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LOWER CRETACEOUS BELEMNITE ASSOCIATIONS FROM THE RYCHALTICE LOCALITY AND THE DISINTEGRATION OF THE BAŠKA RIDGE (THE SILESIAN UNIT, OUTER WESTERN CARPATHIANS, CZECH REPUBLIC)

SPODNOKŘÍDOVÉ BELEMNITOVÉ ASOCIACE LOKALITY RYCHALTICE A ROZPAD BAŠSKÉHO HŘBETU (SLEZSKÁ JEDNOTKA, VNĚJŠÍ ZÁPADNÍ KARPATY, ČESKÁ REPUBLIKA)

ZDENĚK VAŠÍČEK

Abstract

Vašíček, Z., 2024: Lower Cretaceous belemnite associations from the Rychaltice locality and the disintegration of the Baška Ridge (the Silesian Unit, Outer Western Carpathians, Czech Republic). – Acta Musei Moraviae, Scientiae geologicae, 109, 1, 125–140 (with Czech summary).

Lower Cretaceous belemnite associations from the Rychaltice locality and the disintegration of the Baška Ridge (the Silesian Unit, Outer Western Carpathians, Czech Republic)

An approximately 200 m long road-cut near the village of Rychaltice uncovered the exposure with Lower Cretaceous sedimentary sequence of the Baška Subunit of the Silesian Nappe at the contact with Paleogene deposits of the Subsilesian Nappe (Outer Western Carpathians). At the base of the Silesian Nappe tectonical melange with blocks, a lenticular olistostrome and pebbles of Štramberk-type limestones occur at the contact zone of both nappes. Weathered and partially reworked belemnite rostra come from the weathered dark grey unstratified mudrocks, in a section of only several meters thick. The collection of more than one hundred incomplete and small-sized rostra of belemnites is the subject of a taxonomic and stratigraphic evaluation. Despite the unfavourably preservation of the rostra, it was possible to identify at least 4 taxa, which indicate the stratigraphic range of almost the entire Lower and the base of Upper Cretaceous series. Among these, the oldest fragments are of *Pseudobelus* ex gr. *bipartitus*, which show a broad stratigraphic range from the late Berriasian to the early late Hauterivian. In addition, there is a small (probably juvenile) specimen of *Duvalia* ex gr. *binervia* of the late Valanginian – earliest Hauterivian age. The rare species mentioned above are accompanied by the occurrence of *Parahibolites tourtiae* and the abundant occurrence of *Neohibolites* ex gr. *minimus* – *ultimus*. The latter association indicates a (late) middle Albian to the early Cenomanian age. Additionally, to the stratigraphic spectrum of belemnites (late Berriasian – early Cenomanian), the finding of a single valve of the aptychus *Punctaptychus* cf. *punctatus* gives the evidence for even older material present, i.e. Tithonian to Berriasian. Determined belemnites and aptychus, indicate the Berriasian to the early Cenomanian age of the conglomerate deposits of Chlebovice facies (Baška Development).

Key words: Outer Western Carpathians, Lower Cretaceous, Cenomanian, belemnite associations.

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INTRODUCTION

This paper presents a collection of Lower Cretaceous belemnites at the Rychaltice locality in deposits of the Baška Development of the Silesian Unit (Flysch Western Carpathians), along a road cut in the vicinity of the village of Rychaltice near Příbor. Belemnites from the

locality of Rychaltice were first described by VAŠÍČEK (1978), after noting the occurrences of belemnites in the years 1974 to 1976 in the clayey matrix surrounding a boulder of the Štramberk-type limestone, and subsequently from the same spot in 2011 (presented herein). The belemnites had weathered or washed out of the clayey matrix, surrounding the olistolith of the Štramberk-type limestone about 120 rostra were collected. The rostra are fragmentary but are not rolled fragments and neither do they show any signs of bio-weathering, but are approximately of the same size, usually only about 25 mm long. Taxonomic processing reveals that the collection is completely dominated by these incomplete rostra, which can largely be indicated as juveniles, as judged from their overall small size. However, caution is needed, because especially the late Albian – early Cenomanian some full-grown *Neohibolites* and *Parahibolites*, are of rather small size. In addition, fragments of rostra belonging to the genera *Duvalia*, and *Pseudobelus* occur, indicating older sedimentary deposits. The rather equally sized remains of the belemnites with the abundant occurrence of Albian-Cenomanian belemnite taxa indicated that most of the rostra must have been redeposited. The varying ages of the material documents that redeposition could have occurred several times. The main event having taken place in the early Cenomanian.

GEOLOGICAL SETTING

Belemnites from the locality of Rychaltice were first described by VAŠÍČEK (1978). Based on the species *Parahibolites tourtiae* (WEIGNER), the early Cenomanian age of the deposits was deduced. This small-sized outcrop is plotted on the geological map of the Moravian-Silesian Beskydy Mountains at a scale of 1:100 000 (MENČÍK and TYRÁČEK 1985), as strata in the sedimentary cover of the Štramberk Limestone, and therefore designated as Cenomanian near Rychaltice.

When a public road between Příbor and Frýdek-Místek was widened in 2011, in the vicinity of the municipality of Rychaltice, on the right side of the road (in the direction of travel from Příbor to Místek), an artificial outcrop about 200 m long was created. The belemnite-bearing layers of this outcrop were studied in two successive years, 2011 and 2012, with the help of P. Skupien and D. Matýsek from the Technical University in Ostrava. The topographical position of the outcrop is indicated in Fig. 1.

