Revison of an atheloptic Visean Trilobite association in the Moravian Karst (Czech Republic)

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Abstract: Recently two new trilobite occurrences were discovered during geological mapping of fossiliferous shales of the Březina Formation around the village of Březina in the Moravian Karst (Czech Republic). The newly discovered localities are extraordinary because of the unexpected occurrence of articulated trilobite exoskeletons associated with brachiopods including supporting spines. The new atheloptic association of Mississippian trilobites is described for the first time from the Moravian Karst.

Key words: Moravian Karst, village of Březina, Czech Republic, Trilobites, Mississippian

Introduction

Trilobites have been known from around the village of Březina village in the Moravian Karst since 1956 with the first descriptions given by Chlupáč (1956). During the last few years new fossiliferous sites in the Moravian Karst were discovered. Recent revision of High-resolution biostratigraphy of the Tournaisian–Visean (Mississippian) boundary interval in the Molčá quarry by Kalvoda et al. (2009) has shown the stratigraphic importance of this fauna. Rak (2012) revised the trilobite association from the quarry for the first time and Weiner et al. (2012) published a preliminary report on a trilobite occurrence from the Říčka Valley. New discoveries of trilobites from the village of Březina have enriched our knowledge of their stratigraphic importance. Owens & Tilsley (1995) studied a trilobite association from the Carboniferous of North Devon and based on the occurrence of blind trilobites and/or ones with reduced eyes they recognized it as an atheloptic assemblage. We state similar conditions in the case of the Březina Formation in Moravia. All the published material has been deposited at Czech Geological Survey in Prague.

Geological settings

The shales forming the typical lithotype of the Březina Formation are of various colours, mostly from greenish grey to greyish olive green, from red-brown to violet-brown, always containing silt. The shales show diverse mineral and chemical composition especially in carbonates (CaO=0.53 to 0.98 wt. %). The Březina Formation shales, with the described trilobite and other fauna, were deposited during an important turning point in the development of the basin. This unit represents the transition from the Lower Carboniferous calciturbiditic sedimentation in the Moravian Karst (Lišen Formation) to the Upper Visean siliciclastic turbidite flysch facies (Culm facies of the Rozštáni Formation).

The Březina Formation sediments reflect an important stage in the tectonic development of the basin. The Březina shales are underlain by pre-orogenic carbonate successions (Moravian Karst Platform) deposited during the extensional phase of the basin’s evolution (e.g. Hladil 1983; Franke 1989). The change from the extensional to compressional phase of basin evolution took place during the deposition of the Březina Formation and coeval facies of the Lišen Formation, namely during the lower and middle Visean. The overlying synorogenic successions are composed of siliciclastic turbidities of the so called “Drahany Culm facies” (Kumpera et al. 1995). The shallower parts of the basin were filled with calcarenites and calcirudites (Lišen Formation). Relatively deeper parts had pelitic, often fossiliferous deposition (Březina Formation), or southerly from the investigated area with initial phases of turbiditic rhythmites (Podolí Formation sensu Otava & Gilíková 2011 and Buriánek et al. 2013). The maximum thickness of the formation is estimated in the lower tens of meters, but usually it is lower, for example in the borehole Křtiny HV105 the total thickness of subhorizontal Březina shales is 8.6 m, while in the Březina 5 borehole near Březina village it is 7.5 m (Otava et al. 2013). Interfingering with the coeval limestone breccia with phosphorites was locally observed and described (Otava et al. 2013). The geological differences between the three trilobite bearing outcrops and their general trilobite occurrences are described below. The change from an extensional to a compressional phase of basin evolution occurred during the deposition of the Březina Formation and coeval facies of the Lišen Formation, namely during the lower and middle Visean. The giant Givetian–Frasnian organic buildups on the Laurussian shelf during the three composed megacycles (sensu Hladil 1983) gave rise to the almost 1000 m thick carbonate sequence of the Moravian Karst. The carbonate shale deposition as well as development were limited drastically, restricted to the middle of the Frasian and Famennian (the Kellwasser event) (Otava et al. 2013). The Březina Formation shales sometimes contain a
mixture of volcanic material and are intercalated by volcanioclastic deposits (Buriánek et al. 2013).

