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Ammonites (Phylloceratina, Lytoceratina and Ancyloceratina) and organic-walled dinoflagellate cysts from the Late Barremian in Boljetin, eastern Serbia

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ABSTRACT

Late Barremian ammonite fauna from the epipelagic marlstone and marly limestone interbeds of Boljetin Hill (Boljetinsko Brdo) of Danubic Unit (eastern Serbia) is described. The ammonite fauna includes representatives of three suborders (Phylloceratina, Lytoceratina and Ancyloceratina), specifically *Hypophylloceras danubiense* n. sp., *Lepeniceras lepense* Rabrenović, *Holcophylloceras avrami* n. sp., *Phyllopachyceras baborense* (Coquand), *Phyllopachyceras petkovici* n. sp., *Phyllopachyceras eichwaldi eichwaldi* (Karakash), *Phyllopachyceras ectocostatum* Drushchits, *Protetragonites crebrisulcatus* (Uhlig), *Macroscaphites perforatus* Avram, *Acantholytoceras* cf. *subcirculare* (Avram), *Dissimilites* cf. *trinodosus* (d'Orbigny) and *Argvethites*? sp. The taxonomic composition and percent abundance of the identified ammonites indicate that their taxa are predominantly confined to the Tethyan realm. Ammonites with smooth and slightly sculptured shells predominate among the studied fauna. The ammonite-bearing succession from Boljetin represents the lower part of the Upper Barremian, ranging in ammonite zonation from the *Toxancyloceras vandenheckei* Zone to the lower part of the *Imerites giraudi* Zone. The associated organic-walled dinoflagellate cysts confirm the Late Barremian age of the ammonite-bearing levels.

1. Introduction

Most of the ammonite specimens under study were collected in the 1980s by Dragoman Rabrenović in a geological section formed in association with the construction of a road near the municipality of Boljetin. During a new joint visit to the Boljetin section in August 2010, additional ammonites were collected, and samples from the pelitic marlstone layers were taken to study the organic-walled dinoflagellate cysts. The ammonites were discussed in two studies. The first study (Vašíček et al., 2013) addresses the ammonites of the suborder Ammonitina. The second study, described in this report, addresses the remaining ammonite suborders.

The aims of this report are threefold: 1) a detailed taxonomic study of the new ammonite collection, 2) the stratigraphic assignment of the section in terms of the current ammonite zonation of the Barremian Stage and 3) a comparison with ammonite faunas of similar age abroad. This work presents the first analysis of organic-walled dinoflagellates in the investigated area and interval, allowing biostratigraphic and palaeoecological conclusions based on the ammonites.

Rabrenović (1991) was mostly concerned with stratigraphic processing and the evaluation of the collection of ammonites from the Boljetin locality. The taxonomic study of the ammonites was performed by Zdeněk Vašíček in Ostrava, where samples were processed for organic-walled dinoflagellates and studied by Petr Skupien. This contribution was prepared based on a co-operative study by the Department of Palaeontology and Department of Historical and Dynamic Geology, Faculty of Mining and Geology, University of Belgrade and the Institute of Geonics, Academy of Sciences of the Czech Republic in Ostrava within the framework of Serbian Project No. 176015, "Geodiversity, lithostratigraphy and geological evolution of the central Balkan peninsula basin and adjacent regions".

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2. Geological setting

The fossils described herein were obtained from an exposure in a new road-cut on the Boljetin Hill, 12 km northwest of the town of Donji Milanovac, near the right bank of the Danube River (see Fig. 1 for location of the Boljetin Hill; GPS coordinates: 44°31′51.2″N latitude; 22°02′24.3″E longitude). Detailed information on the location of the ammonites at Boljetin was given in Vašíček et al. (2013).

The outcrop containing the ammonites belongs to the morphotectonic Poreč-Stara Planina Unit (Tchoumatchenco et al., 2011), a part of the tectono-stratigraphic Danubic Unit of the Carpatho-Balkanides, also known as the Milanovac-Novo Korito structural-facies zone, within the Balkan autochthon (Andjelković and Nikolić, 1974, 1980).

In the Danubic Unit, the Mesozoic Era is represented by a succession of Jurassic and Lower Cretaceous deposits that lie discordantly on the Pre-Cambrian and Palaeozoic deposits. The Jurassic and Lower-Cretaceous deposits were subdivided into three formations: Pesača Formation (siliciclastics and limestone), Boljetin Formation (limestone) and Donji Milanovac Formation (limestone and marlstone; Vasić et al., 1998). The first formation, corresponding to the Lias and Lower Dogger, formed in a transitional shallow-water marine environment and is associated with the Lias transgression. The second formation, part of the Middle and Upper Dogger and the Malm, originated in a deep-water marine environment and is connected to the eastern margin of the Danube trough, between the Gethicum and Moesia (the marginal part of the European craton), i.e., to a narrow, deep basin with submarine swells where sedimentation of condensed deposits took place. The third unit, the Donji Milanovac Formation, represents the Lower Cretaceous and has two components: deep-water limestone and marly limestone with black cherts from the Berriasian–Early Hauterivian age and marl and marly limestone without cherts from the Late Hauterivian–Albian in age. These latter strata were deposited in a deep-water (pelagic) environment under reducing conditions on the sea bottom. Gradual shallowing in the Aptian and Albian is documented for these strata (Vasić et al., 1998).

The 34 m thick Upper Barremian sediments from which the ammonites described herein were collected consist mainly of grey calcareous marlstone intercalated with thinner, harder layers of light grey marly limestone. In addition to the ammonites, the fauna include rare fragments of belemnites, bivalves and several predominantly calcified radiolarians in the upper layers of the succession. There is a total absence of clastic components in the studied strata. These deposits have the greatest distribution and are much richer and diverse in ammonite fauna compared with the other Lower Cretaceous sediments in the study area.

3. Material and methods

Geological documentation of the exposed section was performed by staff of the University of Belgrade. After the section was documented, macrofauna were collected bed-by-bed. In 2010,

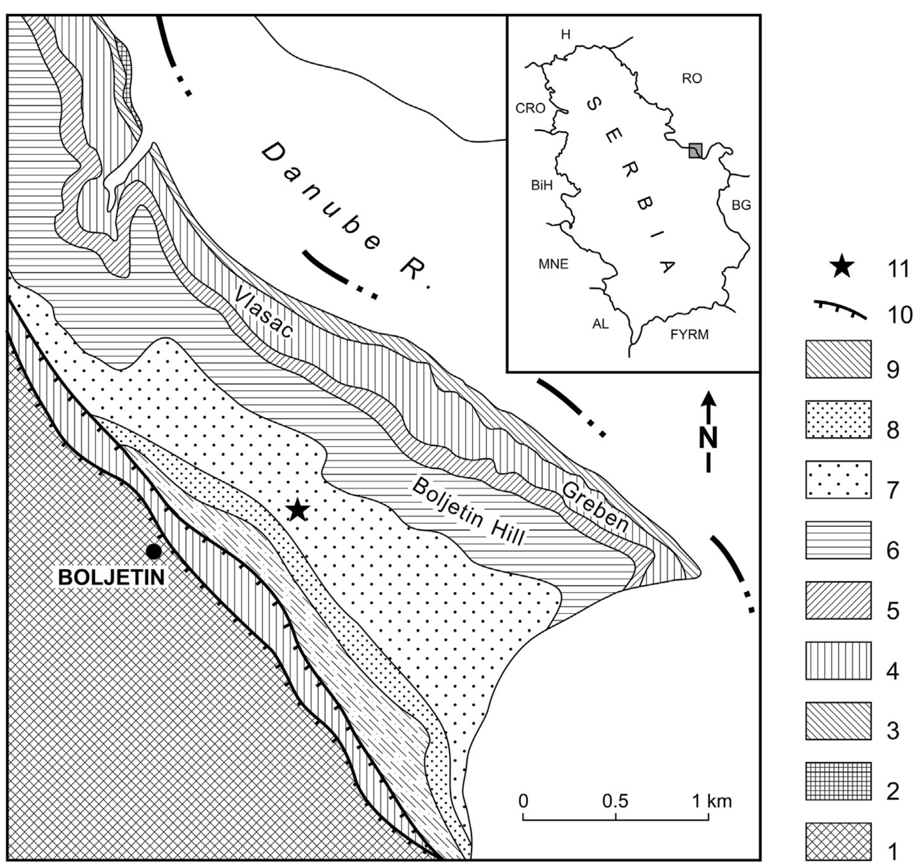

Fig. 1. Geological map of the Boljetin area and location (star) of the Boljetin Hill section, eastern Serbia. 1, Rifeo-Cambrian; 2, Permian red sandstones; 3, Middle Jurassic: red ferruginous limestones ("Klaus beds"); 4, Late Jurassic: Oxfordian micritic limestones with cherts, Kimmeridgian red nodular limestones Ammonitico Rosso, and Tithonian micritic limestones; 5, Berriassian–Valanginian thin bedded micritic limestones with cherts; 6, Hauterivian marly limestones with cherts and marlstones; 7, Barremian marlstones and marly limestones with described ammonites; 8, Aptian marlstones and marly sandstones; 9, Albian marlstones and sandy marlstones. 10, overthrust. 11, studied ammonite site (GPS coordinates: 44°31′51.2″N; 22°02′24.3″E).

samples for organic-walled dinoflagellates were collected from the pelitic marlstone layers.

Ammonites are found in two basic sediment types: relatively soft marly sediments and platy, clayey limestone. The marly deposits mainly contain non-deformed small limonitic moulds of initial whorls. As evidenced by the preserved suture lines, they are always phragmocones. Occasionally, pyritised original shells are still preserved.

In diagenetically consolidated deposits, ammonite living chambers are also preserved, occasionally with limonitic inner whorls. During diagenesis, they were compressed and crushed. Sculpture moulds of bivalves and shells of brachiopods co-occur with ammonites.

The ammonites described herein are housed in the second author's collection at the Department of Palaeontology, the Faculty of Mining and Geology, the University of Belgrade (abbreviated RGF DR).

All specimens in Figs. 2 and 5 were coated with ammonium chloride before they were photographed.

The dimensions of the ammonite shells are given in millimetres. The following abbreviations are used: *D* – shell diameter; *H* – whorl height; *U* – diameter of umbilicus; and *B* – thickness of whorl. The measured values are followed by the ratios of the parameters to the shell diameter (*H*/*D*, *U*/*D* and *B*/*D*) in parentheses and the ratio *B*/*H*.

The basic elements of suture lines are designated herein according to Korn et al. (2003): E – external lobe, A – adventive lobe (= lateral lobe, L, in former nomenclature), U – umbilical lobe, and I – inner lobe.

In the section, 11 marlstone samples were taken to study the organic-walled dinoflagellate cysts (Fig. 7, Table 1). The samples were processed by a standard palynological technique, dissolution in HCl and HF with subsequent sieving on polyethylene sieves of mesh size 15 μm. The palynological permanent mounts are stored at the Institute of Geological Engineering at the VSB – Technical University of Ostrava, Czech Republic. For suitable samples, qualitative observation was supplemented by quantitative analysis.

The quantitative study included:

I. Palynofacies analysis of the organic matter. The relative percentage of these components is based on counting at least 500 particles per slide. The organic matter is grouped into a continental fraction including phytoclasts (opaque and translucent), pollen grains and spores, a marine fraction composed of organic-walled dinoflagellate cysts, foraminiferal linings and acritarchs, and degraded organic matter (AOM). Three palynofacies parameters were observed (Götz et al., 2008): the ratio of continental to marine particles; the size and shape of the opaque plant debris; and an AOM-Phytoclast-Palynomorph ternary plot (Fig. 10) after Tyson (1989, 1993).
II. Counting of the whole assemblage of up to 150 palynomorphs (Skupien and Smaržová, 2011; Fig. 9); this step included the recognition of five broad palynomorph categories: organic-walled dinoflagellate cysts, foraminiferal linings (inner walls of foraminifers), acritarchs, bisaccate pollen, and other pollen and spores (sporomorphs, excluding bisaccates).
III. Counting of the determinable organic-walled dinoflagellate cysts.

4. Taxonomy of ammonites

We comply, in principle, with the system of Wright et al. (1996), with modification of the endings of the subclass and order categories as proposed by Fischer et al. (2006). The classification of well-preserved material of Phylloceratina and Lytoceratina was relatively easy, in contrast to the classification of the heteromorphic ammonites preserved as fragments.

Subclass: Ammonoida Zittel, 1884
Order: Ammonitida Zittel, 1884
Suborder: Phylloceratina Arkell, 1950
Superfamily: Phylloceratoidea Zittel, 1884
Family: Phylloceratidae Zittel, 1884
Subfamily: Phylloceratinae Zittel, 1884

There are two trends in the classification of Phylloceratidae. The first is based on the classification by Wiedmann (1964), which was subsequently modified by western European authors (e.g., Joly, 2000; Klein et al., 2009). Wiedmann (1964) regarded Phylloceratidae as a conservative stock of ammonites that allowed only minimal generic division.

The other view on the classification of Phylloceratidae was that of Murphy and Rodda (2006) based on a study of Californian phylloceratids. They did not consider the division of phylloceratids into subgenera to be useful and raised the former subgenera to the generic level (Murphy and Rodda, 2006). This latter approach is followed in the present study.

Genus *Hypophylloceras* Salfeld, 1924

Type species. *Phylloceras onoensis* Stanton, 1896, p. 74, by monotypy.

Hypophylloceras danubiense n. sp.
Fig. 2A, B

1991 *Euphylloceras ponticuli* (Rousseau); Rabrenović, p. 191, pl. 2, figs 3a, b, 4a, b.
1995 *Holcophylloceras ponticuli* (Rousseau) n. ssp.; Avram, pl. 10, figs 5a, b, 6a, b, 7.

Derivation of name. From the occurrence of studied ammonite along the banks of the Danube River.

Holotype. Specimen RGF DR 6/14 illustrated in Fig. 2A, B.

Paratypes. Two well-preserved specimens (phragmocones) with a limonitised original shell, partially visible suture lines (RGF DR 3/29, 4/59), and no well-preserved saddles.

Type locality. The Boljetin Hill section, eastern Serbia.

Stratigraphic horizon. The lower part of the Upper Barremian (*Gerhardtia sartousiana* Zone), Donji Milanovac Formation.

Diagnosis. Shells involute, with high, relatively narrow whorls that are oval in cross-section. On the flanks of the whorl, numerous shallow and narrow grooves are present between which dense, thin ribs are inserted on the outer half of the flanks.

Description. Shells involute, with high, slightly convex whorls and a narrow umbilicus. The point of greatest convexity of the shell is near the whorl, mid-flank. The flanks pass continuously into a rounded and relatively narrow venter. A narrow funnel-shaped zone develops around the umbilicus and ends on the bottom. The whorls are relatively narrow, with a high oval cross-section.

The flanks of the last whorl show numerous shallow, narrow grooves (furrows). Above the mid-flank, there are thin, dense ribs between the grooves. At the beginning of the terminal whorl between two grooves, 5–7 (or more) ribs are present, with five ribs or fewer farther on. The grooves gradually weaken towards the venter. The venter is covered evenly with dense, thin ribs. The grooves on the whorl flanks are S-shaped; in the lower part, they are concave towards to the aperture; at the mid-flank they are strongly convex, and on the venter (including the thin ribs) they are slightly concave. All the ribs crossing the venter are slightly convex towards the aperture. Near the apertural part of the largest specimen, the grooves are denser (i.e., more abundant) and shallower than on the preceding part of the whorl. In the holotype, there are approximately 25 grooves per whorl.

Measurements (in mm) and ratios.

Specimen No. RGF DR	*D*	*H*	*U*	*B*	*B/H*
3/29	27.4 (max.)	14.8 (0.54)	2.6 (0.09)	9.7 (0.35)	0.65
6/14, holotype (Fig. 2A, B)	34.3 (max. 36.0)	19.1 (0.56)	2.6 (0.075)	12.7 (0.37)	0.66

Remarks. The whorl cross-section and the dense, thin ribs covering the shell of *Hypophylloceras danubiense* n. sp. are reminiscent of those of *Hypophylloceras ponticuli* (Rousseau, 1842); however, the new species is characterised by the presence of grooves, which are completely absent in *H. ponticuli.*

Hypophylloceras cypris cythereae Wiedmann, 1964, from the Upper Aptian and Lower Albian, seems to be morphologically related to *H. danubiense.* The grooves on its shell are not S-shaped (see Wiedmann, 1964, pl. 12, figs 2b, 7a; pl. 15, fig. 8a), and the *B/H* ratio is close to 0.60. In the Serbian specimen, the shape of the first two saddles of the suture line is unfortunately not preserved.

