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TAXONOMY AND STRATIGRAPHIC DISTRIBUTION OF THE AMMONITE *SCHLOENBACHIA* NEUMAYR, 1875 FROM THE BOHEMIAN CRETACEOUS BASIN

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Abstract: Only two specimens of the ammonite genus *Schloenbachia* have hitherto been recorded from the Bohemian Cretaceous Basin (BCB). While the first specimen was originally described by Dr. J. Soukup in the 1970s, the other one was discovered in an older collection of the Faculty of Science, Charles University in Prague in 2018. Recently, both specimens were systematically investigated and interpreted as *Schloenbachia lymensis*, a new ammonite species for the BCB. The stratigraphic distribution of *S. lymensis* as well as the palaeobiogeography of this taxon are discussed in this paper.

Key words: Upper Cenomanian, Bohemian Cretaceous Basin, ammonites, *Schloenbachia lymensis*

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Introduction

The Bohemian Cretaceous Basin (BCB) represents a relic of a sedimentary area (Text-fig. 1) linking the Boreal and the Tethyan Realms (Wiese et al. 2004). Therefore, the presence of faunas typical for both palaeobiogeographic units may indicate palaeoceanographic changes in Central Europe. Although not pivotal, even cephalopods are valuable indicators of these changes. Representatives of the ammonite genus *Schloenbachia* Neumayr, 1875 are widely distributed geographically (from Greenland, UK, France, Germany, Poland to Kara sea – Russia in the north and Iran in the south), especially in northern Cretaceous basins. On the contrary, they are virtually unknown from the southern Tethys (i.e. North Africa, Madagascar, Western Mediterranean). However, they are reported from several sites of the Northern Tethys – Southern France, Crimea, Turkmenistan, Iran (see Wilmsen and Mosavinia 2011, Kennedy 2013, for more details). In this respect, the genus *Schloenbachia* should be considered more as a Boreal taxon with peri-Tethyan occurrences (Wright and Kennedy 2015).

Morphologically, *Schloenbachia* species belong to the most variable taxa within ammonites (Wilmsen and Mosavinia 2011, Kennedy 2013, Wright and Kennedy 2015) with long stratigraphic ranges (Kennedy 2013). The stratigraphic distributions as well as taxonomy of this group is still under discussion (Wright and Kennedy 2015, Machalski 2018, and others). While the Lower Cenomanian representatives are referred to *Schloenbachia varians* (J. Sowerby, 1817) with numerous intergrading variants called forms (Kennedy 2013 – see discussion below), the Middle Cenomanian species belong mostly to *S. coupei* (Brongniart, 1822) and the youngest, variable, and less known taxon *S. lymensis* Spath, 1926 is the Upper Cenomanian species.

Within the BCB, a single record of *Schloenbachia varians trituberculata* Spath, 1926 was documented by Soukup (1971) from organodetritic limestones transgressively overlaying neoproterozoic gneisses in the Plaňany quarry near Kolín. A relatively well preserved specimen (stored in the National Museum, Prague as item NM-O 1801) which was investigated by Soukup in great depth and is discussed herein within modern taxonomic and stratigraphic concepts. A new record of the *Schloenbachia* genus comes from locality Slaný. It was found in the older collections at the Faculty of Science, Charles University, Prague in 2018. According to the lithology of the sample and with respect to newly interpreted strata of the Pecínov Member of the Peruc-Korycany Formation (Košťák et al. 2018), we assign this record to the Upper Cenomanian, the *Metoicoceras geslinianum* Zone (see discussion below). Both these specimens, that of Soukup (1971) and the specimen from Slaný described herein, are interpreted as *S. lymensis*.

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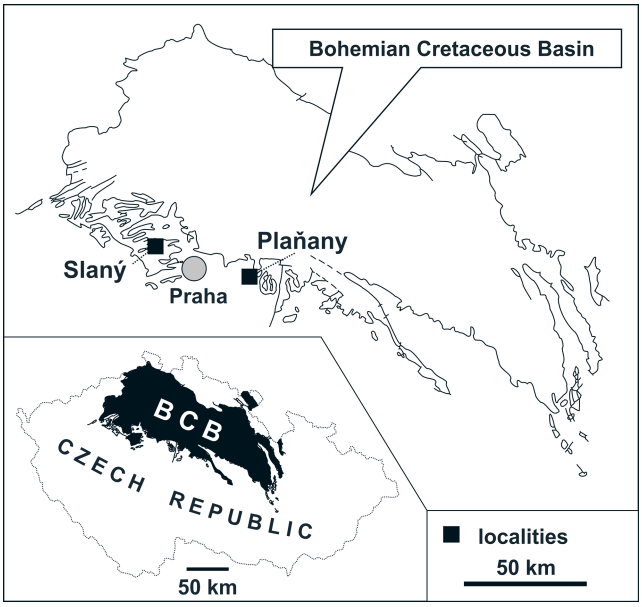
Geological and stratigraphical settings

