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Turonian (Upper Cretaceous) inoceramid bivalves of the genus *Mytiloides* from the Sredna Gora Mountains, north-western Bulgaria

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ABSTRACT**:**

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The inoceramid bivalves of the genus *Mytiloides*, from the Turonian (Upper Cretaceous) of the Sredna Gora Mts (north-western Bulgaria), are studied. The material comes from three sections: Izvor, Filipovtsi, and Vrabchov dol. Eight species are described taxonomically, with one left in open nomenclature: *M.* cf. *mytiloides* (Mantell, 1822), *M. mytiloidiformis* (Tröger, 1967), *M. incertus* (Jimbo, 1894), *M. scupini* (Heinz, 1930), *M. herbichi* (Atabekian, 1969), *M. striatoconcentricus* (Gümbel, 1868), *M. labiatoidiformis* (Tröger, 1967) and *M. carpathicus* (Simionescu, 1899). *Mytiloides incertus* and *Mytiloides scupini* are index species for the eponymous Upper Turonian inoceramid biozones.

Key words: Turonian; Inoceramid bivalves; Taxonomy; *Mytiloides*; Biostratigraphy.

INTRODUCTION

The Turonian (Upper Cretaceous) inoceramid bivalves studied herein, come from the Srednogorie Zone (Sredna Gora Mountains) of north-western Bulgaria. The lower part of the Turonian succession of this zone is quite fossiliferous in the area, with inoceramid bivalves particularly abundant.

During the Cretaceous, the Srednogorie Zone formed an arc/backarc basin system within the Alpine orogenic belt. The zone was composed of a chain of strike-slip and pull apart basins, with unified sedimentary sequences, and with semi-basic volcanic or volcano-sedimentary rocks intermixed. The Srednogore Zone is subdivided into the Western, Central and Eastern parts, based mainly on the basement characteristics and evolution (Text-fig. 1A).

The study area is located in the Western Srednogorie, in the tectonic unit of Lubash-Golo Bardo (Text-fig. 1B). The Upper Cretaceous succession of the unit is represented by a few informal litostratigraphic units (after Kostainov and Chunev 1995) (Text-fig. 1B):

Coal-bearing unit (Lower Turonian); consisting of irregularly bedded fine-grained to pebble-size sands, silts and clays with coal lenses and lateral changes in thickness between 15 and 200 m.

Marly-limestone unit (Middle Turonian–Lower Coniacian); consisting of irregular alternation of thin- to medium-bedded limestone (sandy, clayey, bioclastic, glauconitic) and thin- to medium-bedded marls, with rare white to grey silicate horizons; up to 200 m thick.

Limestone-marly unit (Santonian); composed of white to grey sandy and clayey limestone with silty and clayey marl horizons; 10 to 150 m in thickness.

Marly-sandstone-conglomerate unit (Campanian); in the lower part composed of yellow to red sandstone and conglomerate; in the middle and upper parts composed of grey to beige sandstone, siltstone and marl; up to 350 m thick.

Silty-greywacke flysch unit (Campanian–Maastrichtian); consisting of irregularly bedded, thin-bedded sandstone, sandy and clayey limestone and grey to beige marl; up to 250 m thick.

The Turonian succession reported herein, exposed in sections near the villages of Izvor, Filipovtsi and Vrabcha (Vrabchov dol), represents the 'coal-bearing' and 'marl-limestone' units (Text-figs 1B, 2).

The 'coal-bearing' unit is represented only in the lowest part of the Izvor section.

The lower part of the 'marl-limestone' unit is represented in the Izvor and Vrabchov dol sections and consists mainly of marls with thin- to medium-bedded clayey limestone horizons. The upper part of this unit, accessible in the Filipovtsi section, consists mainly of thin- to medium-bedded limestones, with medium- to thick-bedded beige sandstone and sandy siltstone horizons. Its middle part is accessible in the Vrabchov dol section, where it consists of irregular alternations of grey to light grey thin- to medium-bedded limestone and thin-bedded marl, with siliciclastic horizons in the lower and middle parts of the alternations. The upper part of the unit consists entirely of grey thin-bedded marl (Text-fig. 2).

The inoceramid material studied herein, collected during 2009 and 2010, comes from the Izvor, Filipovtsi and Vrabchov dol sections (Text-fig. 1). This paper provides taxonomic descriptions of representatives of the genus *Mytiloides*, and attempts to apply a zonation based on the group.

PREVIOUS RESEARCH

The first report on inoceramid faunas from the area was published by Jolkičev (1962); it was based, however, on only a few specimens. The main palaeontological investigations in the Western Srednogorie Zone were conducted by Tsankov (1982) and Tsankov *et al.* (1981), who studied the ammonites, inoceramid bivalves and echinoids. Minev (1994) published a detailed description of the Turonian ammonites form the Breznik area.

