

Revision 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 Mokrá 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 (Líšeň Formation) to the Upper Visean siliciclastic turbidite flysch facies (Culm facies of the Rozstání 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 Líšeň Formation, namely during the lower and middle Visean. The overlying synorogenic successions are composed of siliciclastic turbidites of the so called "Drahany Culm facies" (Kumpera et al. 1995). The shallower parts of the basin were filled with calcarenites and calcirudites (Líšeň 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 Líšeň 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 Frasnian and Famennian (the Kellwasser event) (Otava et al. 2013). The Březina Formation shales sometimes contain a

mixture of volcanic material and are intercalated by volcanoclastic 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 (Macrobale) 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 Viséan). 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-red-dish 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 moult 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.

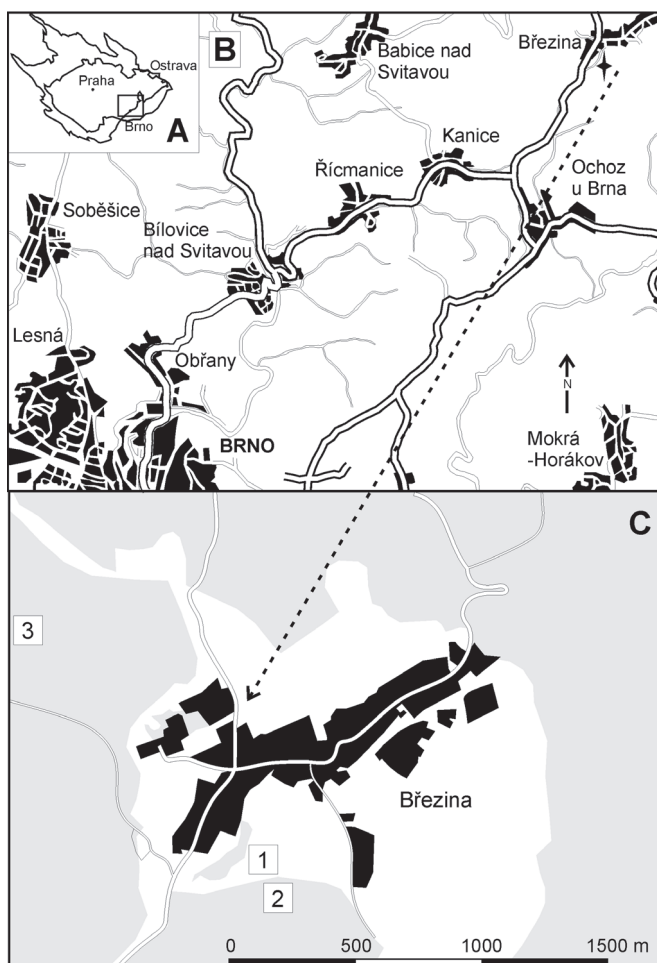


Fig. 1. A — Schematic map of the Bohemian Massif showing the Czech Republic, B — Detailed sketch map of the Brno region with new fossiliferous localities, C — The exact position of Chlupáč's original locality (1) and the newly discovered sites near the village of Březina (2, 3).

Based on occurring trilobite taxa we establish a new trilobite Association *Archegonus* (*Phillibole*)–*Chlupacula* (*Chilides*). 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 Rütten in Sauerland–Immental and Homberg bei Erdbach (Hessen). Owens & Tilsley (1995) studied an atheloptic trilobite assemblage from North Devon. Seven genera have been described in the Tawstock and Kersdown Chert Formation: *Wagnerispina*, *Spatulina*, *Tawstockia*, *Aprathia*, *Liobole*, *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: **Phillipsiidae** Oehlert, 1886

Subfamily: **Cystispininae** 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 2009).

Type locality and horizon: Field on a ridge south of the village of Březina, the Moravian Karst, Czech Republic, lower Viséan (cu II γ), 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 cephalae, 59 pygidia.

Diagnosis: See Chlupáč (1966, p. 69–74).

Discussion

In comparison with *Spinibole* (*S.*) *ruethenensis* Hahn & Hahn, 1969, the cephalon is more semielliptic. In *S.* (*S.*) *ruethenensis* the genal spines are directed nearly backwards whereas in *S.* (*S.*) *olgae* they are curved a little bit posterolaterally 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,EI

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 II δ , Sauerland, Harz (Germany). All the newly found material shows morphological affinities with the type species.

Archegonus (*Phillibole*) aff. *nehdenensis* 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 II δ , Kieselkalke, Germany.

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

Diagnosis: See Hahn & Hahn (1969: p. 277), Brauckmann (1973, p. 47).

Remarks: Chlupáč (1966) figured two incomplete pygidia of phillibolid trilobite and classified them as “*Phillibole?*” sp. Chlupáč (1966) just noticed the character of the rhachial 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* (*Archegonus*) *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.34a,b; paratypes NMW 88.66G. 28–33, 88.66.G. 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 cephalae, 99 cranidia, 5 librigenae, 114 pygidia.