**History of trilobite research from the Březina Formation**

The Trilobite fauna described from the Březina Formation shales in Moravia was published by Hahn & Hahn (1969) from just a few localities, from Březina (type locality in vicinity of the Březina village), Zbrašov locality, Čelechovice locality, Říčka Valley and from the active quarry at Mokrá near Brno (Rak et al. 2012). Chlupáč (1966) also noted one occurrence of trilobites in a borehole, about 100 m north of the swimming pool in the Říčka Valley at a depth of 51–64 m. Shales of the Březina Formation yielded the following six trilobite taxa described by Chlupáč (1966):

- Spinibole (Spinibole) olgae Chlupáč, 1966
- Drevermannia (Drevermannia) moravica Chlupáč, 1956
- Liobole glabra proxima Chlupáč, 1966
- Cyrtosymbole (Macrobole) aff. blax Richter & Richter, 1951
- Phillibole sp.
- Carbonocoryphe sp.

The trilobite association described by Chlupáč (1956) from the Zbrašov locality and from the Říčka Valley belongs to the upper part of the *Pericyclus* Stage cu II (=Lower Visean). Chlupáč (1966) noted the occurrence of trilobites from test pits in the surroundings of the Mokrá quarry. These specimens derived from carbonate facies of the Hády-Říčka Limestones. The trilobite association discovered in shales of the Březina Formation from the active quarry at Mokrá near Brno was recently revised by Rak et al. (2012).

**The trilobite fauna from the village of Březina and comparison with other areas**

About 714 trilobite fragments have recently been collected during excavations in the surroundings of the village of Březina; all of them come from shales of the Březina Formation.

**Březina 1 (Chlupáč’s type locality)**

Chlupáč (1966) described trilobite occurrences from the lower parts of the Březina shales, greenish and brown-redish siltstones, from several pits in fields ca. 400 m east from a crossroads about 250 m southwest from the point 451.5. The typical trilobite association *Spinibole (Spinibole)–Archegonus (Phillibole)* is present. Based on Chlupáč’s investigation the established fauna could belong to the *Pericyclus* cu II. The most common taxon is *Spinibole (Spinibole) olgae*. Chlupáč (1966) reported more than 100 cranidia, about 50 librigenae and 80 pygidia.

**Březina 2 locality**

During geological mapping of the forested area in the vicinity of the village of Březina, a new fossiliferous site was discovered by the junior author. This site is located ca. 200 m west from the village, 80 m from the field on the southern border of Březina village in a forested area (Fig. 1). The unexpected presence of many articulated specimens and undisturbed moul arrangements can be interpreted as evidence of quiet sea bed conditions. No articulated exoskeleton had been found during the earlier research. All the material is strongly dorsoventrally flattened and laterally deformed. It is preserved as internal moulds, most of them with external counterparts. This outcrop yielded three hundred and twenty nine trilobite fragments.

**Březina 3 locality**

This trilobite locality was discovered during mapping of the large forested area northwest of the village of Březina by the junior author.

![Fig. 1. A — Schematic map of the Bohemian Massif showing the Czech Republic, B — Detailed sketch map of the Brno region with new fossiliferous localities, C — The exact position of Chlupáč’s original locality (1) and the newly discovered sites near the village of Březina (2, 3).](image-url)
Based on occurring trilobite taxa we establish a new trilobite Association Archegonus (Phillibole)–Chlupacula (Chides). Three hundred and fifty trilobite fragments have been found during excavations at the Březina 3 locality.

The type of fossilization of the new trilobite association is fully comparable to the material from a few localities in Germany: Ettingen Räthen in Sauerland–Immental and Honmberg bei Erbach (Hessen). Owens & Tilsley (1995) studied an atheloptic trilobite assemblage from North Devon. Seven genera have been described in the Tawstock and Kersdown Chert Formation: Wagnerispinia, Spatulina, Tawstockia, Aprathia, Liobile, Archegonus (Phillibole) and Lichanocoryphe. Our newly described trilobite association constitutes a typical atheloptic assemblage such as that described by Fortey & Owens (1987, p. 105). All the trilobites derived from the newly discovered site near Březina village were photographed and undeformed by the Corell Draw programme and compared to the type material.