In addition, the whole outcrop was documented and sampled for micropalaeontological studies by M. Bubík from the Czech Geological Survey in Brno. BUBÍK (2012, fig. 1) described the lithology, geology and the topographic situation and presented the micropalaeontological results of the sample study. The belemnite-bearing deposits only occur in a small section located on the western margin of the outcrop, which is about 8 m thick (GPS: 49.652141 and 18.236898). The site was marked with the symbol MB027 (BUBÍK 2012, fig. 1). The corresponding section of the site is shown by BUBÍK (2012, fig. 2). However, the exposed rocks were covered up with a retaining wall in early 2012 and subsequently, the outcrop disappeared.

In 2011, as in 1974–1976, when first observations by the author, the outcrop was dominated by an olistolith of the Štramberk-type limestone, surrounded by a dark grey clayey matrix. However, in the 1980s, the outcrop, except for the limestone, soon became overgrown with grass. Eventually, the olistolith was removed at the end of 2011, while as a result a lenticular olistostrome with blocks and cobbles of limestones resting in a dark grey clayey sediment with belemnites was exposed.

Several layers in a sequence of dark grey claystones (and in spotty claystones in the higher part of the exposure) were accompanied by the occurrences of weathered small rostra of belemnites washed out from the clayey matrix. The rostra are incomplete, most frequently in the form of fragments of solid parts (so-called *rostrum solidum*) which are reworked and altered to various degrees. Only a few specimens have comparatively well-preserved rostra.

Study of the exposed stratal sequence has documented that the belemnite-bearing part

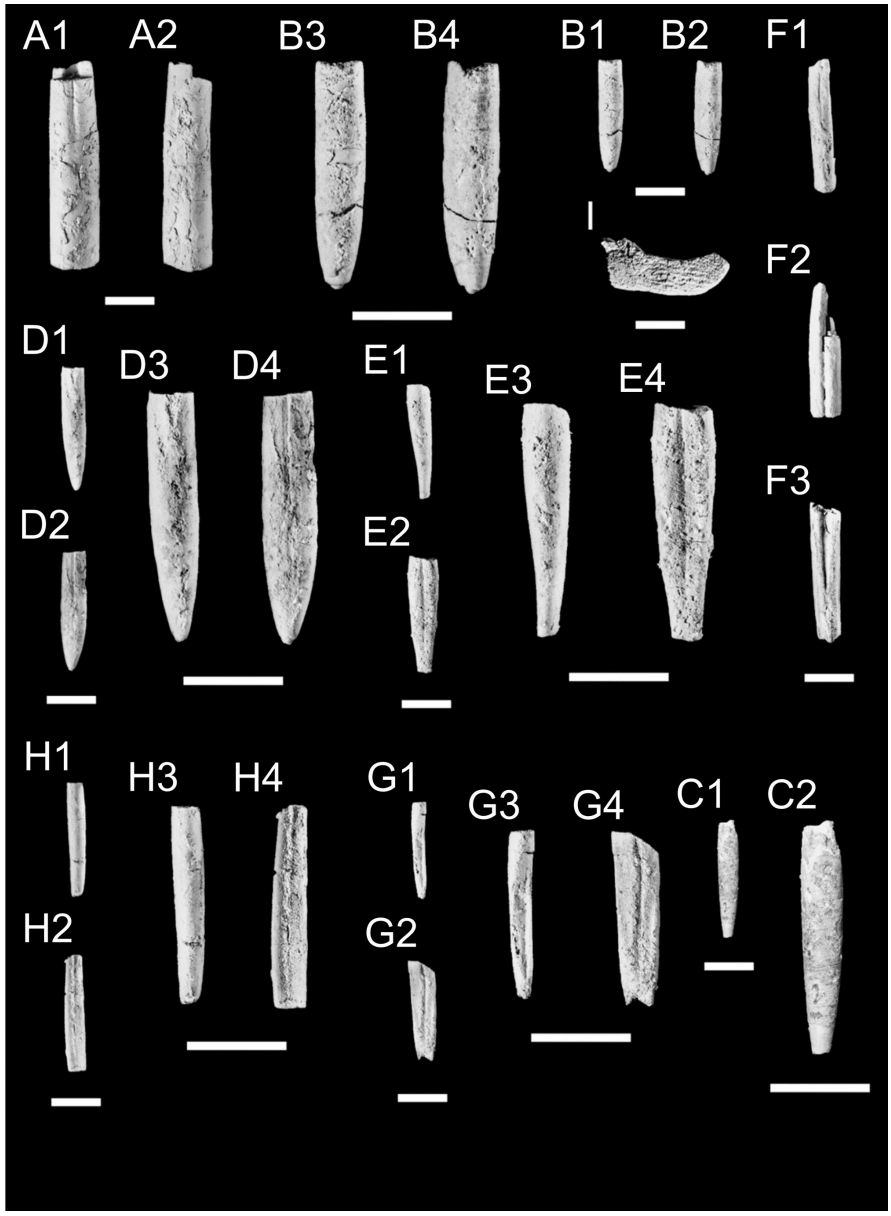
is located in the thrust zone of the Silesian Nappe onto the Subsilesian Nappe. It consists of an alternation of tectonically strained, dislocated fragments of various rocks such as conglomerates, laminated platy sandstones, and dark grey claystones with limestone-clasts of boulder-size. They belong to deposits with a predominance of conglomerates and blocks of limestone, which were described long ago from the village of Chlebovice by Hohenegger (1861). At the beginning of the last century, similar deposits were recorded by Remeš (1905) when he described the macrofossils of the so-called exotic boulders in Rychaltice, mentioning the occurrence of fragmentary belemnite rostra, which were impossible to determine. The belemnite-rich sediments belong to the Chlebovice Conglomerate Formation (former Chlebovice beds), according to the current Czech lithostratigraphic scheme (Stráník *et al.* 2021).