Diagnosis: See Owens & Tilsley (1995, p. 718–720).

Remarks: The frequent occurrences of two *Archegonus* (*Phillibole*) taxa from two newly recognized Březina sites enrich our knowledge of Mississippian trilobites from the

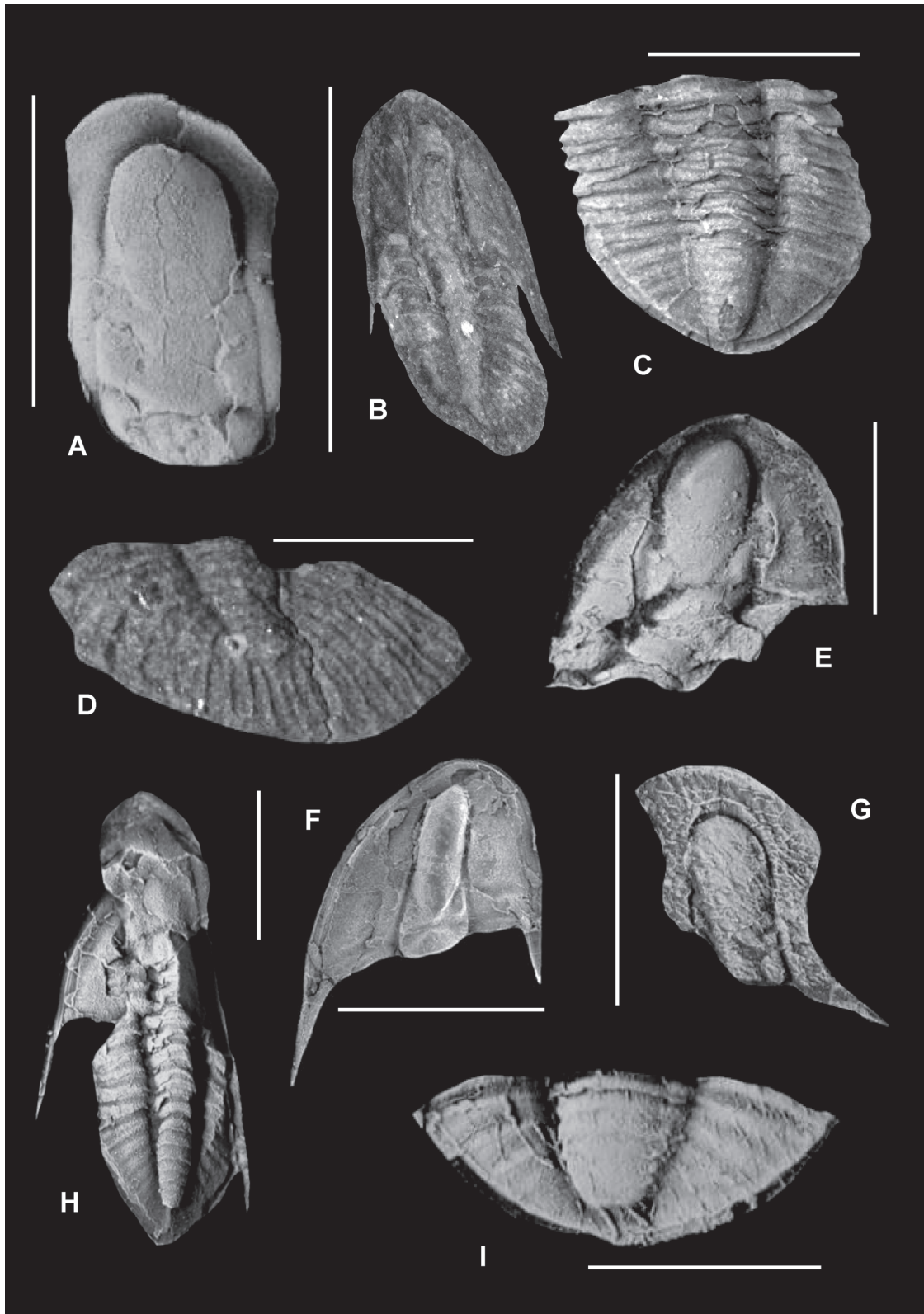


Fig. 2. A, C, E, I — *Spinibole (Spinibole) cf. ruethenensis* Hahn & Hahn, 1969: A — cranidium, Březina 2 locality (SR20); C — incomplete exuvia, Březina 2 locality (SR17); E — incomplete cephalon, Březina 2 locality (SR18); I — pygidium, Březina 2 locality (SR19). B, F — *Chlupacula (Chiides) moravica* (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.