The specimens bear a certain resemblance to *Phylloceras* (*Hypophylloceras*) *ponticuli plicatum* (in Delanoy and Joly, 1995), subsequently renamed *Hypophylloceras delanoyi* Joly, 2000 (in Joly and Delamette, 2008). Both juvenile and adult shells of the latter species are known. On the juvenile specimens (Joly and Delamette, 2008, fig. 16), the thin ribs characteristic of adults are not visible on the venter or in the interspaces between the ribs on the flanks; these ribs appear to be slightly plicate. Adult, large specimens originally designated as *P.* (*H.*) *ponticuli plicatum* (Delanoy and Joly, 1995) differ somewhat from the juveniles. On the outer side of the whorls, they bear dense, thin ribs, and numerous plicate ribs are also present on the flanks. As can be observed from the structure of both growth stages, the above-mentioned shells cannot belong to *H. ponticuli.* The plicate ribs led Klein et al. (2009) to classify the above-mentioned French specimens in the genus or subgenus *Summersites* Murphy and Rodda, 2006. Thus, Klein et al. (2009) designated these specimens *Phylloceras* (*Summersites*) *plicatum* Delanoy and Joly, 1995. We believe that our material is not conspecific to *Hypophylloceras ponticuli* or to *Hypophylloceras plicatum* (or *Hypophylloceras delanoyi*) and deserves recognition as a new species.

Distribution and occurrence. *H. danubiense* n. sp. occurs in the lower part of the Upper Barremian (*Gerhardtia sartousiana* Zone) in the Boljetin section, while Avram's specimens (1995) come from the Lower and Upper Barremian in Romania.

Genus *Lepeniceras* Rabrenović, 1989

Type species. Lepeniceras lepensis Rabrenović, 1989, p. 368, by monotypy.

Lepeniceras lepense Rabrenović, 1989
Fig. 2C, D

1989 *Lepeniceras lepensis* Rabrenović, p. 369, text-figs 2a–c, 3.
1991 *Lepeniceras lepensis* Rabrenović, p. 137, pl. 2, fig. 5a–c.

Holotype. Specimen RGF DR 6/13, fig. 2 in Rabrenović (1989). Upper Barremian, Donji Milanovac Formation.

Material. Two specimens (holotype RGF DR 6/13 and specimen 3/149), well preserved on one side as a limonitic sculpture mould. On the opposite side, it is preserved partly as an internal mould with partially visible fragments of suture lines.

Description. Shell compressed, involute, with a high whorl subtriangular in cross-section and a relatively narrow umbilicus. The point of the greatest convexity of the flanks is situated near the umbilicus. The slightly convex flanks incline and pass to the venter. The venter is narrow and strongly convex. Around the deep umbilicus, there is a narrow, funnel-shaped depression. The depression inclines steeply to the umbilicus and passes to an obliquely inclined umbilical wall.

On the flanks, there are numerous thin, shallow, flexuous constrictions or grooves. Near the umbilicus, they are concave towards the aperture, convex at about the mid-flank and concave again on the circumference. The grooves weaken on the venter. Across the venter, they are convex towards the aperture. Some grooves on the venter are accompanied by similar or somewhat thinner grooves, the arrangement of which is reminiscent of the groove bifurcation on the external side of the flanks. On the terminal half-whorl of the holotype, there are approximately 14 grooves. Between the grooves, there are only indistinct growth lines.

Measurements (in mm) and ratios.

Specimen No. RGF DR	*D*	*H*	*U*	*B*	*B/H*
6/13, holotype (Fig. 2C, D)	24.6 (max. 26.0)	14.0 (0.57)	2.3 (0.09)	10.1 (0.41)	0.72

Remarks. L. lepense is characterised by weakly convex flanks, a narrow venter, a subtriangular cross-section and numerous S-shaped, thin and shallow grooves. At the end of the shell, the grooves are partly bifurcated or trifurcated early near the umbilicus. These features are diagnostic for the genus *Lepeniceras* Rabrenović, 1989. The formation of saddles of the suture line in *L. lepense* is not known, precluding the safe systematic classification of this taxon.

Some specimens with similar whorl cross-sections belong to *Goretophylloceras* Collignon, 1949, especially *G. fortunei* (Honnorat-Bastide, 1892); however, the type material of the latter taxon differs from *L. lepense* in having dense striations covering the shell. An exception among the representatives of *G. fortunei* is an incomplete specimen from the Upper Aptian in Mallorca. This specimen was identified by Wiedmann as *P.* (*Hypophylloceras*) *fortunei* (1964, pl. 14, fig. 7a, b); its grooves are similar in development to those observed in the Serbian material.

Aptian specimens of *Goretophylloceras fortunei*, illustrated by Joly and Delamette (2008), differ markedly from the Serbian specimen, especially in the dense, thin ribs on the shells and the wider cross-section of the whorls.

Distribution and occurrence. Marlstone in the upper part of the Upper Barremian (*Imerites giraudi* Zone), Boljetin Hill section, Donji Milanovac Formation (Rabrenović, 1991).

Subfamily: Calliphylloceratinae Spath, 1927

Genus *Holcophylloceras* Spath, 1927

Type species. *Phylloceras mediterraneum* Neumayr, 1871, p. 340, pl. 17, figs 2a, b (original designation).

Holcophylloceras avrami n. sp.
Fig. 2E

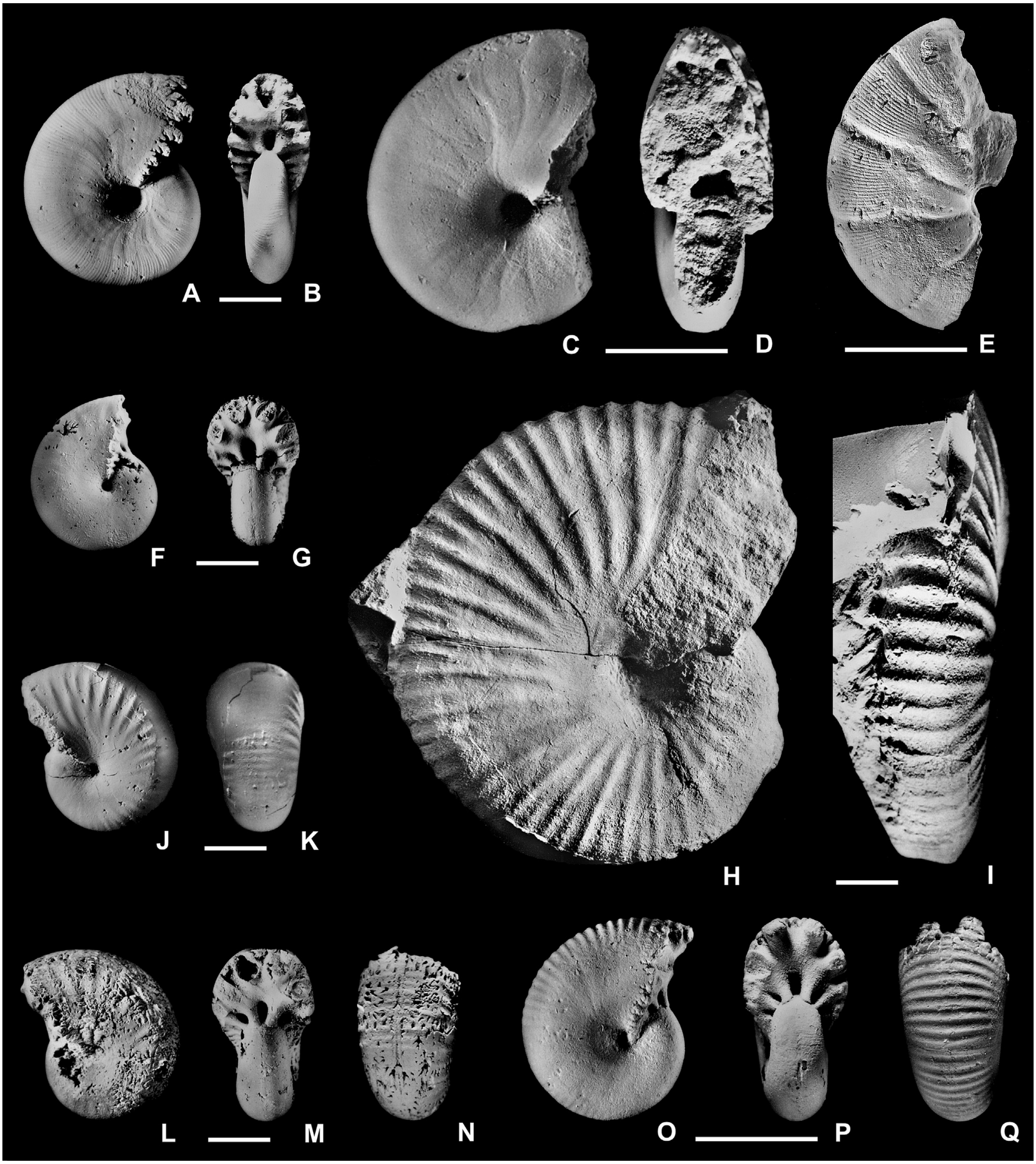

Fig. 2. The Late Barremian ammonites from the Boljetin Hill section, eastern Serbia. A, B, *Hypophylloceras danubiense* n. sp., holotype, lateral (A) and apertural (B) views of RGF DR 6/14, from the lower part of the Upper Barremian (*Gerhardtia sartousiana* Zone). C, D, *Lepeniceras lepense* Rabrenović, holotype, lateral (C) and apertural (D) view of RGF DR 6/13, from the upper part of the Upper Barremian (*Imerites giraudi* Zone). E. *Holcophylloceras avrami* n. sp., lateral view of RGF DR 3/133, from the uppermost lower part of the Upper Barremian (*Gerhardtia sartousiana* Zone). F, G, *Phyllopachyceras baborense* (Coquand), lateral (F) and apertural (G) views of RGF DR 3/135, from the lower part of the Upper Barremian (*Gerhardtia sartousiana* Zone). H, I, *Phyllopachyceras petkovici* n. sp., holotype, lateral (H) and ventral (I) views of RGF DR 4/6, from the lower part of the Upper Barremian (*Gerhardtia sartousiana* Zone). J–N, *Phyllopachyceras eichwaldi eichwaldi* (Karakash), J, K, lateral and apertural views of RGF DR 4/46; L–N, lateral, whorl and ventral views of RGF DR 3/45, from the lower part of the Upper Barremian (*Gerhardtia sartousiana* Zone). O–Q, *Phyllopachyceras ectocostatum* Drushchits, lateral (O), whorl (P) and apertural (Q) views of RGF DR 3/139, from the upper part of the Upper Barremian (*Imerites giraudi* Zone). The specimens whitened with ammonium chloride. Scale bars represent 1 cm.

1995 *Holcophylloceras ernesti* (Uhlig) n. ssp.; Avram, pl. 10, figs 9, 10a, b, 11a, b.

Derivation of name. In honour of Emil Avram, a Romanian palaeontologist, who first recorded and illustrated the species.

Holotype. *Holcophylloceras ernesti* (Uhlig) n. ssp. in Avram (1995), pl. 10, fig. 10a, b. It is housed in the Avram's Collection of the Museum and Repository of the Geological Institute (IG) of Romania, in Bucharest.

Type locality. Outcrop "O" of Avram (1995) on the left bank of Danube River near Svinița (Romania).

Stratigraphic horizon. Upper Barremian, Svinița Formation.

Diagnosis. Shells with high, compressed whorls, oval in cross-section. The umbilicus is relatively wide. There are relatively numerous, deep, falcate constrictions on the shell. Between the constrictions, there are fine, dense ribs on the outer half-whorl and on the venter.

Material. An incomplete half-whorl with the remains of an original nacre wall belonging to the phragmocone (RGF DR 3/133).

Description. Shells involute, with high and compressed whorls and slightly convex flanks. The venter is relatively narrow and strongly convex. The umbilicus is relatively wide. The preceding whorls are visible in the umbilicus well. On the base of whorls, the flanks are bounded by a sharp edge, followed by a very low umbilical wall.

There are conspicuous constrictions on the whorl flanks. They are deeper in the umbilical area than in the flanks. Towards the aperture, they are slightly concave. Just above the midpoint of the whorl height, the constrictions bend sharply. They pass the venter without interruption and more concavely than they pass the lower half whorl. In the Serbian specimen, there are 4–5 constrictions per half-whorl. In the holotype, there are nine constrictions on the terminal whorl; in other Romanian specimens, there are 8–9 constrictions per whorl. In all specimens, there are dense, thin ribs between the constrictions on the outer whorl and on the venter.

Measurements (in mm) *and ratios.* The incomplete Serbian specimen (the diameter of which is not preserved) has a maximum whorl height of approximately 14 mm. At $H = 13.6$ mm, $B = 8.3$ mm, $B/H = 0.61$.

Remarks. In view of the lack of data on the suture line, the generic classification of *Holcophylloceras avrami* n. sp. is uncertain. The presence of deep constrictions, bent sharply at the mid-flank and crossing the whorl without weakening, exclude assignment to *Hypophylloceras* Spath, 1927. *Holcophylloceras avrami* n. sp. is similar to *Holcophylloceras ernesti* (Uhlig, 1883) or to its other synonym *Sowerbyceras ernesti* (as follows, e.g., from synonymy to *Phylloceras* (*Hypophylloceras*)*? ernesti* in Klein et al., 2009, p. 12).

The holotype of *H. ernesti* (Uhlig, 1883, pl. 4, fig. 6) is preserved as a strongly deformed shell with an unknown original cross-section. This specimen is similar in sculpture to *H. avrami* n. sp. *H. ernesti* differs from *H. avrami* n. sp. and the related species *H. pseudoernesti* (Collignon, 1937) and *H. guettardi* (Raspail, 1831) in having a larger number of constrictions.

Distribution and occurrence. Upper Barremian in Romania (Avram, 1995). Same age as the Boljetin section.

Subfamily: Phyllopachyceratinae Collignon, 1937

Genus *Phyllopachyceras* Spath, 1925

Type species. *Ammonites infundibulum* d'Orbigny, 1841, p. 131, lectotype designated by Joly (2000).

Phyllopachyceras baborense (Coquand, 1880)
Figs 2F, G; 3

1872 *Ammonites Rouyanus* d'Orbigny; Tietze, p. 133, pl. 9, figs 7, 8.
1880 *Ammonites Baborensis* H. Coquand; Coquand, p. 26.
1886 *Ammonites Baborensis*; Heinz, pl. 1.
1912 *Phylloceras infundibulum* var. *Baborensis* Coq.; Joleaud, p. 110, pl. 1 bis, figs 1–3.
1991 *Partschiceras baborense* (Coquand); Rabrenović, p. 189, pl. 1, fig. 7a, b; pl. 2, figs 1a, b, 2a, b.
2009 *Phyllopachyceras baborense baborense* (Coquand); Klein et al., p. 53 (cum syn.).

Holotype. Specimen described by Coquand (1880, p. 26) and depicted by Heinz (1886, pl. 1, the first figure on the left high up). Specimen is housed in the Coquand collection of the Hungarian National Museum in Budapest (Ottilia Szives, personal communication).

Material. Four specimens with limonitised shells (RGF DR 3/134, 3/135, 3/136, 3/137) and nine specimens preserved as limonitic or pyrite internal moulds with suture lines, partly weathered on the surface (specimens RGF DR 3/37, 3/43, 3/48, 4/21, 3/9, 3/36, 4/25, 4/26, 4/28). The living chamber is missing in even the largest specimen.

Description. Shells involute, with a deep, very narrow umbilicus and strongly convex whorls. The whorl height is slightly smaller than the whorl width. Specimens with an original shell bear indistinct, slightly S-shaped growth lines. There are indistinct, blunt, sparse ribs near the aperture. The surfaces of the internal moulds are smooth.

Measurements (in mm) *and ratios*. The size of specimens in the collection ranges from 21 to 42 mm, but the final quarter of the terminal whorl of the largest specimen (RGF DR 4/28) is deformed.

Specimen No. RGF DR	*D*	*H*	*U*	*B*	*B*/*H*
4/21	20.6	11.4 (0.55)	0.05 (0.002)	11.1 (0.54)	0.97
3/43	22.8	12.8 (0.55)		11.6 (0.51)	0.91
3/135 (Fig. 2F, G)	23.1	12.7 (0.55)	1.6 (0.07)	12.3 (0.53)	0.95

Suture line. The outer part of the suture line in RGF DR 3/36 is incomplete; the outer and the adventive lobe and the first two contiguous saddles are merely preserved (Fig. 3). These lobes are approximately equal in depth. The adventive lobe is asymmetrically trifid. The saddles are asymmetrically bifid (diphylloid). A conspicuous feature is that the internal branch of the second saddle is more robust than the external branch.