The geological structure of the location under study is extremely complicated. Even before the formation of the neo-Alpine nappe structures of the Outer Western Carpathians, the sedimentary area located in the Baška Ridge zone as part of the Štramberk carbonate platform, was already affected by numerous tectonic movements in the early Cretaceous. In 2011, as in 1974–1976, by the first observations of the author, the outcrop was dominated by an olistolith of the Štramberk-type limestone, surrounded by a dark grey clayey matrix. Deposits of the Baška Ridge were gradually eroded and redeposited, while the belemnite rostra, apparently were repeatedly(?) washed out from the claystones and subsequently redeposited. Depending on their textural character, the Tithonian-Cenomanian sediments in the area of the Chlebovice Development are referred to Chlebovice Conglomerate Formation.

Structurally, these deposits belong to the Baška Development of the Silesian Unit. The geologically younger deposits of the Subsilesian Nappe are distinguished by their brightly coloured, diagenetically less consolidated claystones.

Fig. 1. Geographical position of the area under study, with the locality of the belemnites, indicated by an irregular red tetragon (www.mapy.cz).

Obr. 1. Geografická pozice studované oblasti. Belemnitovou lokalitu na bázi slezského příkrovu označuje nepravidelný červený čtyřúhelník (www.mapy.cz).


A1
A2
B3
B4
B1
B2
F1
I
F2
D1
D3
D4
E1
E3
E4
F3
D2
E2
H1
H3
H4
G1
G3
G4
C1
C2
H2
G2

Obr. 2. Belemnites. A) Mesohibolitidae (*sensu* Riegraf *et al.*, 1998) indet., specimen B14040, A1 – ventral view, A2 – lateral view. ?Barremian to Early Aptian. B) *Neohibolites* ex gr. *minimus* (Miller, 1823), spec. B14041, B1 – ventral view, B2 – lateral view; B3 – ventral view, B4 – lateral view. Seen from the side of the rostrum, the left side is slightly arched compared to the almost straight opposite side, so that the rostrum is slightly asymmetrical. Middle Albian to the Cenomanian. C) *Neohibolites* sp. juv. or *Parahibolites* sp., spec. B14042, lateral view. ?Middle Albian to Cenomanian. D) *Parahibolites tourtiae* (Weigner, 1909), spec. B14044, D1 – ventral view with a very short rest of ventral groove, D2 – lateral view; D3 – ventral view, D4 – lateral view. Late Albian to the basal part of Cenomanian. E) *Duvalia* ex gr. *binervia* (Raspail, 1829) spec. B14045, E1 – ventral view, E2 – lateral view; E3 – ventral view, E4 – lateral view. Late Valanginian – earliest Hauterivian. F) *Pseudobelus* ex gr. *bipartitus* (Blainville, 1827), spec. B14043, F1 – dorsal view, F2 – lateral view, F3 – eroded long alveolus. Uppermost Berriasian to the Hauterivian. G) ?*Pseudobelus* ex gr. *bipartitus* (Blainville, 1827), spec. B14047, G1 – ventral view, G2 – lateral view; G3 – ventral view: a longitudinal shadow in the largest part of the rostrum towards the apex indicates a wider and flat groove, G4 – lateral view. Late Hauterivian. H) ?*Pseudobelus* sp. A sensu Janssen and Főzy, 2004, spec. B14046, H1 – ?ventral view, H2 – lateral view; H3 – ?ventral view, H4 – lateral view. Latest Valanginian – earliest Hauterivian. I) *Punctaptychus* cf. *punctatus* (Zittel, 1868), spec. B14048. Tithonian to the Berriasian.

Photos K. Mezihoráková (Ostrava), only the specimen C was photographed by O. Malek. Specimens were coated with ammonium chloride before photography with exception of Fig. C. All specimens bear the scale bar equals 10 mm. In addition, all specimens with the exception of specimens A and D, are twice enlarged (scale bar 20 mm).

Fig. 2. A) Mesohibolitidae (*sensu* Riegraf *et al.*, 1998), exemplář B14040, A1 – pohled na ventrální stranu, A2 – boční pohled. ?Barrem až raný apt. B) *Neohibolites* ex gr. *minimus* (Miller, 1823), ex. B14041, B1 – pohled na ventrální stranu, B2 – boční pohled; B3 – pohled na ventrální stranu, B4 – boční pohled. Při bočním pohledu na rostrum je levá strana slabě klenutá ve srovnání s téměř přímou protilehlou stranou, takže rostrum je slabě asymetrické. Střední alb až cenoman. C) *Neohibolites* sp. juv. or *Parahibolites* sp., ex. B14042, boční pohled. ?střední alb až cenoman. D) *Parahibolites tourtiae* (Weigner, 1909), spec. B14044, D1 – ventrální pohled s krátkým zbytkem ventrální rýhy, D2 – boční pohled; D3 – ventrální pohled, D4 – boční pohled. Pozdní alb až bazální část cenomanu. E) *Duvalia* ex gr. *binervia* (Raspail, 1829), ex. B14045, E1 – ventrální pohled, E2 – boční pohled; E3 – ventrální pohled, E4 – boční pohled. Svrchní valangin až nespodnější hauteriv. F) *Pseudobelus* ex gr. *bipartitus* (Blainville, 1827), ex. B14043, F1 – pohled na dorzální stranu, F2 – boční pohled, F3 – erodovaná dlouhá, úzká alveola. Nejvyšší berrias až hauteriv. G) ?*Pseudobelus* ex gr. *bipartitus* (Blainville, 1827), ex. B14047, G1 – ventrální pohled, G2 – boční pohled; G3 – ventrální pohled: podélný stín v převážné části rostra až k apexu naznačuje širokou, mělce proláklou rýhu, G4 – boční pohled. H) ?*Pseudobelus* sp. A sensu Janssen a FŐZY, 2004, ex. 14046, H1 – ?ventrální pohled, H2 – boční pohled; H3 – ?ventrální pohled, H4 – boční pohled. Nejvyšší valangin až nejranější hauteriv. I) *Punctaptychus* cf. *punctatus* (Zittel, 1868), ex. B14048. Tithon až berrias.