Detailed information on geological setting and stratigraphy of the Plaňany quarry and the source layer of the specimen itself is given in Soukup (1971, and references therein). The "pocket" filled with organodetritic limestone originally described by Soukup (1971) was destroyed during exploitation in 1969. Later, occasionally multiple sections of the quarry situated in similar or different topographic levels were studied by numerous authors (Žítt and Nekvasilová 1996, Marek et al. 2013, Žítt and Vodrážka 2013). A detailed study focused on post-Cenomanian sedimentary history with special respect to Plaňany elevation morphology was published by Žítt et al. in 2015. The exact stratigraphic position of organodetritic limestones and correlation with other sections in the quarry is complicated also due to frequent gaps in sedimentation, wave sweep action, and faunal reworking at the Cenomanian-Turonian boundary. The accompanying fauna is listed by Soukup (1971) including also cephalopods *Scaphites equalis* (J. Sowerby, 1913) and *Sciponoceras baculoide* (Mantell, 1822) and relatively numerous rudists. According to Soukup (1971), rostra of belemnite *Praeactinocamax plenus* (Blainville, 1827) had not been recorded together with the *Schloenbachia* specimen. Therefore, Soukup (1971) assigned these strata to the Upper (or Middle) Cenomanian, as the so called "*Plenus* Zone" was at that time incorrectly considered as a transitional Zone between the Cenomanian and the Turonian in the BCB (e.g. Zázvorka 1965, etc.). Based on systematic re-interpretation of Soukup's specimen, we suggest more likely an Upper Cenomanian (probably *Calycoceras guerangeri* through the *Metoicoceras geslinianum* zones) occurrence at the Plaňany quarry. A newly discovered specimen of *Inoceramus pictus pictus* J. Sowerby, 1829 in Soukup's original material supports this interpretation.

The specimen from the locality Slaný comes from the off-shore grey to dark grey mudstone, typical for the Pecínov Member of the Peruc-Korycany Formation (Uličný et al. 1997). The Pecínov Member is divided into four units (for details see Uličný et al. 1997, Košťák et al. 2018) and especially the lower part (including units P1–2 sensu Košťák et al. 2018) is biostratigraphically well calibrated by ammonites. The sharp erosional base of the P2 unit is overlain by glauconitic sandy siltstone. The studied specimen (preserved in the sediment; Text-fig. 2e) shows no glauconite content typical for the P2 unit (its lower part respectively – P2a–d) at Pecínov. Therefore, the highest probability is that the stratigraphic level of *S. lymensis* from Slaný corresponds most likely to the equivalent of the P1 unit at Pecínov – i.e. the lower part of the *Metoicoceras geslinianum* Zone. The glauconite lacking upper part of the P2 unit (P2e – upper part of the *Metoicoceras geslinianum* Zone and the uppermost part of the *Sciponoceras gracile*/*Euomphaloceras septemseriatum* Subzone) is similar in lithology. However, this stratigraphic level seems to be rather unlikely, as the last occurrence (LO) of *S. lymensis* is reported from the *Praeactinocamax plenus* Zone (Marcinowski 1972, 1974, Marcinowski and Radwanski 1989) – i.e. strata corresponding to the glauconitic lower part of P2 (Košťák et al. 2018). Therefore, we assume the stratigraphic position for the specimen to be the lower part of the *Metoicoceras geslinianum* Zone, below the *Sciponoceras gracile*/*Euomphaloceras septemseriatum* Subzone within the BCB.



Text-fig. 1. The map of the BCB showing position of localities with recorded specimens.