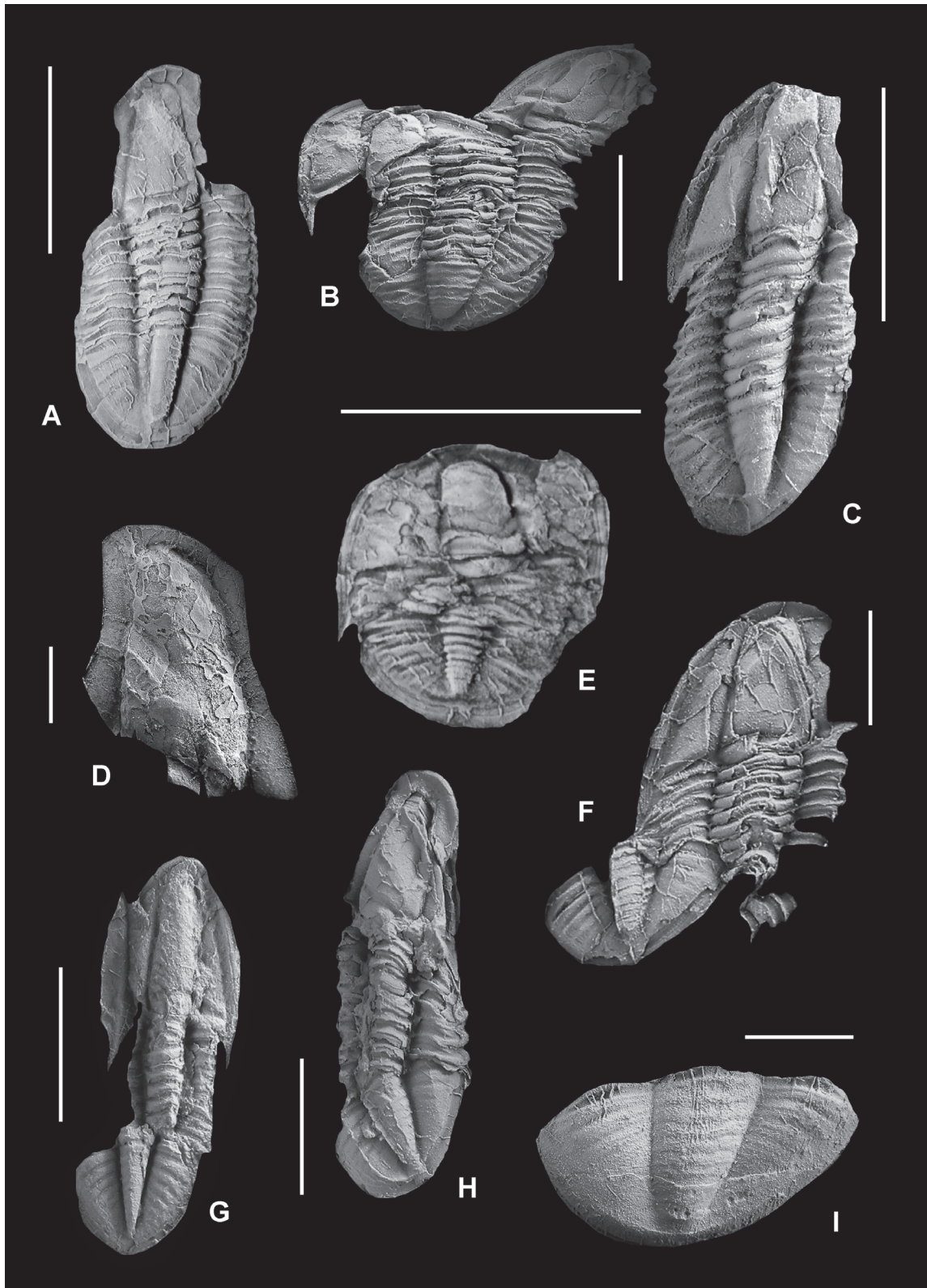


Fig. 3. A, C, F, G, H — *Archegonus (Phillibole)* aff. *nehdenensis* Hahn & Hahn, 1969: A — nearly complete exoskeleton, Březina 3 (SR26); C — nearly complete exoskeleton, Březina 2 locality (SR28); F — nearly complete exoskeleton, Březina 2 locality (SR33); G — nearly complete exoskeleton, Březina 2 locality (SR30); H — nearly complete exoskeleton, Březina 2 locality (SR29). B — *Archegonus (Phillibole)* 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 (Phillibole)* sp. — juvenile specimen of a nearly complete exoskeleton, Březina 3 locality (SR34). All scale bars 5 mm.

Czech Republic and show us similarities with the North Devon Chadian assemblage.

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,I

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, lower Viséan (cu II γ), Březina Formation.

Chlupáč's original material: 5 cranidia of adult specimens, 7 cranidia of young specimens, 1 librigena, 3 thoracic segments and 8 pygidia.

New material: 12 cranidia, 2 cephalae, 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. 2B,F

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, Viséan (=Erdbachium) cu II γ – δ , 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,G

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 III α 3), Upper Erdbachian.

Chlupáč's original material: 3 cranidia, 1 pygidium.

New material: 4 cranidium, 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 Mokrý 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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