Fotografie zhotovila K. Mezihoráková (Ostrava), exemplář C zhotovil O. Malek. Exempláře s výjimkou exempláře uvedeného pod písmenem C byly před fotografováním běleny chloridem amonným. Všem exemplářům patří úsečka 10 mm. S výjimkou exemplářů A a D jsou všechna ostatní rostra rovněž vyobrazená při dvojnásobném zvětšení (označeno úsečkou 20 mm).

MATERIAL AND METHODS

The collection of belemnites published in Vašíček (1978), deposited in the collections of the former Central Institute of Geology in Prague, seems to have been misplaced and could not been located anymore. Except for the specimens illustrated in the work cited in this paper, no other specimens were available. The new collection of belemnites is stored in the Ostrava Museum.

This paper describes the macrofossils collected at the turn of 2011 and 2012, dealing with its taxonomy and deduced stratigraphical distribution. It comprises about 120 rostra of poor-quality, from the clayey matrix only, as apparently no rostrum was found in the solid rocks. The partially preserved rostra, generally of small size, tend to be corroded, to varying degrees. Typically, they are 10–25 mm in size. Some of them, notably the neohibolitid rostra, do show a nacreous lustre on their surface. In general, the rostra have no alveolus, no apex, nor any lateral grooves preserved. In addition, many very slender specimens occur, reaching lengths of up to 20–22 mm, but with their apex missing. They show a small circular cross-section of the rostra. However, this equal size is not their natural morphology but is clearly related to redeposition of the material. All in all, the small size, the fragmentary preservation of the material, and the damage caused by weathering, makes the study of most specimens and the subsequent species identification in the taxonomic section very difficult, if not impossible. Albeit, the taxonomic attribution of the specimens, point to some specifics, regarding their geological age.

In addition to the descriptive terminology, some authors supplement the taxonomic part with numerical objective data obtained by direct measurement of the rostra dimensions, which, although slightly modified, due to the incomplete preservation of the studied specimens, is used herein (Vašíček *et al.* 1994, fig. 27).

Since none of the specimens studied is complete, *R´* is used here instead of the usual *R*, to indicate the incomplete rostrum length, which cannot be defined with more precision. If the beginning of the alveolus is obvious or can be inferred, and if the end of the rostrum (apex) is also preserved, the symbol *Pa* is used. The dorsoventral diameter of the rostrum *DV* and the lateral diameter *LL* (perpendicular to *DV*) are also measured at the beginning of the alveolus. If these measurements are ambiguous, the measured values are labelled *Pa´*, *DV´* and *LL´*. In the case of morphologically suitable rostrum shapes, the maximum dorso-ventral diameter *dv* at the point of reaching the greatest rostrum width, and the equivalent diameter *ll* are also measured, as well as the distance of that point from the apex, labelled with a *p*.

The following indices are calculated from the measured values: the index of post-alveolar dilatation $Id = Pa/dv$, respectively $Id´ = Pa´/dv$ and the index of compression at the level of the beginning of the alveolus $Ic = DV/LL$ (unless *DV* is equal to *LL*), in the case of *Pa´* under the label *Ic´*, respectively the index of compression at the widest point of the rostrum $Ic´´ = dv/ll$. If the compression index has a value greater than 1, then $DV > LL$ and the rostrum is laterally compressed; if the value is less than 1, then $LL > DV$ and the rostrum is compressed dorso-ventrally.

TAXONOMY

The terminology referring to the morphology of the belemnite rostrum and the taxonomic concept in this paper is based on the work of Krymgol'ts (1939), Vašíček *et al.* (1994), Riegraf *et al.* (1998), and Mitchell (2015). The current paper cannot be considered a contribution to the belemnite taxonomy. It is primarily concerned with the identification of taxa needed for subsequent biostratigraphic evaluation of the sedimentary rocks. The descriptive part contains a selection of the synonymy of species only and is supplemented by biometric measurements of few suitable specimens. Species with known occurrences in the territory of former Czechoslovakia, are elaborated in a paragraph on Occur-

rence, which was added additionally to the paragraph on Distribution at the end of the species description.

Order Belemnitida ZITTEL, 1895
Suborder Belemnopsina JELETZKY, 1965
Family Mesohibolitidae NERODENKO, 1983 (*sensu* RIEGRAF *et al.*, 1998)

Mesohibolitidae (*sensu* RIEGRAF *et al.*, 1998) indet.
Fig. 2. A1–2

Material. A fragment of a comparatively large rostrum (spec. B14040), probably slightly spindle-shaped, partially preserved around the base of the alveolus up to about half the expected length of the post-alveolar region (rostrum solidum).

Description. On the ventral side, there is a shallow diminishing ventral groove about 15 mm long. The rostrum is slightly compressed dorso-ventrally at the beginning of the alveolus. At the opposite end of the fragment, the rostrum is of an almost circular cross-section.

Measurements. R' = 39.5 mm. At the presumed beginning of the alveolus, DV = 8.7, LL = 8.8; Ic' = 0.925. At the opposite end of the fragment, DV'' = 9.8, LL'' = 9.9; Ic'' = 0.99. The cross-section of the rostrum is circular.

Remarks. The specimen could possibly belong to the group of belemnites around *Neohibolites* ex gr. *minimus-ultimus*, but despite its relative major size and the unfavourable preservation does not completely exclude any older genera included in the Mesohibolitidae by RIEGRAF *et al.* (1998).