Systematic palaeontology

Order Ammonoidea Zittel, 1884
Suborder Ammonitina Hyatt, 1889
Superfamily Hoplitoidea H. Douvillé, 1890
Family Schloenbachiidae Parona et Bonarelli, 1897

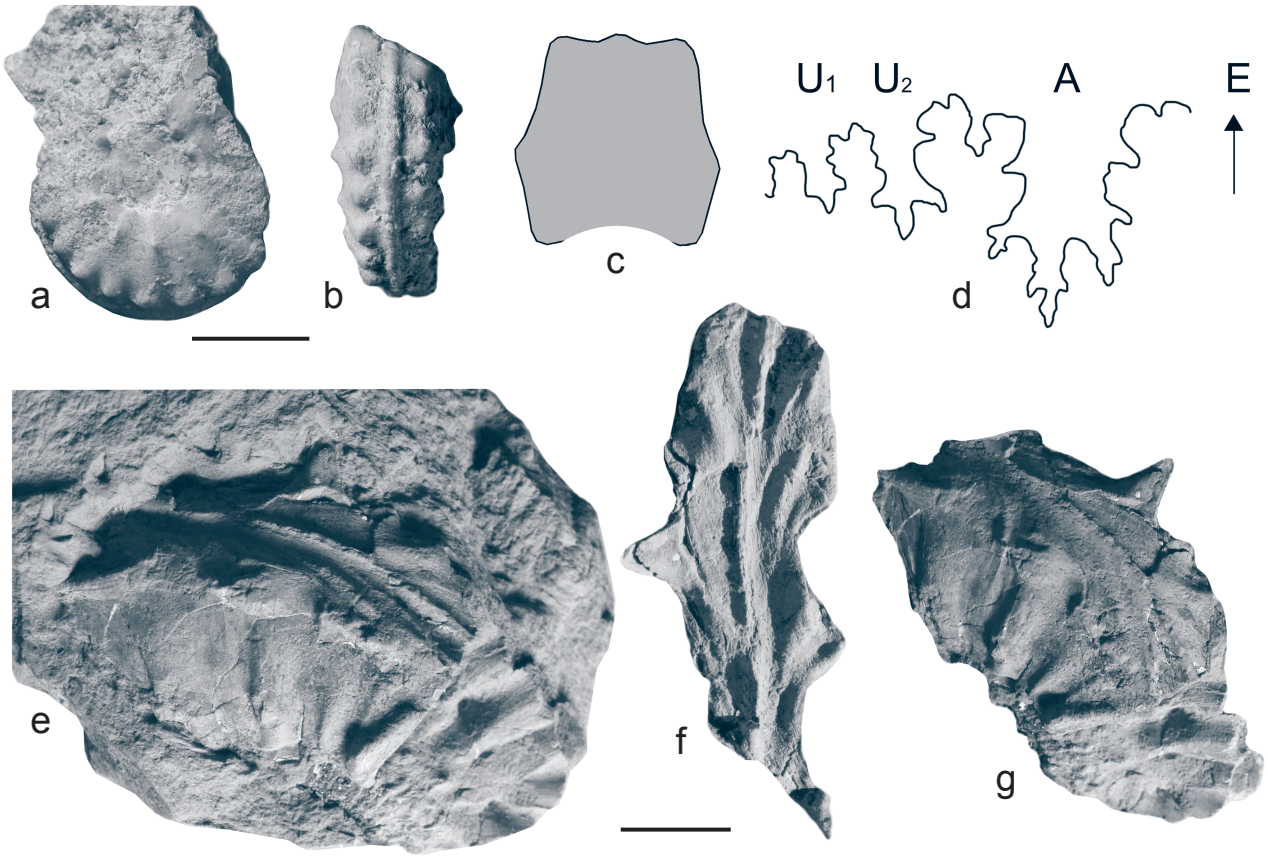
Genus *Schloenbachia* Neumayr, 1875

Type species. *Ammonites varians* J. Sowerby, 1817, p. 169, pl. 176; subsequent designation by Douvillé (1890: 290).

***Schloenbachia lymensis* Spath, 1926**
Text-fig. 2a–g

1853 *Ammonites varians* var. *subtuberculata*; Sharpe, p. 22, pl. 8, fig. 8.
non 1853 *Ammonites coupei* var. *tuberculata* Mantell; Sharpe, p. 24, pl. 8, fig. 4.
1926 *Schloenbachia lymensis*; Spath, pp. 426, 430.
1971 *Schloenbachia varians trituberculata* Spath; Soukup, p. 77, figs 1–2, pl. 1.
1985 *Schloenbachia varians trituberculata* Spath; Svoboda, p. 26.
1998 *Schloenbachia* spp.; Kaplan et al., p. 109.
2002 *Schloenbachia lymensis* Spath; Wright and Kennedy, p. 185, pl. 31, figs 3–4.
2004 *Schloenbachia varians trituberculata*; Košťák et al., p. 515.
2005 *Schloenbachia lymensis* Spath, 1926a; Gale et al., p. 466, fig. 12f.
2013 *Schloenbachia lymensis* Spath, 1926b; Kennedy, p. 464, fig. 11.
2015 *Schloenbachia lymensis* Spath; Wright and Kennedy, p. 450, figs 179–180, pls 141–145. (with complete synonymy)