Tsankov *et al.* (1981) documented in detail the Upper Cretaceous sediments between the towns of Breznik and Slivnitsa. Dimitrova *et al.* (1981) proposed a foraminiferal zonal scheme for the Upper Cretaceous of the area. Based on nannofossils, Sinnyovski (1993) studied the Upper Cretaceous successions in part of the Western Srednogorie Zone, including those exposed in the Izvor, Filipovtsi and Vrabcha sections, and proposed nine nannofossil zones for the Turonian through Maastrichtian interval. Kostadinov and Chunev (1995) proposed an informal lithostratigraphic subdivision of the Upper Cretaceous of the Western Srednogorie Zone. An integrated biostratigraphy of the Turonian of southwestern Bulgaria was published by Minev *et al.* (1996), based on ammonites, foraminifers, dinoflagellate cysts, pollen and spores.

INOCERAMID RECORD

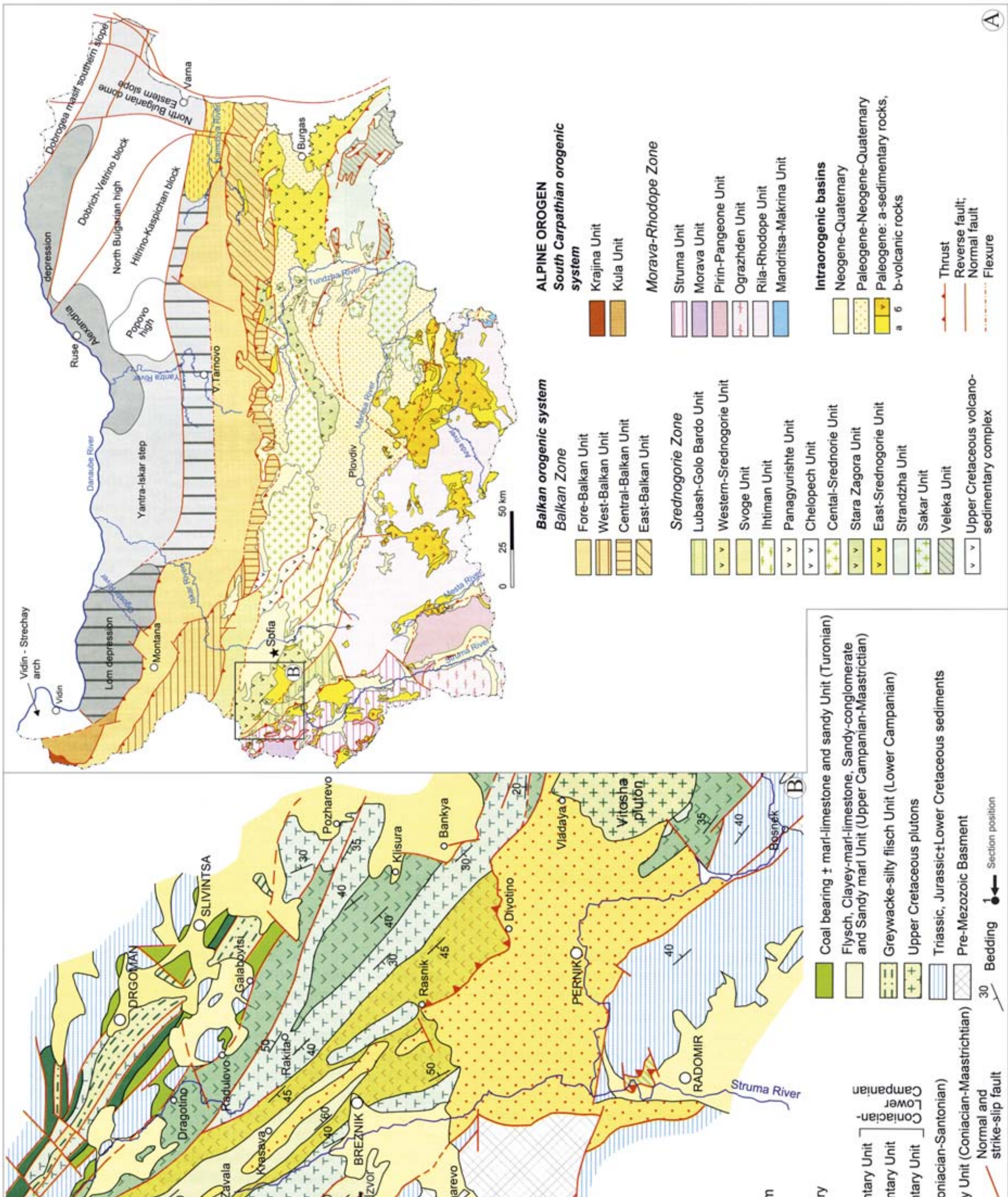
The inoceramid bivalves described in this paper span an interval from the lower Middle Turonian through to the upper Upper Turonian. The group is dominated by representatives of the genus *Mytiloides,* while the genus *Inoceramus* is represented by only a few specimens.

