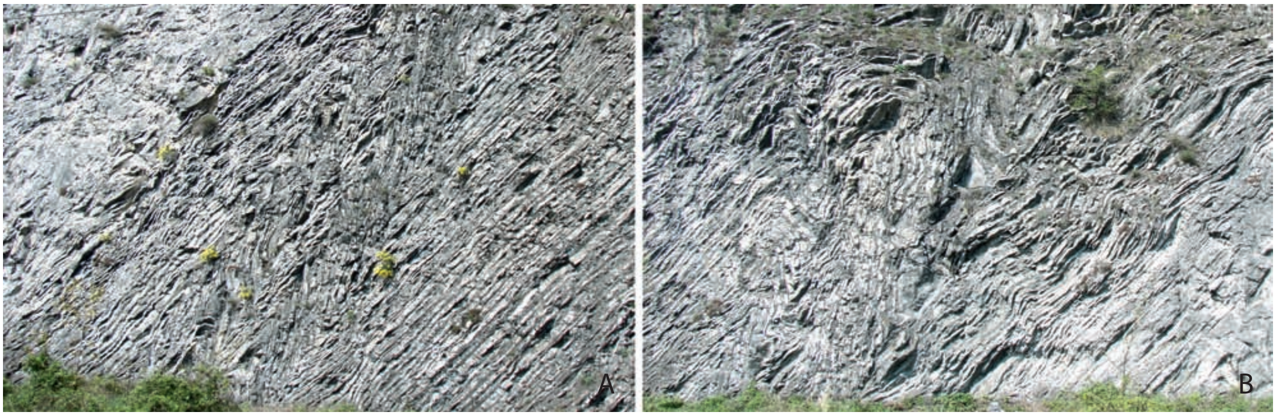

Fig. 13: Partial views of the Barrande's Rock from the E side of the railway. **A** – stationing 95 – 110 m. **B** – stationing 115 – 135 m.

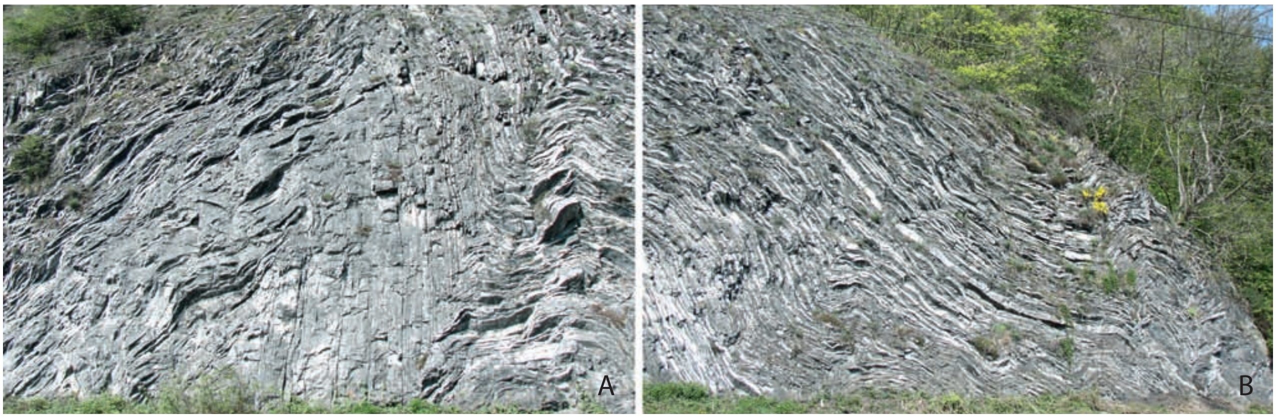

Fig. 14: Partial views of the Barrande's Rock from the E side of the Railway. **A** – stationing 130 – 145 m. **B** – stationing 150 – 170 m.

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