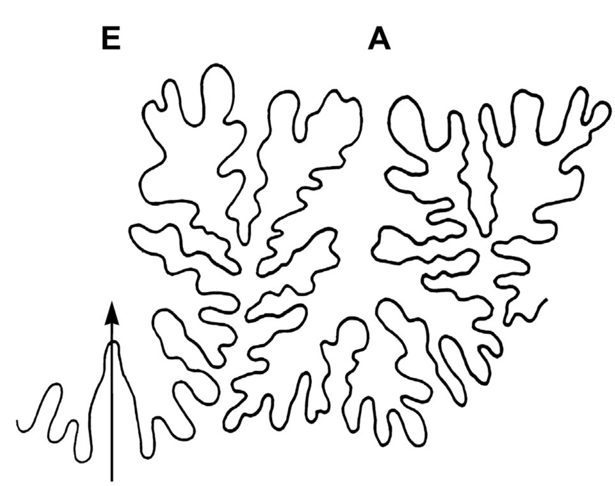

Fig. 3. A part of the outer suture-line of *Phyllopachyceras baborense* (Coquand), RGF DR 3/36 at $D = 27$ mm ($H = 13.5$ mm), from the lower part of the Upper Barremian (*Gerhardtia sartousiana* Zone).

Remarks. Specimens with the original shell are indistinct in sculpture, like those illustrated, e.g., by Wiedmann (1964, pl. 14, fig. 2; pl. 16, figs 1, 2) and Joly (1993, pl. 1, fig. 14; pl. 16, fig. 4).

The smooth shells of *P. baborense* are reminiscent of the shells of *P. rouyanum* (d'Orbigny, 1841); they have intermittently been considered synonyms. According to Busnardo and Joly (in Fischer and Gauthier et al., 2006), *P. rouyanum* differs from *P. baborense* in having a whorl as wide or slightly wider than it is tall (on the lectotype, $B/H = 1.05$). One especially important difference is the stratigraphic position (Upper Hauterivian of *P. rouyanum*); however, the juvenile stages of *P. rouyanum* are morphologically indistinguishable from the juvenile stages of many other phyllopachyceratids.

Distribution and occurrence. The stratigraphic range of *P. baborense* is wide and is usually reported as the Aptian to the Upper Albian. Delanoy and Joly (1995) and Sharikadze in Topchishvili (2005) also report *P. baborense* from the Upper Barremian. The geographic range of the species is considerable, including North Africa, Sardinia, the Balearic Islands, Mallorca, Spain, France, Austria, the Czech Republic, Hungary, Georgia, North Caucasus, the Crimea, the Caspian Sea, and Madagascar.

In the Boljetin Hill, the specimens come from the lower and upper portions of the Upper Barremian (*Gerhardtia sartousiana* and *Imerites giraudi* zones), Donji Milanovac Formation.

Phyllopachyceras petkovici n. sp.
Fig. 2H, I

1991 *Phyllopachyceras bulgaricum* Dimitrova; Rabrenović, p. 187, pl. 1, fig. 8.

Derivation of the name. In honour of Vladimir K. Petković, who studied in detail the Barremian ammonites in Serbia.

Holotype. Specimen RGF DR 4/6, illustrated in Fig. 2H, I.

Type locality. Boljetin Hill section, eastern Serbia.

Stratigraphic horizon. The lower part of the Upper Barremian (*Gerhardtia sartousiana* Zone), Donji Milanovac Formation.

Diagnosis. Shell involute with regularly alternating ribs that reach the umbilicus and shorter ribs that end at the mid-flanks. The whorls are relatively narrow; the flanks are separated from the slightly convex venter.

Material. Only one side of specimen is preserved as a sculpture mould (RGF DR 4/6). Aside from the terminal half-whorl, most of the specimen composes the living chamber.

Description. Specimen of medium size, involute, with high whorls and a narrow umbilicus, partly filled with sediment. Despite a possible slight deformation, the whorl is discernably compressed. The flanks are slightly convex. The whorl width is greatest at the lower one-third of the flank. The flanks incline gradually towards the venter. They are not sharply separated, but are distinct from the flat venter, which has a relatively small width. Towards the dorsum, the whorl inclines markedly to a deep funnel-shaped umbilicus. The shell bears prominent, regularly alternating long (main) and shorter (secondary) simple ribs. The long ribs reach the margin of the funnel-shaped umbilical depression. At the beginning, these ribs are proverse, but they become straight farther on. They bend slightly on the venter, across which they pass continuously. The shorter ribs, which on the venter are as strong as the long ribs, fade away at the upper one-quarter to one-third of the whorl flank. There are 16 main ribs and 16 secondary ribs on the terminal half-whorl.

Measurements (in mm) *and ratios*. At almost the maximum diameter ($D = 74.3$ mm), the whorl height is approximately 42.5 mm (H/D is approximately 0.57). The diameter of the umbilicus could not be measured. At the beginning of the terminal whorl, the whorl width is measurable at one place (the shell diameter is not measurable). At $H =$ approximately 21 mm, $B = 12.3$ ($B/H = 0.58$).

Remarks. The shell ribbing is characteristic of *P. infundibulum* (d'Orbigny, 1841). *P. petkovici* n. sp. differs from *P. infundibulum* in the cross-section and the whorl width. Joly and Fischer and Gauthier et al. (2006) found $B/H = 0.79$ for d'Orbigny's lectotype of *P. infundibulum* (in comparison with $B/H = 0.58$ for *P. petkovici* n. sp.). In the whorl cross-section, *P. petkovici* n. sp. and *P. infundibulum* differ from *P. bulgaricum* Dimitrova, 1967; the whorls of *P. bulgaricum* are wider than they are high.

Phyllopachyceras eichwaldi eichwaldi (Karakash, 1895)
Figs. 2J–N; 4

1868 *Ammonites meridionalis* Eichwald, p. 1146, pl. 36, fig. 4a–c.
1895 *Phylloceras Eichwaldi*; Karakash, p. 13.
1907 *Phylloceras Eichwaldi* Karak.; Karakash, p. 41, pl. 2, fig. 10a–b; pl. 3, figs 4, 6, 13; pl. 24, figs 3, 5?.
1921 *Phylloceras Eichwaldi* Karak.; Petković, p. 57, pl. 1, fig. 10, text-figs 6, 9?.
1991 *Phyllopachyceras eichwaldi* (Karakash); Rabrenović, p. 186, pl. 1, figs 3a, b, 4a, b, 5a, b, 6a, b.
2009 *Phyllopachyceras eichwaldi eichwaldi* (Karakash); Klein et al., p. 57 (cum syn.).

Holotype. *Ammonites meridionalis* Eichwald, 1868, pl. 36, fig. 4, deposited in the Eichwald Collection of the Palaeontological–stratigraphical Museum of the Geological Faculty of Sankt-Petersburg University. Neocomian, Biasala, southwest Crimea.

Material. Five specimens preserved as limonitic internal moulds with suture lines (RGF DR 3/42, 3/45, 3/50, 3/51, 3/151) and two specimens with preserved limonitised original shells (RGF DR 3/138, 4/46).

Description. Shells involute, of medium size, with convex flanks that pass across the round venter. The umbilicus is narrow and deep. The whorl width is usually only slightly greater than the whorl height.

Simple ribs can be distinguished on the flanks. The rib interspaces are somewhat wider than the ribs. The ribs appear on approximately the lower one-quarter of the whorl flank. On some specimens, strongly concave lines continue the ribs and are distinct even below them. The ribs are slightly convex in relation to the aperture. The majority of the simple ribs are equal in length; shorter inserted ribs may appear sporadically. The venter is smooth at the beginning part of the last whorl, and the ribs bifurcate or trifurcate into thin ribs on the transition from the flanks to the venter. They are slightly convex when crossing the venter. On larger specimens, there are 19–22 ribs on the terminal half-whorl.

Measurements (in mm) *and ratios*. The smallest specimen with the appearance of lateral ribs has a maximum diameter of 20 mm. The largest specimen has a diameter of approximately 41 mm.

Specimen No. RGF DR	*D*	*H*	*U*	*B*	*B*/*H*
3/50	21.5	12.5 (0.58)	1.6 (0.07)	12.7 (0.59)	1.02
3/45 (Fig. 2L–N)	28.5	15.9 (0.56)	2.4 (0.08)	16.8 (0.59)	1.06
3/151	39.4	22.8 (0.58)	–	23.0 (0.58)	1.01

Suture line. On specimen RGF DR 3/50, an outer part of a suture line is preserved (Fig. 4). The outer lobe bears a low, secondary, bottle-shaped saddle. The adventive lobe is slightly asymmetrically trifid, divided on the base by two roughly equally high secondary saddles. The first two contiguous saddles, both divided by a deep secondary lobe, are two-branched.

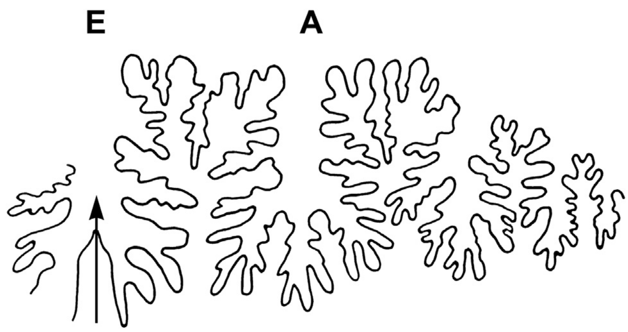

Fig. 4. Outer suture-line of *Phyllopachyceras eichwaldi eichwaldi* (Karakash). Specimen RGF DR 3/50 at $D = 26$ mm ($H = 14$ mm), from the lower part of the Upper Barremian (*Gerhardtia sartousiana* Zone).

Remarks. In the Serbian material, lateral ribs appear at a diameter of approximately 20 mm. The ratio of whorl width to whorl height (B/H) is approximately 1 and usually slightly greater (1.02–1.06); this ratio is only a little less than in the type Russian specimens, which have whorls wider than they are high (Wiedmann, 1964 states for Karakash's lectotype $B/H = 1.10$). Similar B/H ratios were reported by Joly (1993) for *P. eichwaldi gignouxi* (Collignon, 1937) from Madagascar; however, the Madagascar species has wider whorls (usually $B/D = 0.62$), and its lateral ribbing is indistinct and somewhat irregular. There is another subspecies, *P. eichwaldi occidentale* (Wiedmann, 1964). The subspecies is characterised by having whorls markedly wider than they are high (Wiedmann, 1964 states $B/H = 0.87$ to 0.88) and sparser lateral ribs (approximately 15 per half-whorl) than *P. eichwaldi eichwaldi* (approximately 20). For the reasons mentioned above, we classify the Serbian specimens as *P. eichwaldi eichwaldi*. Murphy and Rodda (2006) consider *Partschiceras eichwaldi occidentale* Wiedmann, 1964 a synonym of *Phyllopachyceras occidentale* (Anderson, 1938).

In addition to the specimens having both moulds and original shells, as stated in the material, three non-juvenile specimens with size parameters almost identical to those of the described shells are at our disposal (RGF DR 3/30, 3/149, 3/150). These specimens have poorly preserved sparse lateral ribs; the venters lack characteristic thin, dense ribs. We identified them as *P.* cf. *eichwaldi*.

Distribution and occurrence. Typical specimens occur, e.g., according to Khalilov (1988), in the Upper Hauterivian and the Barremian in the Crimea, southeast Caucasus, southeast France and Azerbaijan. The French specimens, however, belong to *P. eichwaldi occidentale* (see, e.g., Delanoy and Joly, 1995) or to *P. occidentale* (Anderson). Azerbaijanian occurrences are uncertain because they are represented by smooth juvenile shells; Fatmi and Rawson (1993) report one finding from Baluchistan, but there is no nearer stratigraphic position.

The specimens come from the lower part of the Upper Barremian (*Gerhardtia sartousiana* Zone) in the described section.

Phyllopachyceras ectocostatum Drushchits, 1956
Fig. 2O–Q

? 1921 *Phylloceras infundibulum* d'Orb. sp.; Petković, p. 54, pl. 1, figs 7, 8.
1956 *Phyllopachyceras ectocostatum* Drushchits, p. 128, pl. 13, figs 52a, b, 53a, b, 54a, b, text-fig. 58a, b, v.
? 1962 *Phyllopachyceras ectocostatum* Drushchits; Khalilov, p. 47, pl. 3, fig. 3a, v, c, text-fig. 7.
? 1988 *Phyllopachyceras ectocostatum* Drushchits; Khalilov, p. 339, pl. 4, fig. 3a, v, c, pl. 23, fig. 7.
? 1995 *Phyllopachyceras stuckenbergi* (Karakash); Avram, pl. 11, figs 4a–c, 5.

Holotype. *Phyllopachyceras ectocostatum* in Drushchits (1956), pl. 13, figs 52 a, b (specimen No. 1591), deposited in the Drushchits Collection at the Moscow State University.

Material. A single juvenile limonitic phragmocone with imperfectly preserved suture lines (RGF DR 3/139).

Description. Small specimen, involute, with high convex whorls and a narrow, deep, open umbilicus. The whorl is wider than it is tall. The whorl is widest slightly above the mid-flank. The flanks pass continuously to the convex venter, which is not very wide.

The venter is covered with numerous, medium-strong, simple ribs that fade out on the flanks. The ribs are slightly proverse and bent on the transition from the flanks to the venter. On the venter, they are straight and uninterrupted. The remainder of the specimen is smooth. There are indistinct concave growth lines in the umbilical area, near the aperture.

Measurements (in mm) and ratios.

Specimen No. RGF DR	*D*	*H*	*U*	*B*	*B*/*H*
3/139 (Fig. 2O–Q)	16.2 (max.)	8.7 (0.54)	1.0 (0.06)	8.1 (0.50)	0.93
Same specimen	13.5	7.4 (0.55)	0.9 (0.07)	6.7 (0.50)	0.91

Remarks. *P. ectocostatum* is, according to Drushchits (1956, p. 130), similar to *P. stuckenbergi* (Karakash, 1907).

The type material of *P. ectocostatum* (Drushchits, 1956, pl. 13, figs 52–54) was studied by one of the authors (ZV) at Moscow State University. Specimen No. 1324, from Drushchits's collection, has developed ribs on the venter. That shell ($D =$ approximately 19 mm) is very similar to the Serbian specimen in all respects.

Distribution and occurrence. Drushchits (1956) reported an Early Aptian age for the Crimean specimens. For Romanian specimens of *P. stuckenbergi*, Avram (1995) suggested an Upper Barremian origin. It is also found in the upper part of the Upper Barremian (*Imerites giraudi* Zone), in the Boljetin section.

Suborder: Lytoceratina Hyatt, 1889
Superfamily: Lytoceratoidea Neumayr, 1875
Family: Lytoceratidae Neumayr, 1875
Subfamily: Lytoceratinae Neumayr, 1875
Genus *Protetragonites* Hyatt, 1900

Type species. *Ammonites quadrisulcatus* d'Orbigny, 1841, p. 191, lectotype designated by Wiedmann (1962).

Protetragonites crebrisulcatus (Uhlig, 1883)
Figs 5A, B; 6

1872 *Ammonites quadrisulcatus* d'Orbigny; Tietze, p. 138, pl. 9, fig. 12a, b.