The specimens studied are deposited in the Czech Geological Survey in Prague, collection of Ivo Chlupáč (ICH) and new material, collection of Štěpán Rak (SR).

Systematic paleontology

Phylum: Arthropoda
Family: Pholidocidae Oehlert, 1886
Subfamily: Cystipsininae Hahn & Hahn, 1982
Genus: Spinibole Chlupáč, 1966
Subgenus: Spinibole (Spinibole) Chlupáč, 1966
Type species: Spinibole (Spinibole) olgae Chlupáč, 1966

Spinibole (Spinibole) olgae Chlupáč, 1966
Fig. 2H

1966 Spinibole olgae — Chlupáč, pl. 13, figs. 1–17, text-fig. 20
1995 Spinibole olgae — Owens & Tilsley, fig. 3o–u

Holotype: The cranidium figured by Chlupáč (1966): Pl. 13, fig. 15, text-fig. 20, deposited in the Czech Geological Survey Prague (ICH 1990).

Type locality and horizon: Field on a ridge south of the village of Březina, the Moravian Karst, Czech Republic, lower Viséan (cu IIγ), Březina Formation.

Chlupáč’s original material: More than 100 cranidia, about 53 cheeks, 80 pygidia, numerous thoracic segments.

New material: 2 articulated exoskeletons, 4 exuviae, 22 cranidia, 12 librigenae, 20 cephala, 59 pygidia.


Discussion

In comparison with Spinibole (S.) ruethenensis Hahn & Hahn, 1969, the cephalon is more semieliptic. In S. (S.) ruethenensis the genal spines are directed nearly backwards whereas in S. (S.) olgae they are curved a little bit postero-laterally and their base is marked by a distinct concave lace. As far as can be judged from the rather poorly preserved materials, S. (S.) sugambra Brauckmann, 1974 seems to be more close to S. (S.) olgae.

Spinibole (Spinibole) cf. ruethenensis Hahn & Hahn, 1969
Fig. 2A,C,E,F

New material: 1 articulated exoskeleton, 2 exuvia, 19 cranidia, 10 pygidia.

Subfamily: Archegoniinae G. Hahn & Brauckmann, 1980
Genus: Archegonus Burmeister, 1843
Subgenus: Archegonus (Phillibole) Richter & Richter, 1937
Type species: Phillibole aprathensis Richter & Richter, 1937

Remarks: This taxon is recognized for the first time from the Czech Republic. Hahn & Hahn (1969) described it from cu IIβ, Sauerland, Harz (Germany). All the newly found material shows morphological affinities with the type species.

Archegonus (Phillibole) aff. nehdennensis Hahn & Hahn, 1969
Fig. 3A,C,F,G,H

Holotype: Articulated complete exoskeleton SMF 22917, Hahn & Hahn 1969, Taf. 1, Fig. 1.

Type locality and horizon: Immental near Nehden, Raum Brilon, Sauerland, cu II/cu III, probably cu IIβ, Kieselkalk, Germany.

New material: 10 complete exoskeletons, 8 exuviae, 86 cranidia, 4 cephala, 5 librigenae, 85 pygidia.


Remarks: Chlupáč (1966) figured two incomplete pygidia of phillilobid trilobite and classified them as “Phillibole?” sp. Chlupáč (1966) just noticed the character of the rachial segmentation and especially of the lobes, which were very similar to Archegonus (Phillibole) aprathensis Richter & Richter, 1937. However this species has a shorter pygidium, a narrower doublure and a broader axis. Chlupáč (1966) compared it with related Archegonus (Phillibole) aequalis aequalis (Meyer, 1831), but it has a different number of ribs on lobes. Because of the restricted material contained in Chlupáč’s collection, its incompleteness and unfavourable preservation, its taxonomic position is still doubtful.