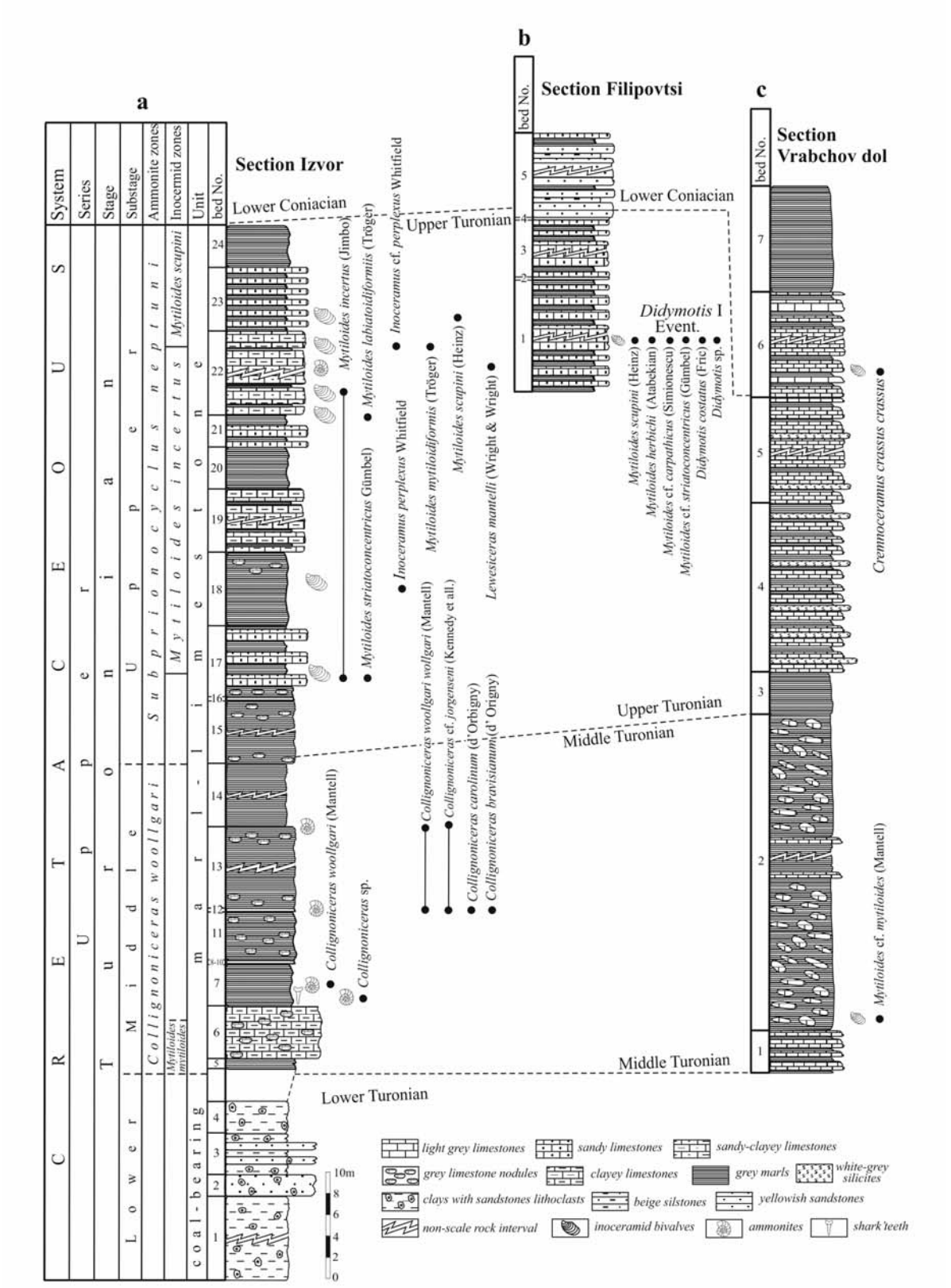
Most of the studied specimens come from the middle and upper parts of the Izvor section (Text-fig. 2). In the lower part of bed 17, there occur *Mytiloides incertus* (Jimbo) and *Mytiloides striatoconcentricus* (Gümbel). *Inoceramus perplexus* Whitfield is the only species found in bed 18. The inoceramid fauna in both beds characterizes the *Mytiloides incertus* Zone (Text-fig. 3). Bed 22 is the most inoceramid-rich interval. It yielded *Mytiloides incertus* (Jimbo), *Mytiloides labiatoidiformis* (Tröger), *Mytiloides mytiloidiformis* (Tröger), *Mytiloides scupini* (Heinz) and rare *Inoceramus* cf. *perplexus* Whitfield. This inoceramid association corresponds to the upper part of the *Mytiloides incertus* Zone (Text-fig. 3). The first appearance of *M. scupini*, in the lower part of bed 23, marks the base of the eponymous zone.