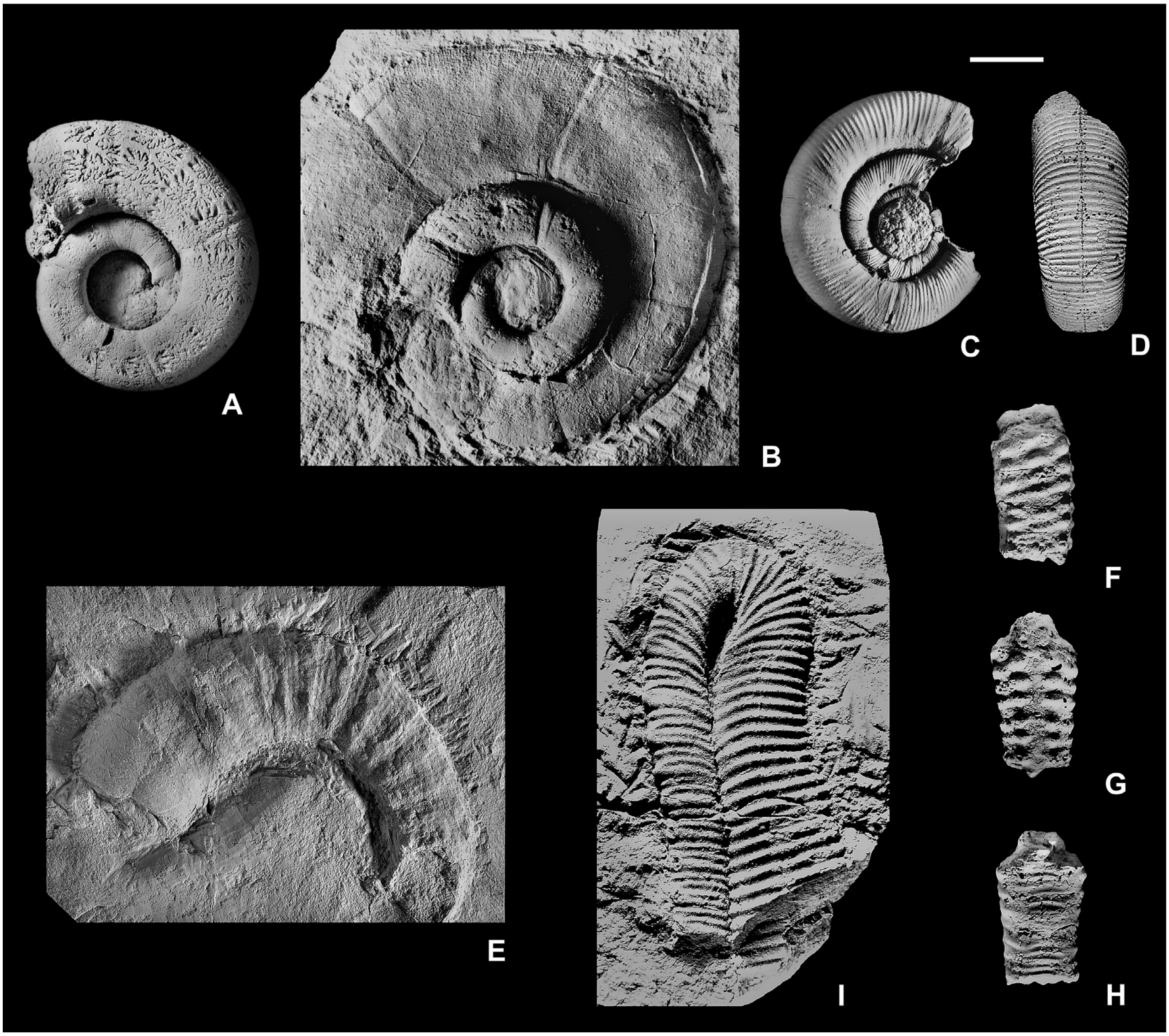

Fig. 5. The Late Barremian ammonites from the Boljetin Hill section, eastern Serbia. A, B, *Protetragonites crebrisulcatus* (Uhlig), A, lateral view of RGF DR 3/41, from the lower part of the Upper Barremian (*Gerhardtia sartousiana* Zone); B, lateral view of RGF DR 4/23, from the upper part of the Upper Barremian (*Imerites giraudi* Zone). C, D, *Macroscaphites perforatus* Avram, lateral (C) and ventral (D) views of RGF DR 3/103, from the upper part of the Upper Barremian (*Imerites giraudi* Zone). E, *Acantholytoceras* cf. *subcirculare* (Avram), lateral view of RGF DR 3/146, from the upper part of the Late Barremian (*Imerites giraudi* Zone). F–H, *Dissimilites* cf. *trinodosus* (d'Orbigny), lateral (G), ventral (H) and dorsal (I) views of RGF DR 3/148, from the boundary between the *Gerhardtia sartousiana* and *Imerites giraudi* zones. I, *Argvethites*? sp., lateral view of RGF DR 3/147, from the upper part of the Upper Barremian (*Imerites giraudi* Zone). The specimens whitened with ammonium chloride. Scale bars represent 1 cm.

1883 *Lytoceras crebrisulcatus* Uhlig, p. 191, pl. 5, figs 8a–d, 9, 10.
1907 *Lytoceras auctum* Trautschold; Karakash, p. 48, pl. 23, fig. 30; pl. 24, fig. 7; non pl. 20, fig. 18 (=*Protetragonites eichwaldi* Karakash).
1921 *Lytoceras crebrisulcatum* Uhlig; Petković, p. 49, pl. 1, figs 3, 4; text-fig. 1.
1956 *Protetragonites mediocris* Drushchits, p. 97, pl. 6, fig. 21a, b; text-fig. 42a, b, v.
1991 *Protetragonites crebrisulcatus* (Uhlig); Rabrenović, p. 203, pl. 3, figs 6a, b, 7a, b, 8, 9a, b.
2009 *Protetragonites crebrisulcatus* (Uhlig); Klein et al., p. 137 (cum syn.).
2012 *Protetragonites crebrisulcatus* (Uhlig); Baudouin et al., p. 613, pl. 2, fig. 8, pl. 3, figs 1–4.

Holotype. *Lytoceras crebrisulcatum* in Uhlig (1883), pl. 5, fig. 8. This specimen is deposited in the Hohenegger Collection in the Bayerische Staatsammlung für Paläontologie und historische Geologie in Munich. Barremian, Hradiště Formation (Czech Republic).

Material. Altogether 12 specimens of which 11 are relatively complete. They are prevailingly non-deformed and preserved, with shell diameters ranging from 15.8 mm to 63 mm. The majority have preserved original limonitised shells (RGF DR 3/140, 3/141, 3/142, 3/1, 3/2, 4/20, 3/143); the others are preserved as less perfect internal moulds, with the remains of suture lines (RGF DR 3/44, 3/144, 4/27, 4/23) and as a perfect internal mould with a well-preserved suture line (RGF DR 3/41). The largest specimen is represented by a fragment of a whorl (of phragmocone) of an internal mould; its maximum whorl height is 24 mm, which corresponds to a shell diameter of approximately 70 mm (without the living chamber). Most juvenile whorls are preserved in many of the specimens.

Description. Small-to-medium specimens are evolute, with low whorls of sub-circular cross-section with relatively flat flanks. The most convex area of the flanks is near the umbilicus. The flanks pass continuously into the venter. Towards the umbilicus, the flanks cross a narrow rounded zone, below which there is a low umbilical wall that is not sharply separated, followed by a deeply submerged line of coiling. The whorl width usually exceeds the whorl height.

The internal moulds are substantially smooth. There are usually five narrow constrictions on each whorl, and they are not bound by ribs. The constrictions are relatively weak, straight, and slightly inclined to the aperture. On the specimens with shell between the constrictions, there are dense, fine growth lines.

Measurements (in mm) and ratios.

Specimen No. RGF DR	*D*	*H*	*U*	*B*	*B*/*H*
3/1	24.5 (max.)	8.3 (0.34)	11.0 (0.45)	8.7 (0.35)	1.05
3/41, (Fig. 5A)	31.2	10.6 (0.34)	14.0 (0.45)	10.8 (0.35)	1.02

Suture line. In specimen RGF DR 3/41, a substantial part of the outer part of the suture line, i.e., the outer lobe, two complete lobes and one incomplete umbilical lobe and three saddles are preserved (Fig. 6). The outer lobe is approximately as deep as the adventive lobe. The outer lobe has only a very low median saddle. The adventive lobe is considerably wider than the next lobe, and both are asymmetrically bifid. The throat of the adventive lobe is narrow. The saddles have very narrow bases and are asymmetrically branched and separated by a deep secondary lobe. The most complete outer part of the suture line of *P. crebrisulcatus* was illustrated by Uhlig (1883, pl. 5, fig. 8c) and Petković (1921, text-fig. 1).

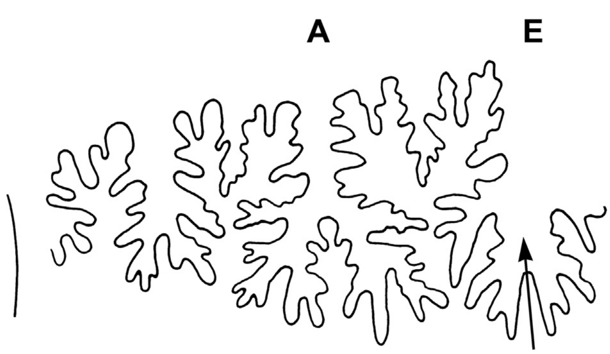

Fig. 6. Outer suture-line of *Protetragonites crebrisulcatus* (Uhlig). Specimen RGF DR 3/41 at $D = 36$ mm ($H = 12.5$ mm), from the lower part of the Upper Barremian (*Gerhardtia sartousiana* Zone).

Remarks. Hoffmann in Klein et al. (2009, p. 134) is of the opinion that *Protetragonites* is a subjective synonym of *Lytoceras*. We disagree because representatives of *Lytoceras* have crinkled ribs, which are unknown in *Protetragonites*.

In the Serbian material, small specimens prevail; in principle, they do not differ from subadult shells. Drushchits (1956) included the small shells in his rich collection of protetragonitids of the species *Protetragonites mediocris* Drushchits, 1956. A study of this collection by one of the authors (ZV) at Moscow State University revealed that the shells of diameters $\leq$35 mm, classified by Drushchits as *P. crebrisulcatus*, are characterised by a whorl height approximately equal to the whorl width (the smallest specimen has a shell diameter of 27 mm). The largest specimen in Drushchits's collection (1956) as *P. mediocris* has a diameter of 36 mm; the diameters of the others are less than 20 mm. The ratio *B*/*H* of the majority is negligibly smaller than 1. One of the authors measured specimen No. 1598 and found an identical whorl width and whorl height (5.8 mm), for a shell diameter of $D = 15.7$ mm. For this reason, we believe that *P. mediocris* is a synonym of *P. crebrisulcatus*. Wiedmann (1962, p. 21) previously arrived at a similar conclusion.

Distribution and occurrence. *P. crebrisulcatus* has been found in the Barremian and the Lower Aptian strata of Serbia, Bulgaria, Romania, Hungary, the Czech and Polish Republics, Ukraine, the Crimea and North Caucasus, Georgia, Mallorca, Italy, southeast France, Spain, Madagascar, Cuba and others.

In the Boljetin Hill section, it has been found in the lower and upper part of the Upper Barremian (*Gerhardtia sartousiana* and *Imerites giraudi* zones), Donji Milanovac Formation.

Suborder: Ancyloceratina Wiedmann, 1966
Superfamily: Ancyloceratoidea Gill, 1871
Family: Acrioceratidae Vermeulen, 2004
Genus *Dissimilites* Sarkar, 1954

Type species. *Hamites dissimilis* d'Orbigny, 1842, p. 529, lectotype designated by Busnardo in Fischer and Gauthier et al. (2006).

Vermeulen (2004) classified *Dissimilites* into a newly established family Acrioceratidae Vermeulen, 2004; however, according to Kakabadze in Klein et al. (2007, p. 94), the establishment of this family is not sufficiently justified and the genera classified into it must be classified into Ancyloceratidae. Ebbo et al. (2000) arrived at a similar conclusion; they described and illustrated the most complete shell so far designated as *Dissimilites* aff. *dissimilis*, in which the hitherto unknown juvenile spire corresponding in shape to ancyloceratids was preserved.

Only recently, Vermeulen (2010), in response to the opinions of Bert (2009), defended the validity of the family Acrioceratidae and called attention to the non-validity of the genus *Helicancylus* Gabb, 1869 and the family Helicancylinae Hyatt, 1894.

Dissimilites cf. *trinodosus* (d'Orbigny, 1852)
Fig. 5F–H

1852 *Hamulina trinodosa* d'Orbigny, p. 215, pl. 4, figs 1–3.
2002b *Dissimilites trinodosus* (d'Orbigny); Avram, p. 25, pl. 1, figs 2–4; pl. 2, figs 2–4.
2007 *Dissimilites trinodosus* (d'Orbigny); Klein et al., p. 105 (cum syn.).

Holotype. *Hamulina trinodosa* d'Orbigny, 1852, pl. 4, figs 1–3, deposited in the Collections of the Muséum national d'histoire naturelle in Paris. Upper Neocomian, Escragnolles (France).

Material. A small, 22 mm long fragment of a free non-deformed shaft of a limonitic mould with the remains of incomplete suture lines (RGF DR 3/147).

Description. A fragment of a slightly bent shaft of a subcircular cross-section. The dorsal side is flatter and wider than the arched venter. The flanks are strongly arched, converging conspicuously to the venter.

On the flanks, there are simple, strong, slightly proverse trituberculate ribs. The lower row of tubercles (umbilical) is relatively weakest; the ventrolateral row is the most conspicuous. In the siphonal region, the ribs become weaker and then are interrupted in a narrow zone. In comparison with the other parts of the shell, the dorsal side is covered with numerous thin ribs. The greatest part of the thin ribs begins in the umbilical tubercles, from which the ribs run in pairs. Between these ribs, there are equally thin simple ribs.

Measurements. In the central part of the fragment, the shaft height is 11.8 mm and the width 11.9 mm.

Remarks. The fragment of the small Serbian specimen enables a relatively broad interpretation of the generic and species classification. The most probable candidates are *Helicancylus* Gabb, 1869, *Toxoceratoides* Spath, 1924 and *Dissimilites* Sarkar, 1954. In all the mentioned genera, the shells begin with a loosely coiled planispiral spire passing into a hook-shaped shell with shafts that do not contact with each other. The first (juvenile) shaft bears trituberculate main ribs. *Toxoceratoides* should differ, according to Aguirre-Urreta (1986), from *Helicancylus* in having interribs without tubercles between the trituberculate ribs on the juvenile shaft; in *Helicancylus,* the interribs should be missing.

Another candidate is *Dissimilites*. In *D. trinodosus,* the pattern of trituberculate ribs and simple ribs changes near the hook-shaped bend of the shell, where only main ribs remain. The fragment of the Serbian specimen represents a position close to the transition of the juvenile shaft to the hook, as seen, e.g., in the specimens designated *D. trinodosus* illustrated by Avram (1995, pl. 15, figs 3–5; 2002b, pl. 1, figs 2–4). The species classification is also supported by the thin ribs on the dorsal side of the d'Orbigny's holotype (1852, pl. 4, fig. 1), as in the Serbian fragment.

Distribution and occurrence. According to Avram (2002b) his specimens of *D. trinodosus* from Romania come from the uppermost part of the Lower Barremian and the base of the Upper Barremian upwards up to, and including, the ammonite *Gerhardtia sartousiana* Zone.

The Boljetin specimen comes from the upper part of the Upper Barremian (*Imerites giraudi* Zone).

Family: Heteroceratidae Spath, 1922
Genus *Argvethites* Rouchadzé, 1933

Type species. *Heteroceras* (*Argvethites*) *minor* Rouchadzé, 1933, p. 234, by monotypy.

Argvethites is represented by small shells that are helicoidally coiled at the beginning. The last whorl of the juvenile helicoid shell passes into a hook-shaped shell. On the first shaft of the hook, there are ribs partly bound to the venter by ventrolateral tubercles. Kakabadze et al. (2005), as well as Rouchadzé (1933), consider *Argvethites* to be a subgenus within the genus *Heteroceras*; Klein et al. (2007, p. 207) consider it a separate genus.

Argvethites? sp.
Fig. 5I

? 1995 *Argvethites* cf. *lashensis* Rouchadzé; Avram, pl. 14, fig. 5.

Material. An incomplete, hook-shaped holotype, preserved as a sculpture mould weakly deformed onto the bedding plane, of which the initial part of the shell is missing (RGF DR 3/148).

Description. The shafts of a medium-sized, hook-shaped shell in contact with each other, slightly S-shaped. On the inner side of the hook-shaped region, there is a free space in the shape of the eye of a needle.

The juvenile shaft bears bent ribs that are inclined forwards, towards the aperture. On the inner side of this shaft, all ribs begin as simple ribs. On the shaft circumference, 2–3 simple ribs join to form clavate tubercles. In the space between two tubercles, one simple rib occurs at first, further the number of ribs increases to two or three. Near the hook, some simple ribs bifurcate, as (occasionally) does the rib running to the tubercle. On the periphery of the hook, this type of tubercle disappears. The ribs remain bent. There are indistinct, weak, needle-shaped tubercles on the periphery of the ribs. The ribs frequently bifurcate near the base at the end of the bend passing into the adult shaft. Shorter inserted ribs appear at about the mid-shaft.

In contrast to the preceding trend, these ribs are concave in relation to the aperture. Further on they are almost straight, orientated obliquely. At the end, the adult shaft broadens strikingly, most likely as a result of a broken arch of the shaft.

Measurements. The preserved length of the juvenile shaft is approximately 56 mm, and the maximum length of the incomplete adult shaft (with the terminal part preserved as an impression) is approximately 62 mm. The juvenile shaft height is 8 mm at the beginning; near the end of the adult shaft, it is 16 mm long. The height at the hook-shaped bend is 10 mm.

Distribution and occurrence. *Argvethites*? sp. was found in the Upper Barremian deposits in the Boljetin section from the *Imerites giraudi* zone. Avram's (1995) imperfectly preserved specimen is similar in age.