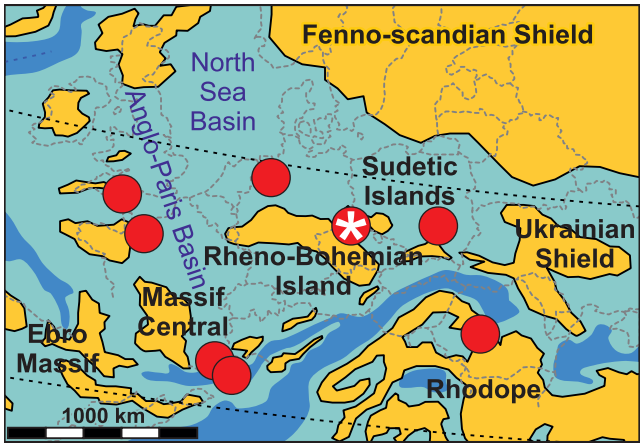
Material. Two specimens No. NM-O 1801 (National Museum, Prague) and No. 2310/2819 (Chlupáč's Museum of Earth History, Faculty of Sciences, Charles University, Prague).



Text-fig. 2. a–g. *Schloenbachia lymensis* Spath, 1926. a–d. *S. lymensis* from the Plaňany quarry. a. Lateral view. b. Ventral view. c. Whorl section (improved from Soukup 1971). d. Suture line (adopted from Soukup 1971; improved). E – external lobe, A – adventive lobe, U1 and U2 – umbilical lobes. e–g. *S. lymensis* from the locality Slaný. e, g. Ventro-lateral view showing larger clavi modified into spines closely to the aperture. f. Ventral view. Scale bars equal 10 mm.

Description. For detailed description of specimen *S. lymensis* from Plaňany quarry see Soukup (1971). The additional record from Slaný represents a larger adult specimen (?macroconch) with the majority of the body chamber preserved (internal mould) including the aperture. The preserved slightly compressed fragment consists of a 70 mm long and 30 mm high part of the whorl. The siphonal keel is well developed, connecting the chevron-like structures resulting from the constriction of the body chamber. The umbilical bullae are coarser and they give a rise to prorsiradiate ribs, coarser in the inner part. Unusual ventrolateral spines (i.e. modified ventrolateral clavi) are well developed in the last three main ribs of the body chamber. The suture line observable in Soukup's original specimen from Plaňany (Text-fig. 2d) corresponds well to the specimen figured by Wright and Kennedy (2015: text-fig. 180 B).

Remarks. Spath's (1926) holotype corresponds with our specimen from Plaňany in the majority of morphological aspects. The only difference are the remarkable coarser lateral tubercles in the second specimen (loc. Slaný; see Text-fig. 2e, g). According to Wright and Kennedy (2015), *S. lymensis* is analogous to *S. coupei* forma *trituberculata* (= *S. varians trituberculata* sensu Soukup 1971) with some differences such as the larger adult size (specimen from Slaný), finer inner ribs, missing lateral and umbilical tubercles typical for *S. coupei* (compare with the specimen from Plaňany), disappearing of the lateral tubercles (partly seen in the Plaňany specimen) and loss of the ventrolateral clavi in adult specimens of *S. lymensis*. Sharpe's specimen (1853: 24, pl. 8, fig. 4) included in the synonymy list by



Text-fig. 3. Palaeogeographic distribution of *Schloenbachia lymensis* (red dots) in the Upper Cenomanian *Calycoceras guerangeri* through the *Metoicoceras geslinianum* Zones. Light blue – shallow epicontinental sea, dark blue – deep marine settings, yellow – land. * asterisk – occurrence in the BCB (modified after Wilmsen 2012).

Soukup (1971) belongs to *S. lymensis* according to Wright and Kennedy (2015).