The inoceramid assemblage found in the lower part of the sandy limestone of bed 1 of the Filipovtsi section (Text-fig. 2) is represented by *M. scupini*, *Mytiloides herbichi* (Atabekian), *Mytiloides* cf. *carpathicus* (Simionescu) and *M.* cf. *striatoconcentricus*. These taxa are associated with the genus *Didymotis*, and mark the *Didymotis* I Event, characteristic of the *M. scupini* Zone (Walaszczyk and Wood 1999).

The fossils from the lower part of the Vrabchov dol section were collected from grey limestone nodules. Only a few inoceramid specimens were found, and

Text-fig. 1. Geological map of Bulgaria with main structural units (A) and geological and geographical position of the study area (B) (after Georgiev and Dabovski 1997; Dabovski *et al*. 2002 and Geological map of Bulgaria on scale 1:100 000, modified)


A
B
ALPINE OROGEN
South Carpathian orogenic system
Krajina Unit
Kula Unit
Morava-Rhodope Zone
Struma Unit
Morava Unit
Pirin-Pangeone Unit
Ograzhden Unit
Rila-Rhodope Unit
Mandritsa-Makrina Unit
Intraorogenic basins
Neogene-Quaternary
Paleogene-Neogene-Quaternary
Paleogene: a-sedimentary rocks, b-volcanic rocks
Thrust
Reverse fault; Normal fault
Flexure
Balkan orogenic system
Balkan Zone
Fore-Balkan Unit
West-Balkan Unit
Central-Balkan Unit
East-Balkan Unit
Srednogorie Zone
Lubash-Golo Bardo Unit
Western-Srednogorie Unit
Svoge Unit
Ihtiman Unit
Panagyurishte Unit
Chelopech Unit
Cental-Srednorie Unit
Stara Zagora Unit
East-Srednogorie Unit
Strandzha Unit
Sakar Unit
Veleka Unit
Upper Cretaceous volcano-sedimentary complex
Neogene and Quaternary
Paleogene
Upper volcano-sedimentary Unit
Middle volcano-sedimentary Unit
Lower volcano-sedimentary Unit
Coniacian-Lower Campanian
Limestone-marl Unit (Coniacian-Santonian)
Limestone-clayey-sandy Unit (Coniacian-Maastrichtian)
Reverse fault
Normal and strike-slip fault
Coal bearing ± marl-limestone and sandy Unit (Turonian)
Flysch, Clayey-marl-limestone, Sandy-conglomerate and Sandy marl Unit (Upper Campanian-Maastrichtian)
Greywacke-silty flisch Unit (Lower Campanian)
Upper Cretaceous plutons
Triassic, Jurassic+Lower Cretaceous sediments
Pre-Mezozoic Basment
Bedding
Section position
Sofia
Plovdiv
Burgas
Varna
Ruse
Vidin
Montana
V.Tarnovo
PERNIK
RADOMIR
BREZNIK
DRGOMAN
SLIVINTSA
Struma River
Vitosha pluton
0 2 4 6 8 km
0 25 50 km



Text-fig. 2. Lithological logs, inoceramid and ammonite occurrences in sections studied: **a** – section in the village of Izvor; **b** – section in the village of Filipovtsi; **c** – section in the village of Vrabcha