Superfamily: Ancyloceratoidea? Gill, 1871
Family: Macroscaphitidae Hyatt, 1900

Based on the form of the cruciform inner lobe (I) of the suture line (see the inner suture line of *Costidiscus* = *Macroscaphites recticostatus* d'Orbigny, 1841 in Uhlig, 1883, pl. 5, fig. 15b and the suture line of *Macroscaphites striatisulcatus* d'Orbigny, 1841 in Uhlig, 1883, pl. 5, fig. 19), the family Macroscaphitidae was originally considered to be a part of the suborder Lytoceratina (Uhlig, 1883; Arkell et al., 1957; Vašíček, 1972, etc.).

Wright et al. (1996) regarded Macroscaphitidae as a member of the suborder Ancyloceratina Wiedmann, 1966 (although with a question mark).

Busnardo in Fischer, Gauthier et al. (2006) and Vašíček (2008) believed that the Macroscaphitidae belonged to the suborder Lytoceratina.

Vermeulen (2006, 2007a) assigned = Macroscaphitidae to the suborder Turrilitina Beznosov and Mikhailova, 1983.

Klein et al. (2007) included Macroscaphitidae in the superfamily Ptychoceratoidea Gill, 1871 (with a note = Acantholytocerataceae Vermeulen, 2003).

Baudouin et al. (2012) used, without further justification, the suborder Ancyloceratina for Macroscaphitidae, which is used in the submitted contribution as well.

The family Macroscaphitidae is also remarkable for the fact that two basic representatives, namely the genera *Macroscaphites* Meek, 1876 and *Costidiscus* Uhlig, 1882 form dimorphic pairs. Based on this idea, the genus *Costidiscus* is a synonym of *Macroscaphites*; *Costidiscus* represents the macroconch form of the genus *Macroscaphites.* This classification is also supported by biometric studies by Baudouin et al. (2012).

Genus *Macroscaphites* Meek, 1876
Type species. *Scaphites Yvanii* Puzos, 1832, p. 356, by monotypy.

Macroscaphites perforatus Avram, 1984
Fig. 5C, D

1984 *Macroscaphites perforatus* Avram, p. 74, pl. 1, figs 1a–c, 2, 3a, b, 4, 5, 6a–c; text-figs 3b, 9a–d.
1991 *Costidiscus microcostatus* (Sim., Bac. et Sor.); Rabrenović, p. 211, pl. 4, figs 3a, b, 4a, b, 6a, b, 7a–c.

1995 *Macroscaphites perforatus* Avram; Avram, pl. 13, figs 7, 8a, b, 9.

Holotype. *Macroscaphites perforatus* Avram, 1984, pl. 1, fig. 1, deposited in collections of the Institute of Geology and Geophysics in Bucharest (specimen No. 14189). The Upper Barremian, Sviniţa Formation, Sviniţa (southwest Romania).

Material. One fragment with a well-preserved, limonitised original shell (RGF DR 3/145), two fragments of internal moulds with an incomplete outer part of the suture line (RGF DR 4/2, 4/75), two incomplete, but relatively well-preserved internal moulds with an incomplete outer part of the suture line (RGF DR 3/14, 4/9), two incomplete specimens with an original limonitised shell; two are well preserved, with the exception of the juvenile whorls, which are filled with pyrite microconcretions (RGF DR 3/104, 3/103).

Description. Specimens are evolute, with low, convex whorls. The flanks pass without interruption into a wide, somewhat flattened venter. The whorl is markedly wider than it is tall. The greatest whorl width is at the lower third of the whorl flank. The flanks incline to the umbilicus. Above the line of coiling, there is a low zone with the character of an unlimited umbilical wall.

The whole shell bears dense, thin, distinct ribs. These ribs run across the venter without interruption. On the juvenile whorls, the ribs are straight to slightly bent and strongly proverse. The majority of the ribs run from relatively elongated umbilical tubercles that appear in close vicinity to the line of coiling. The tubercles are narrow and relatively high. After they broke off, their wider drop-shaped bases remained. The tips of the drops are at the upper ends. At the transition of the umbilical wall to the whorl flanks, two to three ribs run from each of the mentioned tubercles. Some of the ribs may sporadically bifurcate at the upper quarter of the flanks. Between the pairs or triplets of ribs running from the tubercles, simple inserted ribs appear sporadically. On the terminal whorl, relatively high above the line of coiling, two ribs usually run from the tubercles. Simple inserted ribs reaching as far as the upper ends of the tubercles are more frequent. The first constriction, which is not bound by stronger ribs, appears at a shell diameter of approximately 24 mm. The following constrictions are accompanied by stronger ribs from both the sides. Between 3 and 4 constrictions occur on the adult whorl.

Measurements (in mm) and ratios.

The maximum whorl height was measured on the adult whorl of the fragment of two whorls of specimen 4/75; $H = 10.6$ mm, and $B = 13.9$ mm. It can thus be derived that this evolutely coiled part of the shell had a diameter of approximately 50 mm.

Specimen No. RGF DR	*D*	*H*	*U*	*B*	*B/H*
3/104	20.6	6.0 (0.29)	9.6 (0.47)	7.9 (0.38)	1.32
3/103 (Fig. 5C, D)	36.0	9.7 (0.27)	19.4 (0.54)	12.8 (0.35)	1.32
4/9, largest specimen	37.2 (max. ≈46)	9.2 (0.25)	19.6 (0.53)	12.3 (0.33)	1.34

Remarks. *M. perforatus* is morphologically similar to *M. yvani* (Puzos, 1832). In some cases, *M. perforatus* is considered a synonym of *M. yvani* (see e.g., Vermeulen in Klein et al., 2007b, p. 295; footnote). A similar situation also applies to *M. striatisulcatus* (d'Orbigny, 1841). In *M. yvani* and *M. perforatus,* the shell has a hook-shaped portion not observed in *M. striatisulcatus.* For *M. perforatus* and *M. striatisulcatus,* the parameters of non-deformed individuals are known (for the holotype of *M. perforates*, $B/H = 1.29$; for the type material of *M. striatisulcatus*, according to Busnardo in Fischer and Gauthier et al., 2006, the *B/H* ratio for the type material of d'Orbigny is 0.75–1; but for the neotype of *M. striatisulcatus*, $B/H = 1.4$), while for the non-deformed *M. yvani*, according to Baudouin et al. (2012), *B/H* usually lies between 1.1 and 1.4.

Avram (1984) in did not exclude the possibility that Uhlig's deformed specimens of *M. yvani* did not belong to *M. yvani*, but rather to *M. perforatus* because *M. yvani* should not have tubercles on the internal whorls (see the refiguration of Puzos's holotype by Busnardo in Fischer and Gauthier et al., 2006, pl. 29, fig. 2a, b).

For the sake of completeness, we state that Avram (1984) identified a specimen of diameter of 25.2 mm (with parameters that correspond well to Serbian specimen 3/104, which is approximately equal in size) as the holotype of *M. perforatus*. According to Avram's depiction (1984, text-fig. 9a), the coiled part of the shell has a diameter of approximately 45 mm. When the illustration and the description of *M. yvani* by Uhlig (1883, p. 206, pl. 9, figs 5, 6) are compared with the illustration of *M. perforatus* in Avram (1984) and with the Serbian material, it is evident that the Serbian specimens correspond well to Avram's specimens. The tubercles on the coiled part of Uhlig's specimens (1883), for which exact size parameters cannot be measured, are of another type; for this reason, we do not consider them to be *M. perforatus*.

Distribution and occurrence. Avram (1984) reports its occurrence throughout the Upper Barremian in Sviniţa in Romania.

The studied specimens come from the upper part of the Upper Barremian (*Imerites giraudi* Zone), Donji Milanovac Formation.

Genus *Acantholytoceras* Spath, 1923

Type species. *Hamites* (*Pictetia*) *longispinus* Uhlig, 1883, p. 220, type designated by Uhlig (1883).

Acantholytoceras is a controversial genus in systematic classification. We consider *Acantholytoceras* to be a specialised representative of lytoceratids, with a loosely coiled shell, the main ribs of which are trituberculate. The ventrolateral tubercles bear long spines. Arkell et al. (1957) illustrated Uhlig's specimen in fig. 234 according to the generic description (1883 from pl. 14, figs 10, 11); some authors consider this representative the type specimen (e.g., Egoian, 1969; Avram, 2002a). It is a fragment of a whorl with a single preserved main rib and with obliquely oriented ventrolateral spines. According to Arkell et al. (1957), this genus is characterised by four rows of tubercles.

Uhlig (1883) illustrated three specimens. As the first to identify the species, Uhlig states explicitly on page 220 that he relates the species name to the specimen illustrated in pl. 15, fig. 1, which is thus the type specimen. He did not exclude the possibility that the other specimens (pl. 14, fig. 10 and pl. 15, fig. 2) belong to other species (Vašíček, 1973).

Egoian (1969) established a new genus, *Pseudocrioceratites.* He compared this genus to the morphologically related *Acantholytoceras.* The main difference between the genera is the three rows of tubercles by *Pseudocrioceratites* and four rows of tubercles by *Acantholytoceras.* Avram (2002a) accepted this interpretation in an error based on the incorrect number of tubercles on the main ribs in the illustration of Uhlig's fragment (1883, pl. 14, fig. 10).

The type specimen designated by Uhlig (1883, pl. 15, fig. 1) is illustrated in Wright et al. (1996, fig. 166/2). Wright et al. (1996), like Klein et al. (2007, p. 289), states that the genus *Pseudocrioceratites* Egoian, 1969 is a synonym of the genus *Acantholytoceras.* While Wright et al. (1996) classify *Acantholytoceras* in the family

Ancyloceratidae Gill, 1871, Klein et al. (2007) assigns it to the family Macroscaphitidae.

Acantholytoceras cf. *subcirculare* (Avram, 2002)
Fig. 5E

1995 *Crioceratites*? sp. aff. *C. munieri* Sarasin and Schöndelmayer; Avram, pp. 120, 122, pl. 16, figs 5a, b, 6a, b.
2002a *Pseudocrioceratites subcircularis* Avram, pl. 1, figs 2a–d, 3; text-fig. 2a.
2007 *Acantholytoceras subcirculare* (Avram); Klein et al., p. 292.

Holotype. *Pseudocrioceratites subcircularis* in Avram (2002a), pl. 1, figs 2a–d, (specimen IGP 16556), deposited in the collections of the Institute of Geology and Geophysics in Bucharest. Lower part of the Upper Barremian, Sviniţa Formation, Sviniţa (Romania).

Material. An incomplete half-whorl of specimen deformed onto the bedding plane and preserved as a poor-quality mould. According to several poorly preserved remains of suture lines, the specimen (RGF DR 3/146) belongs to the phragmocone.

Description. At the beginning of the whorl, there are numerous, conspicuous straight main ribs with three rows of tubercles. The longitudinally elongated umbilical tubercles are the weakest; the peripheral (ventrolateral) tubercles are the strongest. There are spines on the latter tubercles. The longest (last) ones are approximately 15 mm long. The intermediate row of tubercles is relatively close to the ventrolateral tubercles. Two to four thin, simple ribs are inserted at the beginning, between the main ribs. The majority run on the length of the whorl, as do the main ribs. There are shorter inserted ribs along the posterior side of the main ribs, which extend to about the half the whorl height. On the remainder of the whorl, the number of inserted ribs increases to 6–7. At the end of the phragmocone, the deformed whorls are is approximately 19 mm high. The maximum diameter of the deformed shell is estimated at 60 mm.

Remarks. The imperfectly preserved Serbian specimen with long ventrolateral spines characteristic of *Acantholytoceras* is morphologically very similar to Avram's non-deformed holotype, designated as *Pseudocrioceratites subcircularis* (Avram, 2002a, pl. 1, fig. 2a–c); however, in the latter, only the bases of spines are preserved. The illustrated suture line in Avram (pl. 1, fig. 2d) is characterised by a lytoceratid inner lobe (I) shaped as a cross. Avram (2002a) thus erroneously classified the genera *Acantholytoceras* and *Pseudocrioceratites* in the newly established family Pseudocrioceratitidae, within the framework of the superfamily Lytoceratoidea.

Distribution and occurrence. According to Avram (2002a), *Acantholytoceras subcirculare* occurs in Romania, in the area of Sviniţa in the Lower and the Upper Barremian (below the level where the genera *Imerites* and *Eristavia* are found).

The Boljetin Hill section specimen comes from the upper part of the Upper Barremian (*Imerites giraudi* zone) section.

5. Discussion

The second taxonomically elaborated subset of the ammonite collection from the Boljetin Hill section includes representatives of the suborders Phylloceratina, Lytoceratina and Ancyloceratina. Whereas the first two suborders are abundantly represented in the number of species and specimens, the suborder Ancyloceratina is represented by only two specimens belonging to two species (Fig. 7).

Four genera and eight species of the suborder Phylloceratina are described from Boljetin. Three species are new: *Hypophylloceras danubiense* n. sp., *Holcophylloceras avrami* n. sp. and *Phyllopachyceras petkovici* n. sp. *Lepeniceras lepense* Rabrenović is so far known only from the studied Serbian location.

The most abundant species of phylloceratids at this location is *Phyllopachyceras baborense.*

The suborder Lytoceratina is represented by five species that belong to five genera. *Protetragonites crebrisulcatus,* which is synonymous with the small shells of *Protetragonites mediocris* Drushchits, 1956, is the most abundant species.

The representatives of the suborder Ancyloceratina are extremely rare on the section. There were found only two fragmentary preserved specimens: *Dissimilites* cf. *trinodosus* and *Arvethites*? sp.

In the literature, the Barremian to Early Aptian age is usually given for the species identified here. There is no unambiguous species confined only to the Aptian, even among the representatives of the suborder Ammonitina, described in Vašíček et al. (2013). The most stratigraphically significant and most narrowly time-defined species in the present collection is, paradoxically, a fragment of an ancyloceratid, identified as *Dissimilites* cf. *trinodosus.* At the topographically and stratigraphically close Romanian localities Sviniţa and Dambovicionara, *D. trinodosus* occurs along the Lower/Upper Barremian boundary up to the *Gerhardtia sartousiana* Zone inclusive (Avram, 2002b). We suppose that the faunistic assemblage of the section under study represents the time span from the upper part of the *Toxancyloceras vandenheckii* Zone, the whole of the *Gerhardtia sartousiana* Zone and the lower part of the *Imerites giraudi* Zone (sensu Reboulet et al., 2011). The Serbian ammonite assemblage is close to those from localities in the Romanian territory that are richer in species (Avram, 1995, 2002a,b and others).

At the studied locality, the ammonite fauna is represented by species with smooth or inconspicuously sculptured shells, mainly phylloceratids, lytoceratids and barremitids (suborder Ammonitina). Ancyloceratids occur only sporadically. In accordance with a stylised panorama of Jurassic–Cretaceous ammonoid habitats and their distribution in epicontinental seas and the continental slopes described by Westermann in Landman et al. (1996, p. 669, fig. 14, items 7, 20–22), this ammonite assemblage occupied a distal shelf that reached to the edge of the continental slope, i.e., the boundary between the neritic and oceanic environments. It corresponds in depth to an epipelagic or mesopelagic environment. The Serbian section, in comparison with other European Upper Barremian localities (e.g., classic French localities in the Vocontian Basin or in the Silesian Unit in the Outer Western Carpathians), has marly deposits and represents relatively deep water environment.

6. Palynology

In general, the investigated samples constitute rich, diverse, well-preserved palynological assemblages (Figs. 7–9, Table 1). The palynofacies (Fig. 9) are dominated by terrestrial organic matter, mainly opaque particles (17–65%); plant tissue remains in the form of translucent phytoclasts (2–25%), pollen grains (7–29%) and spores (1–4%). Marine species are represented mainly by dinoflagellate cysts (10–27%), acritarchs (1–2%), and foraminiferal linings (1–2%).

The quantitative compositions of palynofacies are plotted in the AOM-Phytoclast-Palynomorph ternary diagram (Fig. 10), after Tyson (1989, 1993).