Archegonus (Phillibole) aff. habena Owens & Tilsley, 1995
Fig. 3B

Holotype: Cranidium NMW 88.66G.34ab, paratypes NMW 88.66G.28–33, 88.66G.35–44, cranidia, librigenae and pygidia.

Type locality and horizon: Park Gate Quarry, Tawstock, Park Gate Member (Chadian), North Devon, Codden Hill Chert Group.

New material: 3 complete exoskeletons, 3 exuvia, 2 cephala, 99 cranidia, 5 librigenae, 114 pygidia.


Remarks: The frequent occurrences of two Archegonus (Phillibole) taxa from two newly recognized Březina sites enrich our knowledge of Mississippian trilobites from the
Fig. 2. A, C, E, I — Spinibole *Spinibole* cf. *ruethenensis* Hahn & Hahn, 1969: A — cranidium, Březina 2 locality (SR20); C — incomplete exuvia, Březina 2 locality (SR17); E — incomplete cephalon, Březina 2 locality (SR18); I — pygidium, Březina 2 locality (SR19). B, F — *Chlupacula* (*Chilides*) *moravica* (Chlupáč, 1956): B — complete exoskeleton with hypostome *in situ*, Březina 3 locality (SR22); F — complete cephalon, Březina 3 locality (SR21). D, G — *Carbonocoryphe* (*Carbonocoryphe*) aff. *bindemanni* Richter & Richter, 1950: D — pygidium, Březina 3 locality (SR24); G — incomplete cranidium, Březina 2 locality (SR23). H — *Spinibole* *Spinibole* *olgae* Chlupáč, 1966: H — complete exoskeleton, Březina 2 locality (SR1). All scale bars 5 mm.
Fig. 3. A, C, F, G, H — Archegonus (Philibole) aff. nehdensis Hahn & Hahn, 1969: A — nearly complete exoskeleton, Březina 3 (SR26); C — nearly complete exoskeleton, Březina 2 locality (SR28); F — nearly complete exoskeleton, Březina 2 locality (SR33); G — nearly complete exoskeleton, Březina 2 locality (SR30); H — nearly complete exoskeleton, Březina 2 locality (SR29). B — Archegonus (Philibole) aff. habena Owens & Tilsley, 1995. Two nearly complete specimens, Březina 2 locality (SR27). D, I — Liobole (Liobole) glabra proxima Chlupáč, 1966: D — incomplete cranidium, Březina 2 locality (SR31); I — pygidium, Březina 3 locality (SR32). E — Archegonus (Philibole) sp. — juvenile specimen of a nearly complete exoskeleton, Březina 3 locality (SR34). All scale bars 5 mm.
Genus: *Liobole* Richter & Richter, 1949
Subgenus: *Liobole* (Liobole) Richter & Richter, 1949
Type species: *Phillipsia glabra* Holzapfel, 1889

*Liobole* (Liobole) *glabra proxima* Chlupáč, 1966

![Fig. 3D](image)

1966 *Liobole glabra proxima* — Chlupáč, 62, 66–67, pl. 16, figs. 1–7, pl. 17, fig. 9, text-fig. 18
1967 *Liobole glabra proxima* — Hahn & Hahn, 279, 281
1969 *Liobole glabra cf. proxima* — Chlupáč, 214, pl. 4, figs. 1–2
1977 *Liobole glabra proxima* — Gandl, 169, 170, 179

**Holotype:** Cranidium ICh 2120, deposited in the Czech Geological Survey.

**Type locality and horizon:** Village of Březina, Moravia, Czech Republic, Visean (=Erdbachian) cu IIβ, Březina Formation.

**Chlupáč’s original material:** 5 cranidia of adult specimens, 7 cranidia of young specimens, 2 librigenae, 1 thoracic segment and 8 pygidia.

**New material:** 12 cranidia, 2 cephalas, 1 librigena, 14 pygidia.

**Remarks:** Chlupáč (1969) published and figured (pl. 16, figs. 1–7, pl. 17, fig. 18) cranidia of various ontogenetic stages and one pygidium from the Březina locality. All new material fully agree with his previous description and enrich knowledge of pygidial shape, its segmentation as well as its convexity.