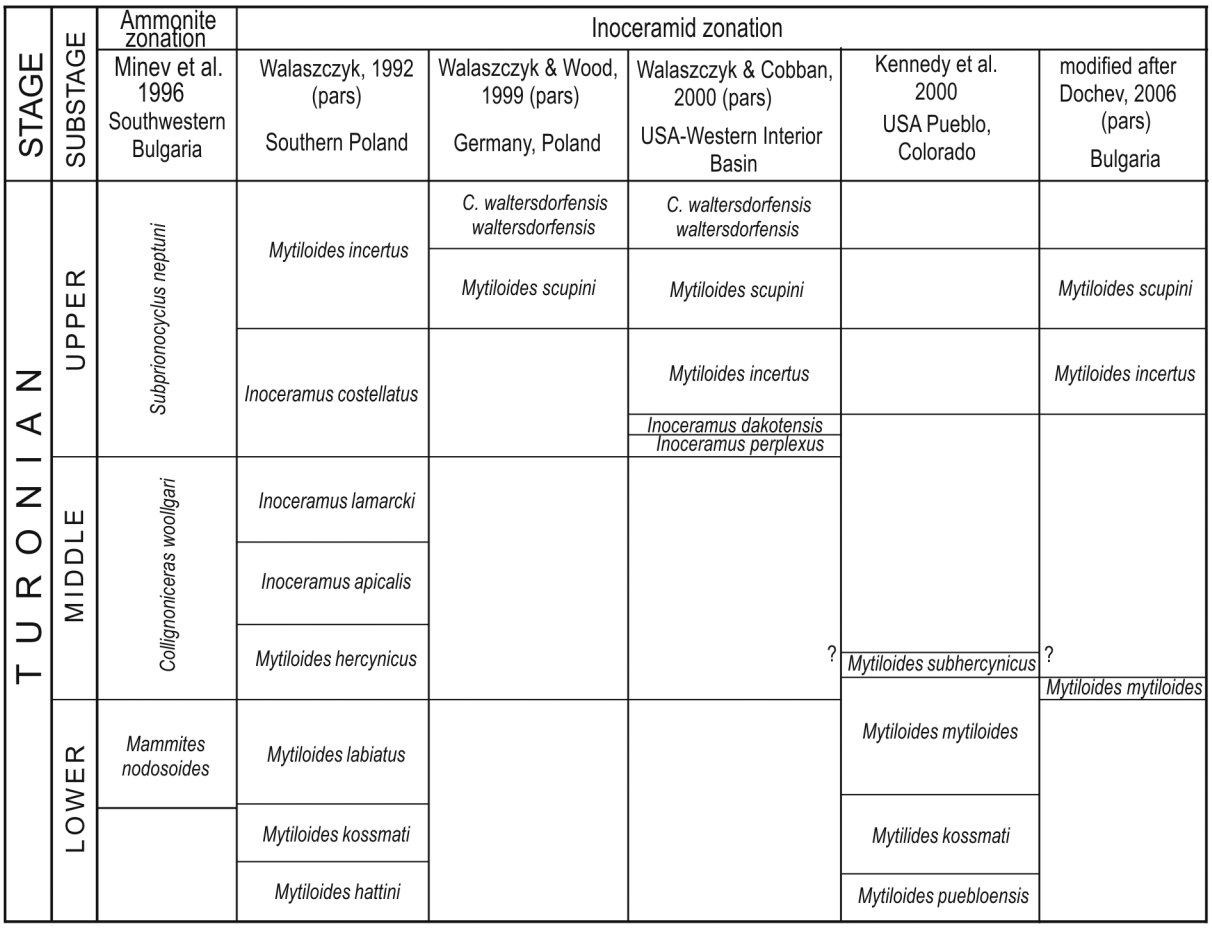
they are referred here to *Mytiloides* cf. *mytiloides* (Mantell). Their co-occurrence with the ammonite *Collignoniceras woollgari* (Mantell) indicates the uppermost part of the *M. mytiloides* Zone, which ranges into the basal Middle Turonian, *C. woollgari* ammonite Zone (Text-figs 2, 3).

Although inoceramids dominate the fossil record, the lower part of the Izvor section yielded a relatively abundant ammonite fauna (Text-fig. 2). The first ammonites, represented by *C. woollgari* and *Collignoniceras* sp., came from bed 7. A rich collignoniceratid assemblage, with *C. woollgari woollgari* (Haas), *Collignoniceras* cf. *jorgenseni* Kennedy *et al*., *Collignoniceras carolinum* (d'Orbigny) and *Collignoniceras bravaisianum* (d'Orbigny), was found a little bit higher, in beds 12 and 14. The whole interval spans the lowermost Middle Turonian, *C. woollgari* Zone (see Kennedy 1984; Kennedy *et al.* 2001). A single specimen of *Lewisiceras mantelli* (Wright and Wright) came from bed 22, and is apparently of Late Turonian age.

INOCERAMID ZONATION

The inoceramid taxa recognized and described from the study area are known in most of the European and US Western Interior sections (Walaszczyk 1992; Walaszczyk and Wood 1999; Walaszczyk and Cobban 2000; Kennedy *et al.* 2000). This enables us to attempt inoceramid-based correlations with these areas (Poland: Walaszczyk 1992; Germany and Poland: Walaszczyk and Wood 1999; United States Western Interior Basin: Walaszczyk and Cobban 2000 and Kennedy *et al.* 2000) (Text-fig. 3) and application of the biozones recognized there to the Bulgarian sections. The ammonite zonation for the Turonian of south-west Bulgaria, referenced herein, is after Minev *et al.* (1996).

The following three inoceramid zones were recognized (in ascending order): *Mytiloides mytiloides* Zone; *Mytiloides incertus* Zone and *Mytiloides scupini* Zone (Text-fig. 3).



Text-fig. 3. Correlation of the inoceramid zonation applied in this paper with inoceramid zonations for Southern Poland (after Walaszczyk 1992), Germany and Poland (after Walaszczyk and Wood 1999), the US Western Interior (after Walaszczyk and Cobban 2000), USA Pueblo Colorado (Kennedy *et al.* 2000) and ammonite zonation of Minev *et al*. 1996 for Southern Bulgaria

***Mytiloides mytiloides* Range Zone**: The base of the zone is defined by the first appearance datum (FAD) and its upper boundary by the last appearance datum (LAD) of the index taxon. The zone was documented only in the lower part of the Vrabchov dol section, where apparently only its upper part is present. In complete successions the zone ranges from the upper Lower to basal Middle Turonian, ranging into the lower part of the Middle Turonian *Collignoniceras woollgari* ammonite Zone (Minev *et al.* 1996).