6.1. Dinoflagellate cysts

Cysts of organic-walled dinoflagellates obtained from the 11 samples taken from marlstone are well preserved and identifiable

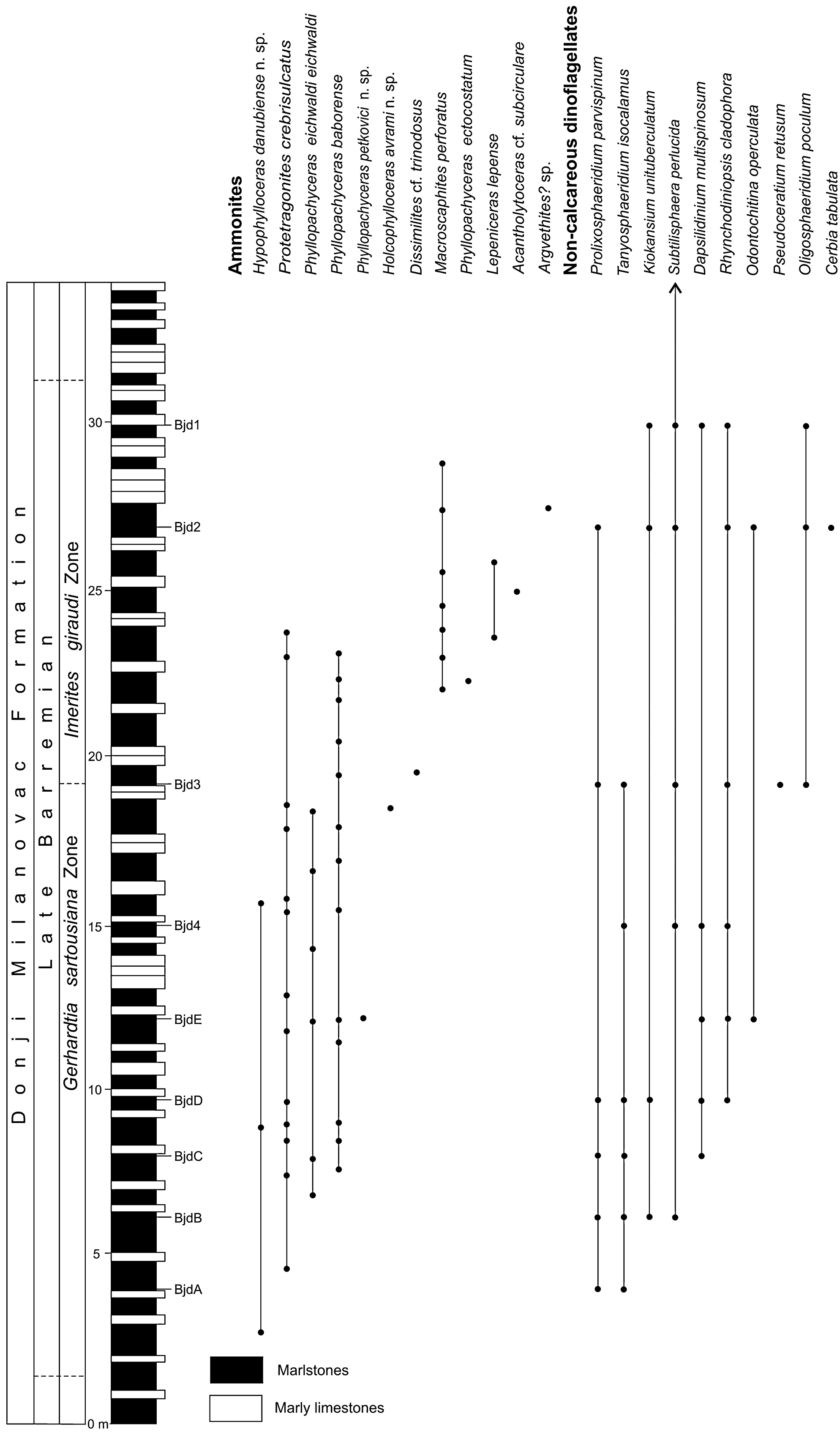

Fig. 7. Stratigraphic column and range chart of ammonites and organic-walled dinoflagellates of the Boljetin Hill section, eastern Serbia. Ammonite zonation after Reboulet et al. (2011).

Table 1
Distribution of the Late Barremian acritarchs and dinoflagellates in the Boljetin Hill section.

Late Barremian										
BjdA	BjdB	BjdC	BjdD	BjdE	Bjd4	Bjd3	Bjd2	Bjd1	Bjdß	Samples/Taxa
1	2	2								*Achomosphaera neptunii* (Eisenack) Davey & Williams
2										*Achomosphaera ramulifera* (Deflandre) Evitt
1			1							*Bourkidinium granulatum* Morgan
1	4			3			10	2		*Circulodinium vermiculatum* Stover & Helby
3	3	7	7	4		1	1		1	*Cometodinium? whitei* (Deflandre & Courteville) Stover & Evitt
2		1								*Exochosphaeridium muelleri* Yun
1										*Kiokansium* sp.
1	1									*Muderongia pariata* Duxbury
1					2	8	5	3		*Oligosphaeridium? asterigerum* (Gocht) Davey & Williams
2	4	1	32	20	1	18	120	45	1	*Oligosphaeridium complex* (White) Davey & Williams
2		27	14			1	1			*Prolixosphaeridium parvispinum* (Deflandre) Davey et al.
1										*Pseudoceratium* sp.
7	12	16	19			4	17			*Spiniferites ramosus* (Ehrenberg) Mantell
1		3								*Subtilisphaera* sp.
1	1	1	4		2	1				*Tanyosphaeridium isocalamus* (Deflandre & Cookson) Davey & Williams
2		4	1	1						*Wallodinium krutzschii* (Alberti) Habib
	1		1							*Callaiosphaeridium asymmetricum* (Deflandre & Courteville) Davey & Williams
	2		2		1		3	1	1	*Endoscrinium campanula* (Gocht) Vozzhennikova
	2		1				1	3		*Kiokansium unituberculatum* (Tasch) Stover & Evitt
	1									*Kleithriasphaeridium eoinodes* (Eisenac) Davey
	1									*Protoellipsodinium clavulum* Davey & Verdier
	1				2	1	2	2	1	*Subtilisphaera perlucida* (Alberti) Jain & Millepied
	1						1			*Systematophora* sp.
	2			1						*Tenua hystrix* Eisenack
		12								*Chlanydoporella nyei* Cookson & Eisenack
		5								*Chlamydoporella* sp.
		5	4		1	2		3	1	*Circulodinium* sp.
		7	8					1		*Cleistosphaeridium clavulum* (Davey) Below
		1				2	1			*Cribroperidinium orthoceras* (Eisenack) Davey
		7	10	1	1			4		*Dapsilidinium multispinosum* (Davey) Bujak et al.
		1					2			*Gonyaulacysta helicoidea* (Eisenack & Cookson) Sarjeant
		2	3		1					*Gonyaulacysta* sp.
		6	6		1	2	8	4		*Pterodinium cingulatum* (O. Wetzel) Below
		1		4	1			5	1	*Spiniferites* sp.
		1				1				*Tanyosphaeridium magneticum* Davies
			1							*Muderongia tabulata* (Raynaud) Monteil
			7	5	1	2	5	2		*Rhynchodiniopsis cladophora* (Deflandre) Below
				1				1		*Gonyaulacysta cretacea* (Neale & Sarjeant) Sarjeant
				1						*Lithodinia stoveri* (Millioud) Gocht
				5				2		*Occisucysta* sp.
				1			1			*Odontochitina operculata* (O. Wetzel) Deflandre & Cookson
				1			1			*Protoellipsodinium spinosum* Davey & Verdier
						4	2	1		*Oligosphaeridium poculum* Jain
						1				*Pseudoceratium retusum* Brideaux
							11			*Cerbia tabulata* (Davey & Verdier), Below
									1	*Florentinia mantellii* (Davey & Williams) Davey & Verdier

(Table 1, Fig. 8). The diverse assemblage is characterised by the following species: *Achomosphaera ramulifera* (Deflandre) Evitt, *Circulodinium vermiculatum* Stover and Helby, *Cleistosphaeridium clavulum* (Davey) Below, *Oligosphaeridium*? *asterigerum* (Gocht) Davey and Williams, *O. complex* (White) Davey and Williams, *Pterodinium cingulatum* (O. Wetzel) Below, *Pseudoceratium retusum* Neale and Sarjeant, *Spiniferites ramosus* (Ehrenberg) Mantell and others (Table 1). Of the acritarchs, *Wallodinium krutzschii* (Alberti) Habib appears most frequently.

The first appearances of the distinctive dinoflagellate cyst species *Prolixosphaeridium parvispinum* and *Odontochitina operculata* (Fig. 7), in samples Bjd A and in Bjd E, respectively, occurred in the lower part of the Upper Barremian at the base of the *T. vandenheckii* Zone in southeast Spain (Leereveld, 1995, 1997), southeast France (De Renéville and Raynaud, 1981; Wilpshaar, 1995), and the Western Carpathians (Skupien and Vašíček, 2002). A similar age was documented for the first occurrences of *O. operculata* and *P. parvispinum* in some ammonite-belemnite-dated sections of the Boreal Realm (Duxbury, 1977; Harding, 1990; Prössl, 1990), suggesting that they may be important biohorizons in the lower Late Barremian of the Northern Hemisphere.

The peak abundance of the dinoflagellate cyst *P. parvispinum* before the first occurrence of *O. operculata* seems significant for an oceanic environment. *O. operculata* have been reported from near-shore environments (Leereveld, 1995; Michalík et al., 2008; Svobodová et al., 2004).

The uppermost Barremian (*I. giraudi* Zone) can be considered in terms of the first occurrence of the dinoflagellate cyst *Pseudoceratium retusum*. Their first occurrence was reported in the uppermost Barremian strata in the Outer Western Carpathian (Skupien and Vašíček, 2002).

6.2. Remarks about palaeoecology and palaeoclimatology

Palynofacies (Fig. 9) of samples Bjd A, C, and 4 is characterised mainly by large, equidimensional particles, whereas in samples Bjd B, D, E, 3 and 2, a significant increase in the number of large, blade-shaped particles is observed within the phytoclast group. Large

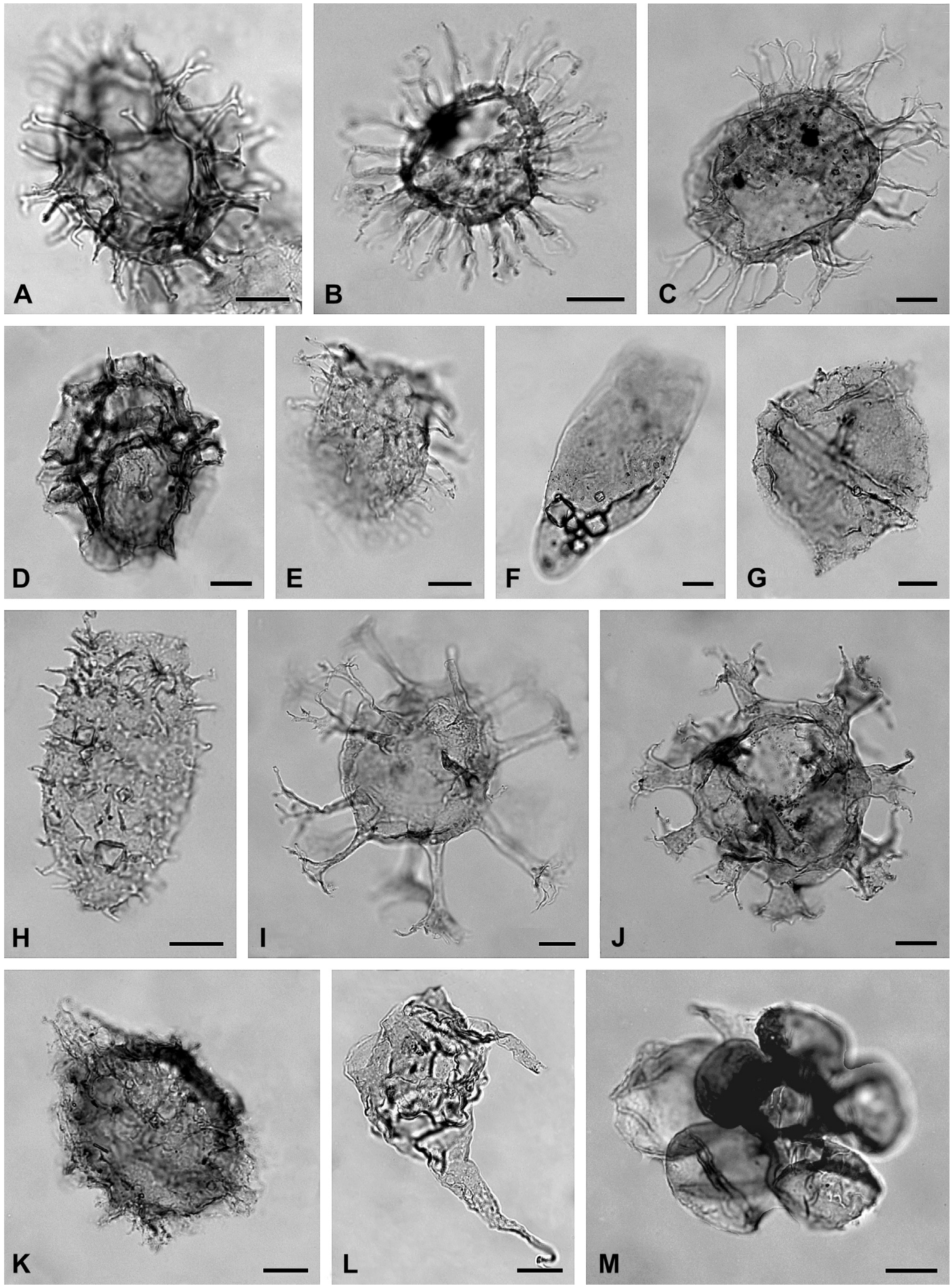

Fig. 8. Dinoflagellate cysts. The species name is followed by the sample location and England Finder coordinates (for localization of the specimen in the slide). Scale bars = 10 μm. A, *Spiniferites ramosus* (Ehrenberg) Mantell; sample Bjd A, K 46. B, *Dapsilidinium multispinosum* (Davey) Bujak et al.; sample Bjd C, O36/2. C, *Achomosphaera neptunii* (Eisenack) Davey and Williams; sample Bjd C, U40. D, *Pterodinium cingulatum* (O. Wetzel) Below; sample Bjd C, D 28. E, *Tanyosphaeridium isocalamus* (Deflandre and Cookson) Davey and Williams; sample Bjd D, K/L 40. F, *Wallodinium krutzschii* (Alberti) Habib; sample Bjd C, V40/1. G, *Subtilisphaera perlucida* (Alberti) Jain and Millepied; sample Bjd 4, M40. H, *Prolixosphaeridium parvispinum* (Deflandre) Davey et al.; sample Bjd D, H 28/39. I, *Oligosphaeridium complex* (White) Davey and Williams; sample Bjd D, G 41. J, *Oligosphaeridium poculum* Jain; sample Bjd 3, R 36/2. K, *Cometodinium*? *whitei* (Deflandre and Courteville) Stover and Evitt; sample Bjd 3, O 41. L, *Odontochitina operculata* (O. Wetzel) Deflandre and Cookson; sample Bjd E, K 27/3. M, Foraminiferal lining; sample Bjd 3, M 41.

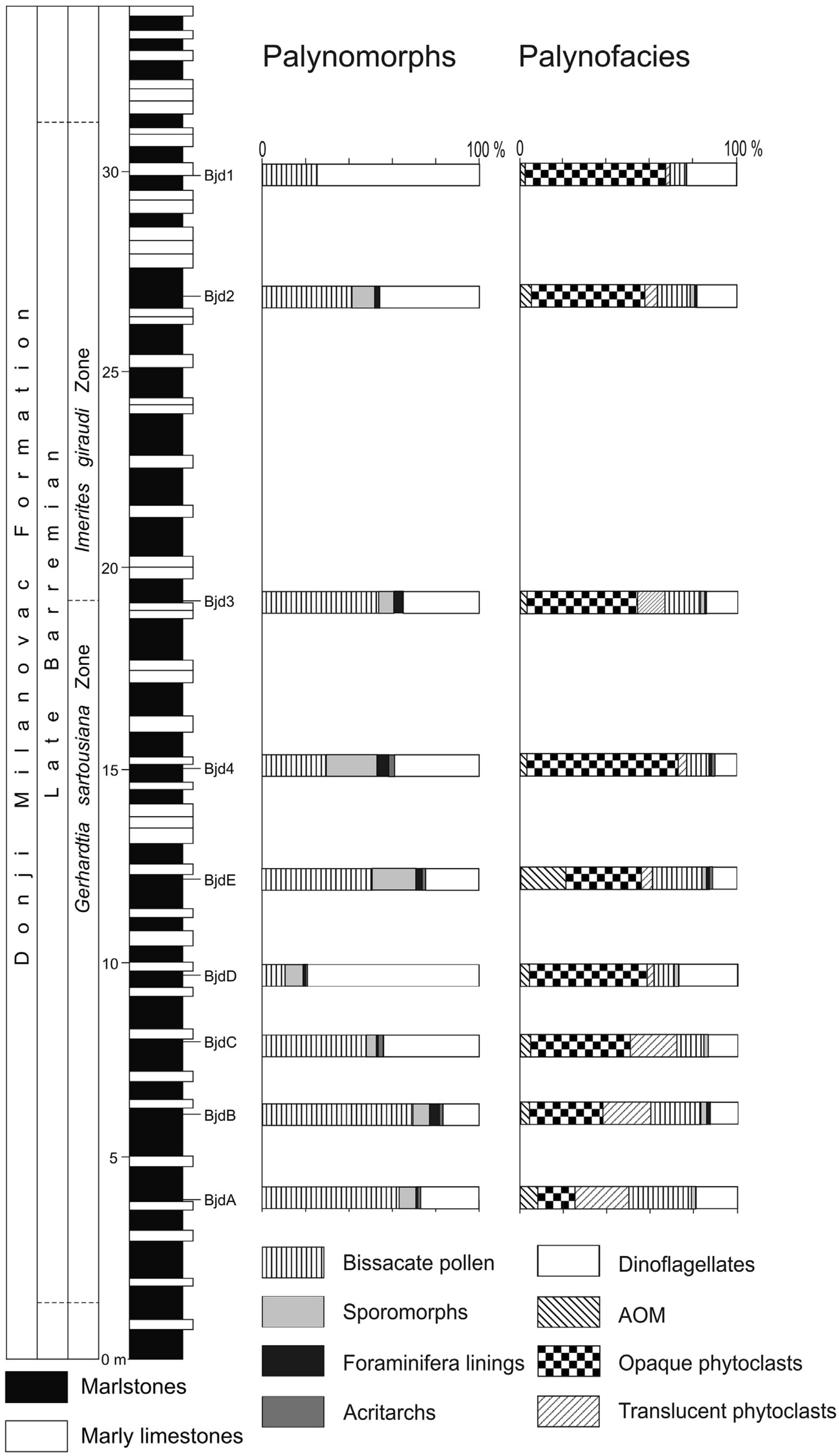

Fig. 9. Relative abundance of palynomorphs and palynofacies in the Boljetin section. The relative percentages of the components are based on the counting of at least 150 palynomorphs and 500 palynofacies particles per slide.

blade-shaped particles are abundant in proximal settings. The ratio of opaque to translucent phytoclasts has the highest values in the lower part of the section (samples Bjd A–C). Phytoclasts of the sample Bjd1 are mainly small and equidimensional, evidence of more distal deposits (Götz et al., 2008) that correspond to the dominance of marine plankton in palynomorph assemblages.