Wright and Kennedy (2015) recognized five forms of *S. lymensis*: *lymensis* sensu stricto, *simplicosta*, *lautiforme*, *flexicosta* and *lissa* based on differences in morphology. Both specimens from the BCB correspond to the forma *lymensis* sensu stricto. Additionally, in the specimen from Slaný, we observed unusual ornamentation consisting of markedly developed ventrolateral clavi slightly modified as spines. This morphological feature modifies to some extent the opinion (Wright and Kennedy 2015) that the loss of the ventrolateral clavi occurred in mature specimens of *S. lymensis*.

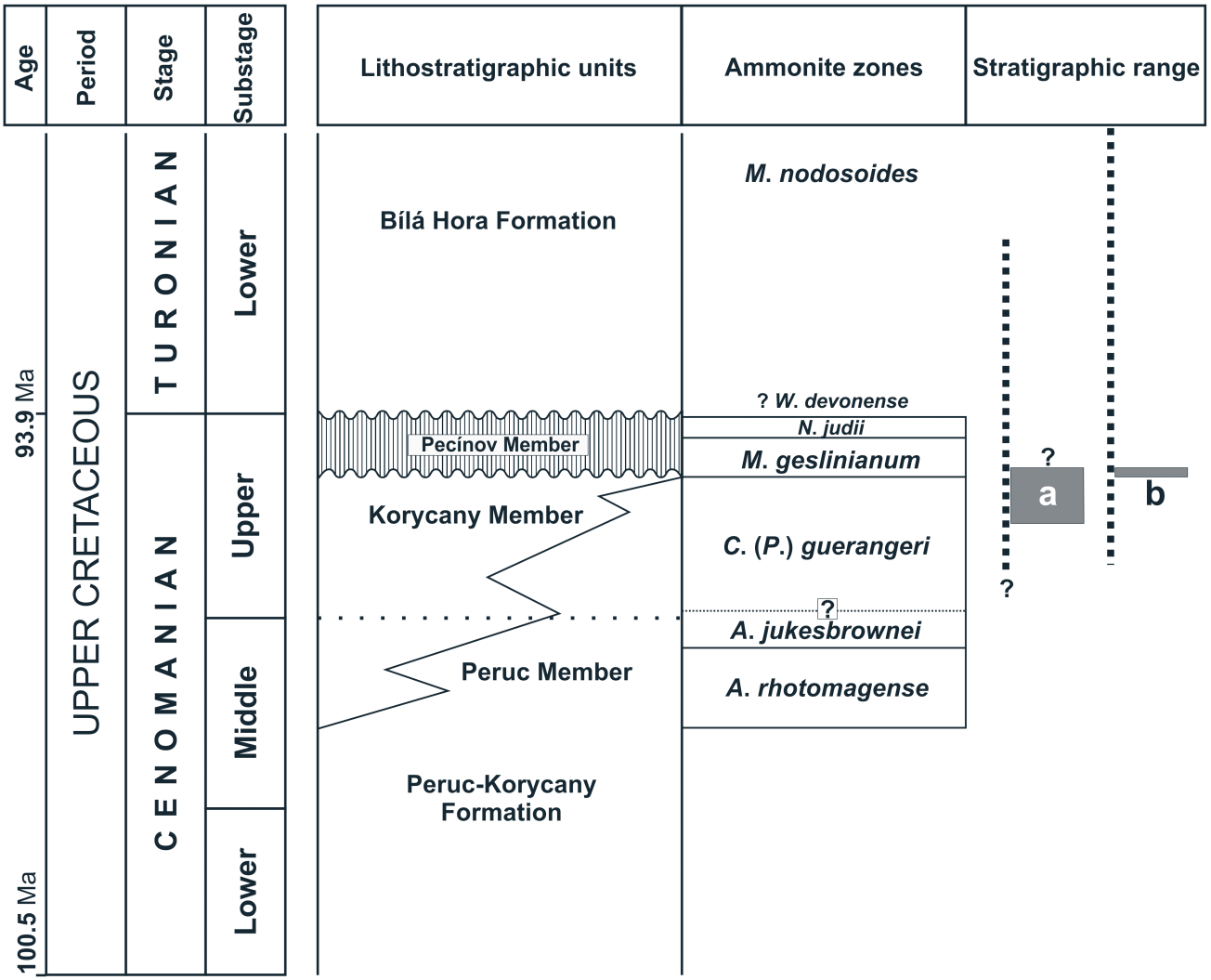
The specimen from Slaný was originally labelled as "*Ammonites dentato-carinatus* Roem.". A taxon corresponding to the Coniacian genera *Barroisiceras* de Grossouve, 1894 or Santonian *Texasia* Reeside, 1932. The keel in our specimen does not show any serration or clavi typical for these taxa. Moreover, no sediments of the same age have been recognized in the vicinity of Slaný town.