***Mytiloides incertus* Interval Zone**: The base of the zone is defined by the FAD of *M. incertus* and its upper boundary by the FAD of *Mytiloides scupini*. The presence of the zone is confirmed in the middle and the upper parts of the Izvor section. *M. striatoconcentricus* occurs in the lower part of the zone, whereas *M. labiatoidiformis* and *M. mytiloidiformis* dominate its upper part. The zone corresponds to the lower and upper parts of the *Subprionocyclus neptuni* ammonite Zone (Minev *et al.* 1996).

***Mytiloides scupini* Interval Zone**: The base of the zone is marked by the FAD of the index taxon and its upper boundary by the FAD of *Cremnnoceramus waltersdorfensis waltersdorfensis* (Andert, 1911). The zone was documented in the uppermost part of the Izvor section and in the lowermost part of the Filipovtsi section (see Text-fig. 2). The lower part of the zone yields an inoceramid assemblage dominated by *M. herbichi*, *M.* cf. *carpathicus*, *M.* cf. *striatoconcentricus* and *M. mytiloidiformis*. The zone corresponds to the upper part of the *Subprionocyclus neptuni* ammonite Zone (Minev *et al.* 1996).

MODE OF PRESERVATION OF INOCERAMIDS

The inoceramids in the studied sections are preserved as internal moulds and only a few specimens were found with shell fragments still attached. All of the specimens were collected from clayey and sandy limestones or marlstones. The fossils show various degrees of cracking and crushing and the collected specimens are represented by single valves. In some cases, the specimens preserved in marlstones or fine clayey limestones are more flattened with crushed and displaced rugae as a result of settling and compaction during the sedimentation process. In some specimens, the valves and rugae outline are deformed and overlap for the same reason. Much better preserved are specimens collected from the sandy limestones, commonly with their original outline and well preserved ornamentation.

SYSTEMATIC PALAEONTOLOGY

Eight species of the genus *Mytiloides* are described herein. The terms used for description of external morphology and ornamentation follow Harries *et al*. (1996).

Type Mollusca

Class Bivalvia Linné, 1758
Order Pterioida Newell, 1965
Suborder Pteriina Newell, 1965
Superfamily Inoceramoidea Giebel, 1852
Family Inoceramidae Giebel, 1852

Genus *Mytiloides* Brongniart, 1822

TYPE SPECIES. By monotypy, *Ostracites labiatus* Schlotheim, Schlotheim [= *Inoceramus* (*Mytiloides*) *labiatus* (Schlotheim), (Cox 1969, p. 320); = *Mytiloides labiatus* (Schlotheim) (Kauffman and Powell 1977, p. 71).

DESCRIPTION: Subequivalve to moderately inequivalve, with left valve slightly larger than right. Strongly to moderately prosocline, outline subovate to elongate-ovate (labiatoid). Beak-umbo anterior and slightly to moderately projecting, suberect. Small anterior auricle or marginal projection rarely present. Posterior auricle small to moderate in size, subtriangular, flattened, usually without prominent auricular sulcus. Hinge line of moderate length. Low geniculation may be present.

Ornamentation usually consists of equally to unequally spaced, strongly to weakly developed concentric rugae, with regularly to irregularly developed raised growth lines. Juvenile ornamentation commonly different from adult ornament, composed of closely spaced and subequally developed coarse or fine raised growth lines, without rugae. Many species without growth lines in juvenile and/or early adult growth stages. Growth lines rarely missing altogether, rugae may be missing over most of shell.

REMARKS: *Mytiloides* differs from *Inoceramus* in shell outline (labiatoid), and usually in weaker inflation, and in ornamentation. The genus *Cremnoceramus* possesses clear geniculation and associated change in shell ornament.

OCCURENCE: Uppermost Cenomanian – Lower/? Middle Coniacian, worldwide.

Mytiloides cf. *mytiloides* (Mantell, 1822)
(Text-figs 4A, B)

Compare:

part 1935. *Inoceramus labiatus* var. *mytiloides* Mantell; Seitz, p. 435, pl. 36, figs 1–4; text-fig. 2a–f; text-fig. 3a–c.
1965. *Inoceramus paramytiloides* n. sp.; Sornay, p. 13, pl. C, figs 1–4, text-figs 6, 7.
part 1975. *Inoceramus labiatus* (Mantell); Matsumoto and Noda, p. 197, pl. 18, fig. ?2, 3, 5.
1977. *Mytiloides mytiloides* (Mantell); Kauffman and Powell, p. 74, pl. 6, figs 11–16.
non 1978. *Mytiloides mytiloides* (Mantell); Kaufman *et al*., p. 35, pl. 10, figs 8, 12.
1980. *Inoceramus* (*Mytiloides*) aff. *paramytiloides* Sornay; Sornay, p. 140, pl. 2, fig. 2.
part 1981. *Inoceramus* (*Inoceramus*) *labiatus* Schlotheim; Tsankov, 1981, p. 97, pl. 41, fig. 2, non fig. 1.
1982. *Mytiloides mytiloides* (Mantell); Keller, p. 121, pl. 3, figs ?4, ?6.
1984. *Mytiliodes mytiloides* (Mantell); Cobban, p. 9, pl. 2, figs 14, 15.
part 1992. *Mytiloides labiatus* (Mantell); Walaszczyk, p. 13, pl. 1, fig. 10; pl. 2 figs 4, ?5, 6; pl. 4, figs 1, 3.
2000. *Mytiloides mytiloides* (Mantell, 1822); Kennedy *et al*., p. 325, pl. 12, figs 4, 5, 7–12; pl. 13, fig. 7.
2005. *Mytiloides mytiloides* (Mantell, 1822); Andrade, p. 63, pl. 2, figs 5–11; pl. 3, figs 1–6

TYPE: The lectotype is the original of Mantell (1822, pl. 28, fig. 2), re-illustrated by Woods (1911, text-fig. 37), from the Middle Chalk (*Mammites nodosoides* ammonite Zone) of Plumpton, Sussex, England.

MATERIAL: 2 specimens (1 is incomplete), represented by internal moulds of single valves nos. DDI 111, DDI 112.

Dimensions: (mm)

Specimen no.	H	h	L	l	s	VR	α	δ
DDI 111	85.5	41.2	82.0	42.5	49.5	53.0	98°	40°

DESCRIPTION: Medium-sized for the genus, inequilateral, equivalved. Shell outline oval, prosocline, markedly elongated axially (with δ=40°). Disc axially elongated, narrow or with medium breadth. Beak projecting above hinge line. Hinge line long, straight. Posterior auricle, flat, elongated parallel to growth axis. Disc weakly inflated. Anterior margin long, slightly convex, passing into rounded antero-ventral and ventral margin. Posterior margin usually long and straight. Growth axis typically slightly convex in juvenile part and straight in adult part.

Ornament in juvenile stage composed of raised growth lines or slightly visible concentric rugae. In middle-stage and adult disc, composed of irregularly concentric rugae with sharp or rounded edges. Pallial part almost smooth or with low concentric rugae.

REMARKS: *Mytiloides mytiloides* (Mantell) and *Mytiloides labiatus* (Schlotheim) are very similar in shell form and ornamentation, but *M. labiatus* differs by having curved umbonal part and beak, projecting above the hinge line. In spite of this, both species are difficult to distinguish. Walaszczyk (1992, p. 14) interpreted *M. mytiloides* (Mantell) as an extreme variant of *M. labiatus* (Schlotheim) He described a number of specimens from the Lower Turonian as *M. labiatus* but some of them seem to be in fact *M. mytiloides* (p. 14, pl. 1, fig. 10; pl. 2 figs 4, ?5, 6; pl. 4, figs 1, 3).

One of the specimens of *Inoceramus* (*Inoceramus*) *labiatus* Schlotheim illustrated by Tsankov *et al.* (1981, pl. 41, figs 1, 2) possesses traits characteristic of *M. mytiloides* and should be referred to this species.

Specimens from Vrabchov dol are close to those described by Sornay (1965, pl. C, figs 1–4) as *Mytiloides paramytiloides* (Sornay), but Sornay's specimens fall in the synonymy of *M. mytiloides*.