During the two intervals (samples Bjd A–Bjd D and Bjd E–Bjd 1) the share of terrestrial material (sporomorphs) decreased (Fig. 9). Saccate pollen grains are the main constituents of the continental palynomorph group. They are prone to being transported far into the basin by wind and water (Batten, 1996). Spores are rare.

The samples plotted in the AOM-Phytoclast-Palynomorph ternary diagram (Fig. 10) occurred in palynofacies fields III and V, as defined by Tyson (1989), and represent a proximal shelf and an oxic shelf (distal shelf). The palynofacies data are plotted; the phytoclasts/palynomorph axis displays the change from distal to proximal settings. Only sample Bjd E exhibits a higher content of degraded organic matter (AOM), which most likely corresponds to anoxia.

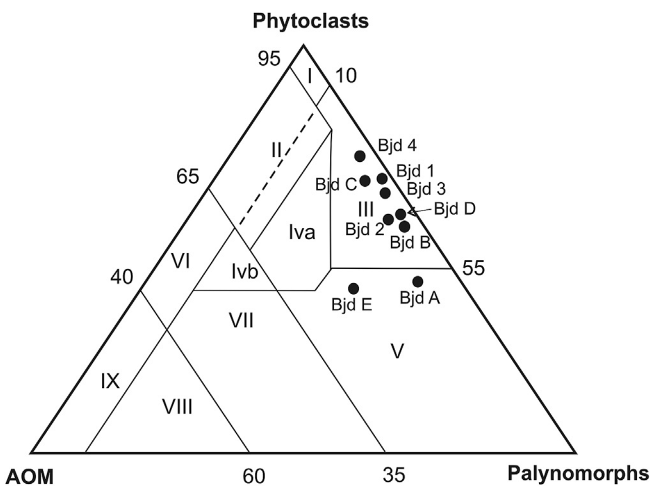

Fig. 10. AOM-Phytoclast-Palynomorph ternary diagram (after Tyson, 1989, 1993). The palynofacies of the studied samples indicate an oxic shelf setting.

Dinoflagellate cysts began to prevail in the interval between samples Bjd D and Bjd 1., A change in the composition of the assemblage of dinoflagellate cysts occurs simultaneously, while the share of a shallow marine declines markedly; on the contrary, the proportion of dinoflagellate cysts characteristic of the open neritic sea increases (*Chlamydoporella*, *Oligosphaeridium*, *Spiniferites*; Leereveld, 1995). Oceanic dinoflagellate cysts (*Pterodinium*; Leereveld, 1995; Michalík et al., 2008) and autochthonous elements can also be observed. From the palaeoecological point of view, the cysts correspond especially a neritic zone.

Two transgressive intervals can be distinguished based on the composition of palynofacies, palynomorphs and dinoflagellate cysts, i.e., the sample interval from Bjd A to Bjd D, and most likely from Bjd E to Bjd 1. The trend crossing deep-basin limestone sedimentation is documented by the increasing values of the ratio of opaque to translucent phytoclasts, as well as by an increase in marine palynomorphs (Götz et al., 2008).

The dinoflagellate cysts in the material are almost entirely warm-water taxa, indicating a relatively high sea surface temperature during deposition.

7. Conclusions

The collection of Serbian ammonites taxonomically studied in two subsets (Vašíček et al., 2013 and the present work) includes more than one hundred specimens with 27 species of ammonites, and 22 genera, among which seven new species were identified. Ammonites of the suborders Phylloceratina, Lytoceratina and Ammonitina (Desmoceratoidea) predominate; representatives of the suborder Ancyloceratina occur only sporadically. The dominant species (10–15% of the collection) are printed in bold.

Phylloceratina: *Hypophylloceras danubiense* n. sp., *H.* ex gr. *tethys* (d'Orbigny), *Lepeniceras lepense* Rabrenović, *Holcophylloceras avrami* n. sp., ***Phyllopachyceras baborense*** (Coquand), *P. petkovici* n. sp., *P. eichwaldi eichwaldi* (Karakash), and *P. ectocostatum* Drushchits.

Lytoceratina: ***Protetragonites crebrisulcatus*** (Uhlig) and *Eulytoceras phestum* (Matheron).

Ammonitina: ***Barremites balkanicus*** Manolov, *Montanesiceras breskovskii* Vašíček, Rabrenović, V. Radulović, B. Radulović and Mojsić, *Plesiospitidiscus boljetinensis* Vašíček, Rabrenović, V. Radulović, B. Radulović and Mojsić, *Barremitites strettostoma strettostoma* (Uhlig), *B. panae* Avram, *Torcapella serbiensis* Vašíček, Rabrenović, V. Radulović, B. Radulović and Mojsić, *Pseudohaploceras tachthaliae* (Tietze), *P. portaeferreae* (Tietze), *Melchiorites haugi* (Kilian), *Patruliusiceras* cf. *crenelatum* Avram, *Silesites trajani* (Tietze), and *S. seranonis* (d'Orbigny).

Ancyloceratina: *Dissimilites* cf. *trinodosus* (d'Orbigny), *Argvethites*? sp., and Macroscaphitidae? *Macroscaphites* cf. *recticostatus* (d'Orbigny), *Macroscaphites perforatus* Avram, and *Acantholytoceras* cf. *subcirculare* Avram.

It could be concluded that the Serbian section belongs stratigraphically to the lower part of the Upper Barremian, the upper part of the *Toxancyloceras vandenheckii* and *Gerhardia sartousiana* ammonite zones and the lower part of the *Imerites giraudi* Zone. The boundary between the *Toxancyloceras vandenheckii* and the *Gerhardia sartousiana* zones cannot be precisely defined in the section under study.

The composition of the ammonite fauna in the studied section (according to Westermann in Landman et al., 1996) corresponds to environments ranging from the epipelagic to the mesopelagic, from a distal shelf to below the edge of a continental slope.

The analysed samples contain the assemblage of dinoflagellates, which corresponds to the same stratigraphic interval as the ammonites.

From the palaeoecological point of view, the dinoflagellate cysts correspond especially well to the neritic zone with an influx of terrestrial material. It is also possible to assume a deepening of the sedimentation during the Late Barremian.

The assemblage of organic-walled dinoflagellates with a predominance of warm-water representatives indicates a relatively warm ocean.

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References

Aguirre-Urreta, M.B., 1986. Aptian ammonites from the Argentinian Austral Basin, the subfamily Helicancylinae Hyatt, 1894. Annals of the South African Museum 96, 271–314.

Anderson, F.M., 1938. Lower Cretaceous Deposits of the Pacific Coast. Proceedings of the California Academy of Sciences, Series 3. Geology 2, 1–154.

Andjelković, M., Nikolić, P., 1974. Tectonic regionalization of the Carpatho-Balkanides in eastern Serbia. Zbornik radova 16, 57–71 (in Serbian, English summary).

Andjelković, M., Nikolić, P., 1980. Tectonics of the Carpato-Balkanides of Yugoslavia. In: University of Belgrade Monographs 20, pp. 1–248 (in Serbian, English summary).

Arkell, W.J., Kummel, B., Wright, C.W., 1957. Mesozoic Ammonoidea. In: Moore, R.C. (Ed.), Treatise on Invertebrate Paleontology, Part L, Mollusca 4, Cephalopoda, Ammonoidea. The Geological Society of America and the University of Kansas Press, New York and Lawrence, pp. 80–437.

Avram, E., 1984. Correspondent species of the genera *Macroscaphites* Meek and *Costidiscus* Uhlig. In: 75 Years of the Laboratory of Paleontology (1906–1981), Special Volume, Bucharest, pp. 67–79.

Avram, E., 1995. Lower Cretaceous (Valanginian–Early Aptian) ammonite succession in the Sviniţa region (SW Rumania). Géologie Alpine, Mémoire Hors Serie 20 (1994), 113–167.

Avram, E., 2002a. The taxonomic position and biostratigraphic value of the genus *Pseudocrioceratites* Egoian, 1969 (Lytoceratina, Lower Cretaceous). Abhandlungen der Geologischen Bundesanstalt 57, 257–264.

Avram, E., 2002b. Representatives in Romania of the genera *Dissimilites* Sarkar, 1954 and *Toxoceratoides* Spath, 1924 (Ancyloceratina, Ammonoidea). Acta Palaeontologica Romaniae 3 (2001), 23–30.

Batten, D.J., 1996. Palynofacies and palaeoenvironmental interpretation. In: Jansonius, J., McGregor, D.C. (Eds.), Palynology: principles and applications. American Association of Stratigraphic Palynologists Foundation 3, Dallas, pp. 1011–1064.

Baudouin, C., Delanoy, G., Boselli, P., Bert, D., Boselli, M., 2012. Les faunes d'ammonites de la zone à Sarasini (Barrémien supérieur) dans les Baronnies (Drôme, France). Revue de Paléobiologie 31 (2), 601–677.

Bert, D., 2009. Description de *Artareites landii* nov. (Ammonoidea) du Barrémien supérieur de Majastre (Sud-Est de la France) et discussion sur les Helicancylidae Hyatt, 1894. Annales de Paléontologie 95, 139–163.

Busnardo, R., 2006. In: Fischer, J.-C., Gauthier, H., avec la collaboration de Busnardo, R., Combemorel, R., Delanoy, G., Guérin-Franiatte, S., Joly, B., Kennedy, W.J., Sornay, J., Tintant, H. (Eds.), *Macroscaphites striatisulcatus* (d'Orbigny, 1841). Premiere partie, Révision critique de la Paléontologie française d'Alcide d'Orbigny, volume IV. Céphalopodes crétacés. Backhuys, Leiden, p. 55.

Busnardo, R., Joly, B., 2006. In: Fischer, J.-C., Gauthier, H., avec la collaboration de Busnardo, R., Combemorel, R., Delanoy, G., Guérin-Franiatte, S., Joly, B., Kennedy, W.J., Sornay, J., Tintant, H. (Eds.), *Phyllopachyceras rouyanum* (d'Orbigny, 1841). Premiere partie, Révision critique de la Paléontologie française d'Alcide d'Orbigny, volume IV. Céphalopodes crétacés. Backhuys, Leiden, p. 132.

Collignon, M., 1937. Paléontologie de Madagascar, XXII. Les ammonites pyriteuses de l'Aptien d'Antanatanamirafy. Annales de Paléontologie 26, 107–132.

Collignon, M., 1949. Faune néocomienne des couches à Criocères de Belohasifaka (Cercle de Sitampiky, Madagascar). Annales géologiques du Service des Mines de Madagascar 15, 53–86.

Coquand, H., 1880. Études supplémentaires sur la paléontologie algérienne. Bulletin de l'Académie Hippone, Bone 15, 1–449.

Delanoy, G., Joly, B., 1995. Sur quelques Phylloceratidae (Phylloceratina, Ammonoidea) du Barrémien supérieur du sud-est de la France. Mésogée 54, 121–138.

Dimitrova, N., 1967. Fosilite na Balgariya. 4. Dolna kreda. Glavonogi (Nautiloidea and Ammonoidea). Izd. B'lgarska Akademiya na naukite, Sofiya, 424 pp. (in Bulgarian, French summary).

Drushchits, V.V., 1956. Nizhnemelovye ammonity Kryma i Severnogo Kavkaza (litoceratidy, tetragonitidy i filoceratidy). Izdatel'stvo Moskovskogo Universiteta, Moskva, 149 pp. (in Russian).

Duxbury, S., 1977. A palynostratigraphy of the Berriasian to Barremian of the Speeton Clay of Speeton, England. Palaeontographica, Abt. B 160, 17–67.

Ebbo, L., Poupon, A., Delanoy, G., 2000. Nouvelles données paléontologoques sur le genre *Dissimilites* Sarkar, 1954. Annales de Paléontologie 86, 91–99.

Egoian, V.L., 1969. Ammonity iz klansejskikh sloev Zapadnogo Kavkaza (Ammonites from the Clansayan of the Western Caucasus). Geologiya i neftegazonosnost' Zapadnogo Kavkaza i Zapadnogo Predkavkaz'ya (Fauna i stratigrafiya mezozoya i kajnozoya). Trudy Krasnodarskogo Filiala Vsesojuznogo Neftegazovogo Nauchno–issledovatel'skogo Instituta 19, 126–317. Nedra, Moskva (in Russian).

Eichwald, E.I., 1868. Lethaea rossica ou paléontologie de la Russie. Band 2. Periode moyenne, Stuttgart, 1304 pp.

Fatmi, A.N., Rawson, P.F., 1993. The first Early Cretaceous ammonite faunas from Baluchistan. Cretaceous Research 14, 91–100.

avec la collaboration de, 2006. Premiere Partie. Révision critique de la Paléontologie française d'Alcide d'Orbigny. In: Céphalopodes crétacés, volume IV, 292 pp. Seconde Partie. Réédition du tome premier (terrains crétacés, Céphalopodes) de la Paléontologie française d'Alcide d'Orbigny (édition originale), 662 pp. & Supplément (terrains crétacés) à la Paléontologie française d'Alcide d'Orbigny (édition originale 1847), 28 pp. Backhuys, Leiden.

Gabb, W., 1869. Cretaceous and Tertiary fossils: Description of new species. Geological Survey of California. Paleontology 2, 1–299.

Götz, A.E., Feist-Burkhardt, S., Ruckwied, K., 2008. Palynofacies and sea-level changes in the Upper Cretaceous of the Vocontian Basin, southeast France. Cretaceous Research 29, 1047–1057.

Harding, I.C., 1990. A dinocyst calibration of the European boreal Barremian. Palaeontographica, Abt. B 218, 1–76.

Heinz, Ch, 1886. Ammonites décrites par H. Coquand dans le Bulletin de l'Académie d'Hippone, No 15. Bulletin de l'Académie d'Hippone 21, 5 pl.

Hoffmann, R., 2009. Lower Cretaceous Ammonites IV, pars 146, foot-note 61 to Protetragonites. In: Klein, J., Hoffmann, R., Joly, B., Shigeta, Y., Vašíček, Z., Riegraf, W. (Eds.), Fossilium Catalogus I: Animalia. Backhuys Publishers, Leiden and Margraf Publishers, Weikersheim, p. 134.

Honnorat-Bastide, E.F., 1892. Sur une forme nouvelle de Céphalopodes du Crétacé inférieur des Basses–Alpes. Feuille des jeunes naturalistes 22, 241–242.

Hyatt, A., 1900. Cephalopoda. In: Zittel, K.A. von (Ed.), Textbook of Palaeontology (translated by Eastman, C.R.). Macmillan, London & New York, pp. 502–604.

Joleaud, L., 1912. Étude géologique de la Chaine Numidique et des Monts de Constantine (Algérie). Unpublished PhD thesis. Montane–Sicardi et Valentin éditeur, Montpellier (for 1911), 437 pp.