Genus *Neohibolites* STOLLEY, 1911
STOYANOVA-VERGILOVA (1970b) gives a detailed account of nomenclatural difficulties in determining the type species of the genus *Neohibolites*.
Type species: *Belemnites semicanaliculatus* EWALD, 1850 (non BLAINVILLE, 1827) (= *Belemnites ewaldi* STROMBECK, 1861), see RIEGRAF *et al.* (1998, p. 160).

Neohibolites ex gr. *minimus* (MILLER, 1823)
Fig. 2. B1-4
1823 *Belemnites minimus* LISTER; MILLER, p. 62, pl. 9, fig. 6.
?1902 *Belemnites* ex gr. *minimus* LIST.; LIEBUS and UHLIG, p. 114.
1954 *Neohibolites minimus* MILLER var. *minimus* sensu lato; SWINNERTON, p. 70, pl. 17, figs 17–35, pl. 18, figs 1–42.
1968 *Neohibolites minimus* (LISTER); WIEDMANN and DIENI, p. 157, pl. 17, figs 5, 11.
1970a *Neohibolites minimus* (MILLER); STOYANOVA-VERGILOVA, p. 49, pl. 24, figs 8a, b–10a, b (cum syn.)
1971 *Neohibolites minimus minimus* (MILLER); SPAETH, p. 58, pl. 5, figs 1a, b, 2a, b, 5, 6a, b.
1978 *Neohibolites* ex gr. *minimus* (MILLER); VAŠÍČEK, p. 114, pl. 3, figs 2–4.

Material. In addition to the more well, but incompletely preserved specimen described below (spec. B14041), a dozen of other incomplete, mostly corroded and deformed rostra occur, sometimes with the remainders of a pseudoalveolus.

Description. A fragment of a small, spindle-shaped, slender rostrum with the base of the pseudoalveolus (?) to the partially corroded apical area (spec. B14041). A very small part of the apical area is missing. In lateral view, the outline is somewhat more distinctly curved

on one side of the postalveolar region than on the opposite side. The rostrum is only slightly compressed laterally. In the lower third of the postalveolar region the widest part of the rostrum p´ is assumed. No groove is visible on the specimen.

Measurements. *R´*= 22.5 mm; *Pa´* = 19.0 mm; *DV* = 5.0, LL = 4.7; *Ic´*= 1.17. *p´*= 9.0 mm; *dv* = 5.5, *ll* = 5.0; *Ic* = 1.10.

Remarks. Given the small size and morphology of the slender, incomplete specimens, the examined material could belong to *Neohibolites minimus* (MILLER) sensu lato. Specimens of *Neohibolites minimus* sensu lato were described in detail by SWINNERTON (1955). He distinguished a total of 6 subspecies in his studied material. Considering the imperfect preservation of our material, a definite determination of the subspecies is not possible.

Distribution. According to STOYANOVA-VERGILOVA (1970a), *N. minimus* occurs from the middle Albian to the Cenomanian indicating Boreal-Atlantic to Tethyan distribution.

Occurrence. Earlier findings from similar deposits in the Moravian-Silesian Beskydy, indicating the range of this species, were reported by LIEBUS and UHLIG (1902) in the Lhoty Formation, by VAŠÍČEK (1978) on the base of the Palkovice Formation in Palkovice locality and in Chlebovice Member on Tichavská Hůrka.

?Neohibolites sp. juv. or *Parahibolites* sp.
Fig. 2. C1–2

Material. Three more complete, dimensionally small, narrow rostra (one from them – spec. 14042 – is figured) and several of other fragments, often with a pseudoalveolus and with a broken apex.

Description. A small, very slender rostra of a subcylindrical or conical shape, often with a very small remnant of an alveolus (?pseudoalveolus), gradually narrowing towards the apex; with a pointed ending. The rostra have no grooves. The cross-section is circular.

Measurements. R´= 28.0 mm; DV = LL = 4.5 mm.

Remarks. Since I consider the conical cavity at the beginning of the rostra to be the base of the alveolus, it can be assumed that the presented rostra should belong to the genus *Neohibolites*, probably within the range of species *N. minimus - ultimus*. However, *Parahibolites* could also be a possibility. The identification of these small specimens remains problematic.

Genus *Parahibolites* STOLLEY, 1919
Type species: *Neohibolites duvaliaeformis* STOLLEY, 1911.

Parahibolites tourtiae (WEIGNER, 1909)
Fig. 2. D1–4
1909 *Belemnites tourtiae* sp. n.; WEIGNER, p. 125, text-fig. 4a, b, 5 a, b, 6 a, b.
1978 *Parahibolites tourtiae* (WEIGNER); VAŠÍČEK, p. 116, pl. 3, figs 5, 6 (cum syn.).

Material. The only well-preserved specimen with a complete postalveolar region and a pointed apex (spec. B14044). Another dozen incomplete, weakly laterally compressed rostra, often with weak lateral grooves and the two specimens illustrated by VAŠÍČEK (1978).

Description. A small, comparatively complete specimen, well preserved from about the beginning of the alveolus to the apex. The rostrum is a little spindle-shaped, slightly compressed laterally. In lateral view, the outline of one side of the rostrum is more curved than the opposite side, so the rostrum is not symmetrical in dorso-ventral view. There are faint lateral grooves on both sides of the rostrum, which diminish in the vicinity of the apex.

Measurements. *Pa* = 24.0 mm; *DV* = 4.9, *LL* = 4.3; *Ic* = 1.14. *p´* = 11.0 mm, *dv* = 5.3, *ll* = 4.9; *Ic´* = 1.08. *Id* = *Pa/dv* = 4.53.