Stratigraphic and geographic distributions. According to Kennedy (2013) and Wright and Kennedy (2015), the FO of *S. lymensis* is in the Middle Cenomanian terminal *Acanthoceas jukesbrownei* Zone and acme in the Upper Cenomanian *Calycoceras guerangeri* Zone. The LO is reported from the *Praeactinocamax plenus* Zone within the *Metoicoceas geslinianum* Zone. The occurence in the BCB falls into the *Calycoceras guerangeri* through the *Metoicoceras geslinianum* Zones.

This species is known from England (Dorset, Lyme Regis, Shapwick Grange, Bincombe, Eastbourne), France (Seine-Maritime, Rouen, Craie, Les Lattes, Alpes-de-Haute), Germany (Münster Basin), Poland (Holy Cross Mts), Romania (Haţeg) (Wright and Kennedy 2015), and the BCB – this paper (Text-fig. 3).

Discussion

As noticed by Wilmsen and Mosavinia (2011), Kennedy (2013), Wright and Kennedy (2015) and others, the systematics and taxonomy in such a variable taxon are somewhat complicated. There are only minor differences among *Schloenbachia* species. Also quite long stratigraphic ranges (throughout several ammonite zones) have been reported from the Lower through the Upper Cenomanian



Text-fig. 4. Lithostratigraphy of the BCB and standard ammonite zonation in relation to *Schloenbachia lymensis* occurrence. a. Plaňany. b. Slaný. Dashed lines indicate chronostratigraphic ranges of marine strata in both localities. For detailed litho- and biostratigraphy of the Pecínov Member see Košťák et al. (2018).

(Kennedy 2013). The majority of *S. lymensis* records falls into the *Calycoceras guerangeri* Zone, however, the earliest specimens were found in the *Acanthoceas jukesbrownei* Zone (Wright and Kennedy 2015).

Kaplan et al. (1998) report a *Schloenbachia* sp. record (synonymized with *S. lymensis* by Wright and Kennedy 2015) from the limestones with the *Inoceramus pictus* event II. – i.e. the upper part of the *Calycoceras guerangeri* Zone in the Münster Basin. From the same interval, *S. lymensis* is documented in the Hannover area (Wilmsen 2012). Other records within this zone are listed by Wright and Kennedy (2015).

The LO of the species within the *Metoicoceras geslinianum* Zone is reported from a relatively small number of sites (Pop and Szász 1973, Marcinowski 1974, Marcinowski and Radwanski 1989, Thomel 1992, Kaplan et al. 1998). The taxon terminates in the *Praeactinocamax plenus* Zone where it co-occurres with the index belemnite taxon (Marcinowski 1972, Marcinowski and Radwanski 1989).

As mentioned above, the stratigraphic level of the specimen from Slaný falls into the lower part of the *Metoicoceras geslinianum* Zone (Text-fig. 4), slightly below the *Praeactinocamax plenus* Zone.

In the vicinity of Slaný, the lowermost part of the *Metoicoceras geslinianum* Zone is characterized by inoceramid species *Inoceramus pictus* J. Sowerby, 1829, *Inoceramus* cf. *bohemicus* Leonhard, 1897 and *Inoceramus* sp. aff. *Mytiloides praeturonicus* Tröger, 2015 as was also documented in Pecínov quarry (Košťák et al. 2018). This is probably the level of *Inoceramus pictus* – Event III of Kaplan and Best (1985) and Diedrich (2010) in the lowermost part of the *Metoicoceras geslinianum* Zone in the Münster Basin.

Conclusions

We have summarized the record of a rare hoplitoid ammonite of the genus *Schloenbachia* – *S. lymensis* in the BCB. Additionally, the occurrence of *S. lymensis* in the *Metoicoceras geslinianum* Zone (specimen from Slaný) – i.e. slightly below the LO of the taxon, has been confirmed. The specimen from Plaňany may fall into the *Metoicoceras geslinianum* Zone and/or the *Calycoceras guerangeri* Zone. The presence of *Schloenbachia* ammonites in the BCB suggests the Boreal faunal influence in the *Calycoceras guerangeri – Metoicoceras geslinianum* zones. Subsequently, *S. lymensis* raises ammonite diversity within the *Metoicoceras geslinianum* Zone in the BCB.

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