Joly, B., 1993. Les Phyllocerataceae malgaches au Crétacé (Phylloceratina, Ammonoidea). Documents des Laboratoires de Géologie de la Faculté des Sciences de Lyon 127, 1–171.

Joly, B., 2000. Les Juraphyllitidae, Phylloceratidae, Neophylloceratidae (Phyllocerataceae, Phylloceratina, Ammonoidea) de France au Jurassique et au Crétacé. Mémoire Spécial Geobios 23 et Mémoire de la Société géologique de France 174, 1–202.

Joly, B., 2006. In: Fischer, J.-C., Gauthier, H. (Eds.), *Phyllopachyceras infundibulum* (d'Orbigny, 1841). Premiere partie, Révision critique de la Paléontologie française d'Alcide d'Orbigny, volume IV. Céphalopodes crétacés. Backhuys, Leiden, pp. 41–42.

Joly, B., Delamette, M., 2008. Les Phylloceratoidea (Ammonoidea) aptiens et albiens du bassin vocontien (Sud-Est de la France). Carnets de Géologie – Notebooks on Geology 2008/4, 1–60.

Kakabadze, I.M., Kakabadze, M.V., Kvantaliani, I.V., Kotetishvili, E.V., Shirikadze, M.Z., 2005. Otryad Ancyloceratida. In: Topchishvili, M.V. (Ed.), Atlas rannemelovoj fauny Gruzii (Atlas of Early Cretaceous fauna of Georgia) 120. Akademiya nauk Gruzii, Trudy Geologicheskogo Instituta im. A. I. Dzhanelidze, Novaya seriya, pp. 346–403 (in Russian).

Karakash, N.I., 1895. Zur Frage über die Synonymie von *Phylloceras infundibulum* und *Phylloceras Rouyi*. Geologische und mineralogische Mittheilungen der St Petersburger Gesellschaft der Naturforschung 4, 1–13.

Karakash, N.I., 1907. Nizhnemelovye otlozheniya Kryma i ikh fauna. Trudy Imperatorskogo S.-Petersburgskogo Obshchestva Estestvoispytatelej. Otdelenie Geologii i Mineralogii 32, 1–482 (in Russian with French summary).

Khalilov, A.G., 1962. Karlikovye Phylloceratidae nizhnego mela Jugo-Vostochnogo Kavkaza. Izvestiya Akademii nauk Azerbajdzhanskoj SSR, geologiya–geografiya 4, 39–56 (in Russian).

Khalilov, A.G., 1988. Nadotryad Ammonoidea. In: Ali-Zade, A.A. (Ed.), Melovaya fauna Azerbajdzhana. Akademiya nauk Azerbajdzhanskoj SSR, Institut Geologii im. I.M. Gubkina, Izdatel'stvo Ëlm, Baku, pp. 333–364 (in Russian).

Klein, J., Busnardo, R., Company, M., Delanoy, G., Kakabadze, M., Reboulet, S., Ropolo, P., Vašíček, Z., Vermeulen, J., 2007. Lower Cretaceous Ammonites III. Bochianitoidea, Protancyloceratoidea, Ancyloceratoidea, Ptychoceratoidea. In: Riegraf, W. (Ed.), Fossilium Catalogus I: Animalia. Backhuys Publishers, Leiden part 144, 381 pp.

Klein, J., Hoffmann, R., Joly, B., Shigeta, Y., Vašíček, Z., 2009. Lower Cretaceous Ammonites IV. Borreophylloceratoidea, Phylloceratoidea, Lytoceratoidea, Tetragonitoidea, Haploceratoidea including the Upper Cretaceous representatives. In: Riegraf, W. (Ed.), Fossilium Catalogus I: Animalia. Backhuys Publishers, Leiden & Margraf Publishers, Weikersheim part 146, 416 pp.

Korn, D., Ebbighausen, V., Bockwinkel, J., Klug, C., 2003. The A-mode sutural ontogeny in prolecanitid ammonites. Palaeontology 46, 1123–1132.

Leereveld, H., 1995. Dinoflagellate cysts from the Lower Cretaceous Río Argos succession (SE Spain). Laboratory of Palaeobotany and Palynology. Contribution Series 2, 1–175.

Leereveld, H., 1997. Hauterivian–Barremian (Lower Cretaceous) dinoflagellate cyst stratigraphy of the western Mediterranean. Cretaceous Research 18, 421–456.

Meek, F.B., 1876. A report on the invertebrate Cretaceous and Tertiary fossils of the Upper Missouri Country. In: Hayden, F.V. (Ed.), Report of the United States Geological and Geographical Surveys of the Territories 9 xiv + 629 pp.

Michalík, J., Soták, J., Lintnerová, O., Halásová, E., Bak, M., Skupien, P., Boorová, D., 2008. The stratigraphic and paleoenvironmental setting of Aptian OAE black shale deposits in the Pieniny Klippen Belt, Slovak Western Carpathians. Cretaceous Research 29, 871–892.

Murphy, M.A., Rodda, P.U., 2006. California Early Cretaceous Phylloceratidae (Ammonoidea). University of California, Riverside Campus Museum, Contribution 7, pp. 1–97.

Neumayr, M., 1871. Die Phylloceraten des Dogger und Malm. Jahrbuch der Kaiserlich–Königlichen geologischen Reichsanstalt 21, 297–378.

d'Orbigny, A., 1840–1842. Paléontologie française. Description zoologique et géologique de tous animaux mollusques et rayonnés fossiles de France. In: Terrains Crétacés, Volume 1. Céphalopodes. Arthus-Bertrans, Paris, 662 pp.

d'Orbigny, A., 1852. Notice sur le genre *Hamulina*. Journal de Conchyliologie 3, 217–222.

Petković, V.K., 1921. O baremskom katu na Grebenu. Glas Srpske kraljevske akademije 95, 35–78 (in Serbian).
Prössl, K.F., 1990. Dinoflagellaten der Kreide. Unter-Hauterive bis Ober-Turon im niedersächsischen Becken. Stratigraphie und Fazies in der Kernbohrung Konrad 101 sowie einiger anderer Bohrungen in Nordwestdeutschland. Palaeontographica, Abt. B 218, 93–191.
Puzos, M., 1832. Sur le *Scaphites yvani*. Bulletin de la Société géologique de France 2, 355–356.
Rabrenović, D., 1989. *Lepeniceras* n. gen. iz barema sa Grebena kod D. Milanovca (I. Srbija). Geološki anali Balkanskoga poluostrva 53, 367–372 (in Serbian with English summary).
Rabrenović, D., 1991. Stratigrafija donje krede sa cefalopodima od Grebena na Dunavu do Novog Korita, istočna Srbija (Stratigraphy of the Lower Cretaceous with cephalopods from Greben on the Danube to Novog Korito, E Serbia). Unpublished PhD thesis, 262 pp.. Faculty of Mining and Geology, University of Belgrade (in Serbian).
Raspail, F.V., 1831. Histoire naturelle des Ammonites, suivie de la description des Ammonites des Basses Alpes et des Cévennes. Le Lycée. des sciences et des sociétés savantes 27, 1–115.
Reboulet, S., Rawson, P.F., Moreno-Bedmar, J.A. (reporters), Aguirre Urreta, M.B., Barragán, R., Bogomolov, Y., Company, M., Gonzáles-Arreola, C., Idakieva Stoyanova, V., Lukeneder, A., Matrion, B., Mitta, V., Randrianaly, H., Vašíček, Z., Baraboshkin, E., Bert, D., Bersac, S., Bogdanova, T.N., Bulot, L.G., Latil, J.-L., Mikhailova, I.A., Ropolo, P., Szives, O., 2011. Report on the 4th International Meeting of IUGS Lower Cretaceous Ammonite Working Group, the "Kilian Group" (Dijon, France, 30th August 2010). Cretaceous Research 32, 786–793.
De Renéville, P.D., Raynaud, J.F., 1981. Palynologie du stratotype du Barrémien. Bulletin des Centres de Recherches et de Exploration-Production. Elf-Aquitaine 5 (1), 1–29.
Rouchadzé, I., 1933. Les ammonites Aptiennes de la Géorgie occidentale. Bulletin de l'Institut géologique de Géorgie 1 (1932), 165–273.
Rousseau, L., 1842. Déscription principaux fossiles de la Crimée. In: Démidoff, A. de, et al. (Eds.), Voyage dans la Russie méridionale et la Crimée, par l'Hongrie, la Valachie et la Moldavie, exécute en 1837, sous la direction de M. Anatole de Démidoff, Louis Rousseau, Alexander von Nordmann et Adolphe du Ponceau 2. Bourdin, Paris, pp. 781–824.
Salfeld, H., 1924. Die Bedeutung der Konservativstämme für die Stammesentwicklung der Ammonoideen. Grundlinien für die Erforschung der Entwicklung der Ammonoideen der Jura- und Kreidezeit. Verlag Max Weg, Leipzig, 16 pp.
Sarkar, S.S., 1954. Some new genera of uncoiled ammonites from Lower Cretaceous. Science and Culture 19, 618–620.
Skupien, P., Smaržová, A., 2011. Palynological and geochemical response to environmental changes in the Lower Cretaceous in the Outer Western Carpathians; a record from the Silesian unit, Czech Republic. Cretaceous Research 32, 538–551.
Skupien, P., Vašíček, Z., 2002. Lower Cretaceous ammonite and dinocyst biostratigraphy and paleoenvironment of the Silesian Basin (Outer Western Carpathians). Geologica Carpathica 53 (3), 179–189.
Spath, L.F., 1923. A monograph of the Ammonoidea of the Gault. In: Part 1. Monograph of the Palaeontographical Society (for 1921). London, 72 pp.
Spath, L.F., 1924. On the ammonites of the Speeton Clay and the subdivions of Neocomian. Geological Magazine 61, 73–89.
Spath, L.F., 1925. Sur quelques ammonites de Gault nommées par P. Reynés. Annales du Musée d'Histoire Naturelle de Marseille 20, 98–105.
Spath, L.F., 1927. Revision of the Jurassic Cephalopod Fauna of Kachh (Cutch). Part 1. Memoirs of the Geological Survey of India. Palaeontologia Indica (new series) 9, 1–71.
Stanton, T.W., 1896. Contributions to the Cretaceous paleontology of the Pacific Coast: The fauna of the Knoxville Beds. Bulletin of the United States Geological Survey 133 (for 1895), 1–132.
Svobodová, M., Hradecká, L., Skupien, P., Švábenická, L., 2004. Microfossils of the Albian and Cenomanian shales from the Štramberk area (Silesian unit, Outer Western Carpathians, Czech Republic). Geologica Carpathica 55, 371–388.
Sharikadze, M.Z., 2005. Ammonity, otryad Phylloceratida. In: Topchishvili, M.V. (Ed.), Atlas rannemelovoj fauny Gruzii (Atlas of Early Cretaceous fauna of Georgia) 120. Trudy Geologicheskogo Instituta im. A.I. Dzhanelidze, novaya seriya, pp. 284–287 (in Russian).
Tchoumatchenco, P., Rabrenović, D., Radulović, V., Radulović, B., Malešević, N., 2011. Trans-border (east Serbia/west Bulgaria) correlations of the morpho-tectonic structures. Geološki anali Balkanskoga poluostrva 72, 1–6.
Tietze, E., 1872. Geognostische und paläontologische Mittheilungen aus dem südlichen Teil des Banater Gebirgsstockes. Jahrbuch der Kaiserlich-Königlichen geologischen Reichsanstalt 22, 35–142.
Tyson, R.V., 1989. Late Jurassic palynofacies trends, Piper and Kimmeridge Clay Formations, UK onshore and offshore. In: Batten, D.J., Keen, M.C. (Eds.), Nortwest European Micropalaeontology and Palynology, British Micropalaeontological Society, Series. Ellis & Horwood, Chichester, pp. 135–172.
Tyson, R.V., 1993. Palynofacies analysis. In: Jenkins, D.G. (Ed.), Applied Micropaleontology. Kluwer Academic Publishers, Dordrecht, pp. 153–191.
Uhlig, V., 1882. Die Wernsdorfer Schichten und ihre Äquivalente. Sitzungsberichte der Kaiserlichen Akademie der Wissenschaften in Wien, mathematisch-naturwissenschaftliche Classe 86, 86–117.
Uhlig, V., 1883. Die Cephalopodenfauna der Wernsdorfer Schichten. Denkschriften der Kaiserlichen Akademie der Wissenschaften, mathematisch-naturwissenschaftliche Classe 46, 127–290.
Vasić, N., Rabrenović, D., Jankičević, J., 1998. Mesozoic formations of the eastern Serbia Danubicum, 13th Congress of Yugoslavian geologists, 2, Regional geology, stratigraphy and palaeontology, pp. 133–144. Herceg Novi.
Vašíček, Z., 1972. Ammonoidea of the Těšín-Hradiště Formation (Lower Cretaceous) in the Moravskoslezské Beskydy Mts. Rozpravy Ústředního ústavu geologického 38, 1–104.
Vašíček, Z., 1973. Über einige von V. Uhlig (1883) beschriebene Unterkreide-Ammoniten. Sborník geologických věd. Paleontologie 15, 49–74.
Vašíček, Z., 2008. Barremian and Early Aptian ammonites from the Godula Facies of the Silesian Unit in the Outer Western Carpathians, Czech Republic. Acta Geologica Polonica 58, 407–423.
Vašíček, Z., Rabrenović, D., Radulović, V., Radulović, B., Mojsić, I., 2013. Ammonoids (Desmoceratoidea and Silesitoidea) from the Late Barremian of Boljetin, Eastern Serbia. Cretaceous Research 41, 39–54. http://dx.doi.org/10.1016/j.cretres.2012.10.002.
Vermeulen, J., 2003. Ammonites nouvelles ou peu connues du Barrémien méditerranéen. Annales du Muséum d'Histoire Naturelle de Nice 18, 57–109.
Vermeulen, J., 2004. Vers une nouvelle classification à fondement phylogénétique des ammonites hétéromorphes du Crétacé inférieur méditerranéen. Le cas de Crioceratitidae Gill, 1871, *nom. correct* Wright, 1952, des Emericiceratidae fam. nov. et des Acrioceratidae fam. nov. (Ancyloceratаceae Gill, 1871). Riviéra Scientifique 88, 69–92.
Vermeulen, J., 2006. Nouvelle classification à fondement phylogénétique des ammonites hétéromorphes du Crétacé inférieur. Annales du Muséum d'Histoire Naturelle de Nice 21, 137–178.
Vermeulen, J., 2007a. Sur deux espéces nouvelles de la Famille des Macroscaphitidae Hyatt, 1900 (Ammonoidea, Lytocrioceratаceae). Riviéra Scientifique 90 (2006), 77–92.
Vermeulen, J., 2007b. Lower Cretaceous ammonites III, pars 144, foot-note 257 to *Macroscaphites perforatus*. In: Klein, J., Busnardo, B., Company, M., Delanoy, G., Kakabadze, M., Reboulet, S., Ropolo, P., Vašíček, Z., Vermeulen, J., Riegraf, W. (Eds.), Fossilium Catalogus I: Animalia. Backhuys Publishers, Leiden, p. 295.
Vermeulen, J., 2010. Sur les familles des Helicancylidae Hyatt, 1894 et des Acrioceratidae Vermeulen, 2004; réponses et precisions apportées au travail de Bert, 2009. Annales de Paléontologie 96, 61–65.
Westermann, G.E.G., 1996. Ammonoid Life and Habitat. In: Landman, N., Tanabe, K., Davis, R.A. (Eds.), Ammonoid Paleobiology, vol. 13. Plenum Press, New York and London, pp. 607–707.
Wiedmann, J., 1962. Unterkreide-Ammoniten von Mallorca. 1. Lieferung: Lytoceratina, Aptychi. Akademie der Wissenschaften und der Literatur in Mainz. Abhandlungen der mathematisch-naturwissenschaftlichen Klasse 1 (for 1962), 1–148.
Wiedmann, J., 1964. Unterkreide-Ammoniten von Mallorca. 2. Lieferung: Phylloceratina. Akademie der Wissenschaften und der Literatur in Mainz. Abhandlungen der mathematisch-naturwissenschaftlichen Klasse 4 (for 1963), 151–264.
Wilpshaar, M., 1995. Aplicability of dinoflagellate cyst stratigraphy to the analyses of passive and active tectonic settings. Geologica Ultraiectina 134, 1–132.
Wright, C.W., Callomon, J.H., Howarth, M.K., 1996. Cretaceous Ammonoidea. Treatise on Invertebrate Paleontology. In: Part L Mollusca 4, revised. The Geological Society of America and the University of Kansas, Boulder and Lawrence, 362 pp.