Remarks. Size, shape and size parameters of the rostrum are almost identical to the specimen presented in Vašíček (1978, tab. 3, fig. 6a, b), which comes from the same locality.

Distribution. *Parahibolites tourtiae* is identified from sedimentary deposits of the latest Albian and the early Cenomanian in Ukraine, the Crimea, northern Caucasus, Romania, and Germany.

Family Duvaliidae Pavlow, 1914
Genus *Duvalia* Bayle, 1878
Type species: *Belemnites latus* Blainville, 1827.

Duvalia ex gr. *binervia* (Raspail, 1829)
Fig. 2. E1–4

Material. A single, presumably juvenile, incomplete specimen without an alveolus and a part of apical region (spec. B14045).

Description. A fragment of a small part of the rostrum solidum with a broken apex. The rostrum is strongly compressed laterally, showing well-defined lateral lines. It is spindle-shaped with a rather distinct narrowing of the apical region in both lateral and dorso-ventral views. Thin and shallow lateral grooves on both sides. The cross-section of the rostrum is distinctly oval, with both ventral and dorsal sides rounded.

Measurements. *R´* = 22.5 mm. At the broader end of the fragment, *DV´* = 5.7; *LL´* = 4.0; *Ic´´* = 1.425.

Remarks. Regarding the shape and lateral grooves, some juvenile incomplete specimens of *D. binervia* with similar lateral grooves were illustrated by Janssen (2009) and Janssen (2021, pl. 9, figs 5, 6), which the specimen described here resembles to an extent.

Distribution. This taxon is known from the late Valanginian to earliest Hauterivian (Janssen, 2009).

Genus *Pseudobelus* Blainville, 1827
Type species: *Pseudobelus bipartitus* Blainville, 1827.

Pseudobelus ex gr. *bipartitus* Blainville, 1827
Fig. 2. F1–3, G1–4
1827 *Pseudobelus bipartitus* Blainville, p. 113, pl. 5, fig. 19.
1960 *Pseudobelus bipartitus* Blainville; Frajová, p. 327.
1978 *Pseudobelus* ex gr. *bipartitus* Blainville; Vašíček, p. 9, pl. 1, fig. 7a, b, ?6a, b.
1988 *Pseudobelus bipartitus* Blainville; Horák, p. 67, pl. 1, fig. 2.
1996 *Pseudobelus bipartitus* Blainville; Eliáš *et al.*, pl. 5, figs 10, 11.

2009 *Pseudobelus bipartitus* (Blainville); Alsen and Mutterlose, p. 177, figs 11.21–22, 11.26–31, 11.35–37.
2021 *Pseudobelus* gr. *bipartitus* de Blainville; Vaňková *et al.*, p. 13, fig. 6: 8a–c, 9a–c.
2021 *Pseudobelus* gr. *bipartitus* Blainville; Janssen, p. 91, pl. 10, figs. 5–10.

Material. A fragment of a strongly corroded medium-sized rostrum (spec. B14043), fragment? of small-sized rostrum (spec. B14047) and 5 of less-well preserved specimens.

Description. A distinctly incomplete rostrum B14043, preserved with about half of the alveolar region. On both sides of the laterally compressed rostrum there are deep lateral furrows forming a cross-section in the shape of the number 8. On the dorsal side, a slight dorsal furrow is visible, which does not reach the base of the alveolus.

Measurements. Spec. B14043 has *R´* = 26.5 mm; at the presumed beginning of the alveolus, *DH* = 6.4, *LL* = 5.4; *Ic* = 1.185.

Remarks. This taxon has not been revised recently but is generally characterized by the 8-shaped cross-section of the *rostrum solidum*. So far, larger specimen is generally attributed to the older taxon (*P. bipartitus*), while smaller mature specimens are often assigned to a different species. In reality, there are more morphotypes distinguishable in between, with additional characteristics besides their size-differences, however, for the moment these are not yet described as separate species, among these are the specimens described as ?*Pseudobelus* sp. A by Janssen and Főzy (see below).

Distribution. Combémorel (1973) and many other authors state that *P. bipartitus* occurs in the Valanginian. However, Janssen (1997) noted the occurrence of this species at the Río Argos locality (Spain) as early as the late Berrisian. The geographical distribution and the late Berriasian until early Hauterivian age of *Ps. bipartitus* is summarized by Vaňková *et al.* (2021, p. 13).

Occurrence. In the Czech Republic, this species was found in the Plaňava Formation in the Kotouč Quarry in Štramberk and, without more precise localization, in the Kopřivnice Formation in Štramberk (Baška Development of the Silesian Unit, Frajová, 1960). Uhlig (1902) mentions it from the lower part of the Hradiště Formation (Godula Development of the Silesian Unit). Furthermore, this species is known from the early Valanginian in the Tlumačov marlstones in the Kurovice Quarry (Rača Unit of the Magura group of nappes – Eliáš *et al.* 1996).

?*Pseudobelus* sp. A sensu Janssen and Főzy, 2004
Fig. 2. H1–4
2004 *Pseudobelus* sp.; Janssen and Főzy, p. 36, pl. 3, figs 16–19.

Material. A single fragment of a small-sized rostrum (spec. B14046) and two other less well-preserved specimens.

Description. A fragment of a small rostrum with a base of a crushed alveolus and afterwards continuation towards the apex. The apical region is broken off. The rostrum is narrow, slightly compressed laterally. At the beginning of the alveolus, the rostrum is narrower and becomes slightly broader towards the apex. Comparatively distinct lateral grooves are visible along the entire rostrum on both sides. The cross-section at the broken end of the post-alveolar region is slightly oval, almost circular.