Genus: *Chlupacula* Hahn & Hahn & Brauckmann, 1994
Subgenus: *Chlupacula* (*Chiides*) Hahn & Hahn, 2002
Type species: *Silesiops* (*Chlupacula*) kymo Hahn & Wunn-Petry, 1983

*Chlupacula* (*Chiides*) *moravica* (Chlupáč, 1956)

![Fig. 2F](image)

1956 *Drevermannia* (*Drevermannia*) *moravica* — Chlupáč, 268–273, pl. 1, figs. 1–3
2002 *Chlupacula* (*Chiides*) *moravica* — Hahn & Hahn, 45–47, Abb. 32–33

**Holotype:** Cranidium ICh 58.

**Type locality and horizon:** Hranice near Zbrašov locality, Czech Republic, Visean (=Erdbachium) cu Iγ–α, Březina Formation.

**Chlupáč’s original material:** 16 cranidia, 4 librigenae, 16 pygidia.

**New material:** 1 complete specimen, 75 cranidia, 123 pygidia.

**Diagnosis:** See Chlupáč (1966, p. 82–83).

**Description:** The complete articulated exoskeleton SR 22 is 5 mm in sagittal length. The trilobite with clearly visible preserved natant type of hypostome “*in situ*”. Both genal spines as well as palpebral lobes are preserved, rhachis is torn off and left in the external mould.

**Remarks:** This smallest trilobite taxon from the Březina Formation was very abundant in both new Březina sites. The very first articulated carapace of this taxon (SR 22) is known from the Březina 3 site. Its carapace shape, outline and segmentation of pygidium fully agree with Chlupáč’s previously described taxon.

**Subfamily: Weaninae** Owens, 1983
Genus: *Carbonocoryphe* Richter & Richter, 1950
Subgenus: *Carbonocoryphe* (*Carbonocoryphe*) Richter & Richter, 1950
Type species: *Carbonocoryphe bindemanni* Richter & Richter, 1950

*Carbonocoryphe* (*Carbonocoryphe*) *aff. bindemanni* Richter & Richter, 1950

![Fig. 2D](image)

1950 *Carbonocoryphe* *aff. bindemanni* sp. nov. — Richter & Richter, 278–280, pl. 1 fig. 1–7
1975 *Carbonocoryphe* *aff. bindemanni* — Hahn & Brauckmann, 329, fig. 20a–b

**Holotype:** Cranidium SMF X 1333a (Richter & Richter, 1950, pl. 1, fig. 1a–b).

**Type locality and horizon:** Herborn, Hessen, Germany (cu IIb3), Upper Erdbachian.

**Chlupáč’s original material:** 3 cranidia, 1 pygidium.

**New material:** 4 cranidia, 10 pygidia.

**Diagnosis:** See Richter & Richter (1950, p. 57).

**Remarks:** Chlupáč (1966) discovered three cranidia and an internal mould of a pygidium and figured (pl. 9, figs. 11, 12) one cranidium and one incomplete pygidium. There are similarities of outline and of clearly markedly segmented axis. Pleurae taper rapidly backwards, passing at the back into a narrow but pronounced postaxial ridge, which dies out at a notable distance from the posterior border. Sculpture is not preserved on any of them. The shape of glabella and the course of facial suture also agree with *Carbonocoryphe* (*Carbonocoryphe*) *bindemanni* Richter & Richter, 1950. However because of incompleteness the new find needs the systematic classification.

**Conclusion**

The trilobite associations from the village of Březina previously described by Chlupáč (1966) were only fragmentary and their exact taxonomic position is doubtful.

The trilobite associations from the newly discovered sites are stratigraphically older than the trilobites from the Mokrá quarry (Rak et al. 2012). The trilobites from around the village of Březina are described as a typical atheloptic association, adapted for deep water, benthonic conditions and they match closely the North Devon assemblage (see Owens & Tilsley 1995).

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