Measurements: *R´* = 20.5 mm. DH = 3.3, LL = 2.8; Ic = 1.18. At the opposite end, *dv´* = 3.7; *ll´* = 3.2, compression index = 1.16.

Remarks. The fragment is reminiscent of the specimens illustrated by Janssen and Főzy, 2004 from the early Hauterivian of Hungary.

Aptychus

A monograph by Měchová *et al.* (2010) was used to determine a valve of an aptychus.

Family Punctaptychidae Měchová, Vašíček and Houša, 2010

Genus *Punctaptychus* Trauth, 1927
Type species: *Aptychus punctatus* Zittel, 1868.

Punctaptychus cf. *punctatus* (Zittel, 1868)
Fig. 2. I
cf. 1837 *Aptychus punctatus* nob.; Voltz, p. 435.
cf. 1868 *Aptychus punctatus* Voltz; Zittel, p. 52, pl. 1, fig. 15a, b
cf. 2010 *Punctaptychus punctatus* (Zittel); Měchová *et al.*, p. 230, fig. 8A (cum syn.)

Description. A fragment of a large valve of a heavily corroded, thick-walled calcareous aptychus (spec. B14048). In the terminal region, simple terminal ribs tend towards the symphysal margin at a sharp angle. The preserved fragment reaches a length of $L' = 23$ mm. The actual length could have reached 30 mm.

Remarks. It cannot be assessed whether the punctate layer on the corroded surface of the valve was primarily absent, or whether this layer was secondarily dissolved. Considering the size of the valve, it seems most likely it belongs to *Punctaptychus punctatus* (Voltz, 1837 ex Zittel, 1868). This species usually occurs in the Tithonian to Berriasian. This genus does not occur in higher strata.

DISCUSSION

The collection of belemnites from the Rychaltice location gathered from an artificial outcrop in a lithological varied stratigraphic sequence contains at least four taxa. Among the latter, there are at least two different associations; the youngest is dominated by rostra of the genera *Neohibolites* and *Parahibolites*. The older, consists of late Berriasian to early Hauterivian taxa (*D.* ex gr. *binervia* and *Pseudobelus*), but is represented by only a very small number of rostra. In addition, the late Berriasian, or possibly even slightly older age, is indicated by a single, fragmentary record of the aptychus *Punctaptychus* cf. *punctatus*. According to Měchová *et al.* (2010), the genus *Punctaptychus* disappears the late Berriasian. The largest number of rostra are of the genus *Neohibolites*. This species-rich genus occurs from the latest Barremian to the early Cenomanian. However, the taxa related to *Neohibolites* of the *minimus-ultimus* group, occur in the late Albian to early Cenomanian only, as does *Parahibolites tourtiae*. These data indicate that the spectrum of fossils collected at the Rychaltice reaches from the late Berriasian to the early Cenomanian.

According to the current lithostratigraphic scheme (Stráník *et al.* 2021), the Lower Cretaceous dark grey claystones with belemnites in the deposits of the Baška Development of the Silesian Unit is a part of the Hradiště Formation. In the stratigraphic table (Stráník *et al.* 2021, fig. 35) deposits indicated as the "Chlebovice facies" are assigned a Hauterivian to middle Albian age. Eliáš *et al.* (2003) distinguish, within the Hradiště Formation of the Baška Development, the Kotouč and Chlebovice facies. The Kotouč facies is associated with the local development in area of the Kotouč Quarry in Štramberk. The Chlebovice facies was newly defined by Matějka and Roth (1949) and further by Eliáš (1970,

1979). This facies differs from the Kotouč facies by a higher proportion of sandstones and conglomerates. Taking the local deposits into consideration, the Rychaltice locality clearly belongs to the Chlebovice Development. In older literature, the term Chlebovice conglomerates or Chlebovice strata was also used for these deposits.

The abundance of belemnites found in only a few metres at the Rychaltice and their stratigraphic range are unusual. A somewhat similar mass occurrence of belemnites in the Silesian Unit was previously recorded at the Kotouč Quarry in Štramberk. In the local development, dark grey claystones contained nests of belemnites. A collection of these belemnites from three such sites was published by Horák (1988). Herein, only Valanginian belemnites were indicated. Most of the rostra show traces of redeposition, as evidenced by the colour difference of the sediment in the alveolar fills compared to the matrix. However, similar occurrences of belemnites in the Kotouč Quarry have not been seen lately.

The rostra of the Rychaltice belemnites show a higher degree of damage compared to the belemnites from the Kotouč Quarry. In general, they do lack, both their alveolus and apical part. Many of the belemnite taxa, probably lived in swarms, possibly in more proximal waters and near reefs. The destruction of the rostra from the Rychaltice locality was probably linked to the surf environment accompanied by boulders of Štramberk-type limestones (see Vaňková *et al.* 2021, fig. 10). Erosion of diagenetically poorly consolidated deposits in slope slides also played a part, in which the more solid parts were sorted by size.

Eliáš *et al.* (2003) developed palaeogeographic models for the various stages of the Lower Cretaceous sedimentary regimes in the western part of the Silesian Unit. The models are dominated by slides with olistoliths and fans of turbidites, transported from the Baška Ridge. In addition to the Štramberk Limestone, older limestones also occur among the boulders. For example, Bubík (2012) mentions an Oxfordian limestone from the Rychaltice locality, based on micro-palaeontological evidence.

Recently, related issues have been addressed by Hoffmann *et al.* (2021) and Vaňková *et al.* (2021). The environment of the Baška Ridge, part of which can be referred to as the Štramberk carbonate platform, was affected by synsedimentary tectonic movements during the Lower Cretaceous, which led to its disintegration (Hoffmann *et al.* 2021). Multiple reconstructions of the sedimentary space occurred, forming narrow uplifted limestone belts separated by tectonic trenches in which dark claystones were deposited. Some slides were accompanied by deep erosion into the autochthonous bedrock. Vaňková *et al.* (2021, fig. 10) appropriately depicted the hypothetical evolution of the sedimentary area for the Baška part of the Silesian Unit in the Kotouč facies in the Tithonian to middle Barremian. Like Horák (1988), they provide evidence for the redeposits of belemnites the alveolar fills which differ from the surrounding sediment. However, belemnites of Albian to Cenomanian age are not known from the Kotouč facies, in contrast to the Chlebovice facies.

In the final phase of geological development, the deposits studied in the Rychaltice area were affected by a Neogene Alpine tectogenesis. The deposits became part of the Silesian Nappe, which overthrusted the Subsilesian Nappe, evidenced by the fact that the studied site is located at the base of the Silesian Nappe, close to its thrust plane.

These circumstances illustrate the difficulty in assessing the actual geological structure of the Rychaltice locality and all the processes associated with the occurrence of belemnites there.

CONCLUSION

The Rychaltice locality is characterised by a complicated geological structure around the thrust plane of the Silesian Nappe. The abundance of fragmentary rostra of belemnites which show considerable damage and are sorted by size is unusual. The state in which the rostra are preserved, and their sorted sizes suggest multiple redepositions.

Determination of incomplete rostra is very difficult. The collected assemblage represents at least 5 taxa. The belemnites indicate the mixture of at least two different associations, the youngest being compost of late Albian – early Cenomanian taxa (*Neohibolites* ex gr. *minimus-ultimus*, *Parahibolites*), mixed with late Berriasian to Hauterivian belemnite taxa. In addition, a Tithonian – late Berriasian aptychus occurs.

The sedimentary deposits at the Rychaltice locality, point to the upper Berriasian – lower Cenomanian. This is partially inconsistent with the Hauterivian to middle Albian ages reported by Stráník *et al.* (2021). This paper proves that sedimentation in the Chlebovice Development was still in progress at least in the early Cenomanian. According to the data recorded, the Baška Ridge was affected by multiple tectonic movements associated with the redeposition of sediments and their fossil contents in the Lower Cretaceous of the Silesian Unit, both in the Chlebovice and Kotouč facies.

SOUHRN

Při rozšiřování státní silnice R48 Příbor – Frýdek-Místek v roce 2011 byl u obce Rychaltice po pravé straně stávající silnice odkryt skalní podklad v délce kolem 200 m. Z geologického hlediska odkryv náleží do celku vnějších Západních Karpat, k bašskému vývoji slezské jednotky (příkrovu), zde nasunuté na příkrov podslezský. Celý profil původně zdokumentoval a mikropaleontologické vzorky odebral M. Bubík (Bubík 2012). Na bázi násunové plochy slezského příkrovu, ze zóny kolem 8 m mocné, tvořené bloky a valouny vápenců štramberského typu uložených v tmavošedé jílovité matrix, byla z jílovců přírodním procesem vyplavená četná rostra belemnitů, která jsme na sklonku roku 2011 vysbírali.

Vzniklá kolekce více než 100 roster fragmentárně zachovaných belemnitů byla taxonomicky zpracována. Vedle fragmentárního zachování jsou zdejší belemniti pozoruhodní ještě tím, že značná většina roster dosahuje přibližně stejné malé velikosti 15–25 mm. Determinace takto zachovaných roster byla značně obtížná. Na nestejné úrovni bylo určeno 5 taxonů. Belemnity doprovází jen jediný fragmentárně zachovaný aptychus.

Stratigrafické vyhodnocení určených roster (podle údajů z literatury) přineslo nečekaný výsledek. Malou část představují nehojná rostra nižší spodní křídy. Druhou část tvoří hromadný výskyt roster kolem hranice alb/cenoman. Nižší spodní křídu dokládají: *Pseudobelus* ex gr. *bipartitus* (svrchní berrias až hauteriv), *?Pseudobelus* sp. A (raný hauteriv), *Duvalia* ex gr. *binervia* (svrchní valangin až nejranější hauteriv) a blíže neurčitelný zástupce čeledi Mesohibolitidae (?svrchní barrem až spodní apt). Stratigraficky vyšší část křídy dokládají zejména rostra rodu *Neohibolites* (střední alb až cenoman). K tomuto společenství patří též výskyt jediného bezpečně určeného druhu – *Parahibolites tourtiae* (nejvyšší alb až spodní cenoman). Z makropaleontologického hlediska rozsah studovaných uloženin odpovídá berriasu až spodnímu cenomanu. Berrias dokládá nález aptycha rodu *Punctaptychus*, když uvedený rod nepřekračuje berrias.

Složité neoalpinské tektonice ve spodní křídě v sedimentačním prostoru bašského hřbetu, který byl součástí štramberské karbonátové plošiny, předcházely několikanásobné tektonické pohyby. Během nich docházelo k rozrušování bašského hřbetu a k redepozici jeho uloženin (Hoffmann *et al.* 2021). S redeponovanými sedimenty byla transportována a v kalných proudech podle velikosti vytříďována rostra belemnitů. Uvedené uloženiny jsou zahrnovány pod chlebovický vývoj spodní křídy. Na základě litologie bývají v názvosloví vrstevních členů označovány jako chlebovické slepence.

K novým litostratigrafickým poznatkům oproti dosavadnímu pojetí Stráníka *et al.* (2021) patří, že určení belemniti spolu s aptychem nově vymezují stáří slepencových uloženin chlebovické facie bašského vývoje slezské jednotky v rozsahu svrchní berrias až spodní cenoman. Pozoruhodný je zejména hromadný výskyt neohibolitidních roster vytříděných téměř do jednotné velikosti.

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