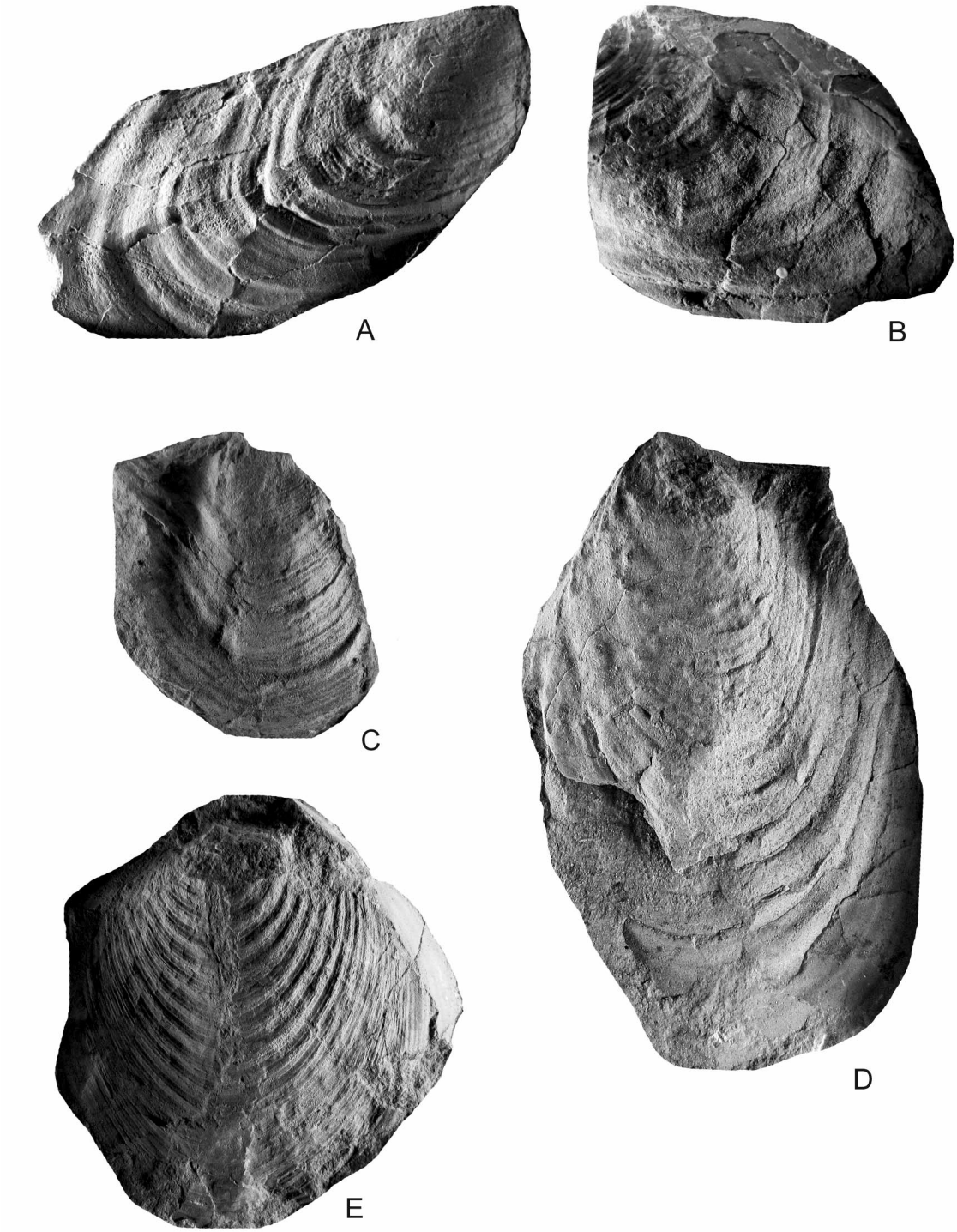
OCCURRENCE: Vrabchov dol section (between the villages of Bankya and Vrabcha), bed 2, Marl-limestone Unit, lowermost part of the Middle Turonian; *Mytiloides mytiloides* Zone. The species apparently has a worldwide distribution (see e.g., Keller 1982; Kennedy *et al.* 2000).

Mytiloides herbichi (Atabekian, 1969)
(Text-figs 4C, D)

1899. *Inoceramus labiatus* var. *regularis* Simionescu, pl. 2, fig. 3.
1969. *Inoceramus herbichi* Atabekian, p. 11.
part 1992. *Mytiloides carpathicus* (Simionescu); Walaszczyk, p. 26, pl.14, figs 1–6, 8; pl. 15, figs 1–3, 5–7.
1997. *Mytiloides herbichi* (Atabekian, 1969); Walaszczyk and Szasz, p. 774, figs 3a, g; 5h.
1999. *Mytiloides herbichi* (Atabekian, 1968); Walaszczyk and Wood, p. 425, pl. 1, figs 3, 5, 7.
2004. *Mytiloides herbichi* (Atabekian, 1969); Wood *et al.*, pl. 1, figs 1, 2, 6; pl.2, fig. 2
2005. *Mytiloides herbichi* (Atabekian, 1969); Andrade, p. 84, pl. 8, figs 5–10.

TYPE: The holotype is UMCN 5851 H, the original of Simionescu (1899, pl. 2, fig. 3), from the upper Turonian of Ürmös, Transylvania, Romania, referred originally to a variety, *Inoceramus labiatus* var. *regularis*.

Because of the homonymy with the species *Inoceramus regularis* d'Orbigny, Atabekian (1969) renamed Simionescu's variety as *Inoceramus herbichi* (see also Walaszczyk and Szasz 1997).



Text-fig. 4. **A, B** – *Mytiloides* cf. *mytiloides* (Mantell, 1822), DDI 111, DDI 112, section in the village of Vrabchov dol, bed 2, lowermost Middle Turonian; **C, D** – *Mytiloides herbichi* (Atabekian, 1969), DDI 102, DDI 103, section in the village of Filipovtsi, bed 1, Upper Turonian; **E** – *Mytiloides incertus* (Jimbo, 1894), DDI 5, section in the village of Izvor, bed 17, Upper Turonian; all figures are natural size

MATERIAL: Two internal moulds of single valves, DDI 102, and DDI 103; the latter with shell fragments attached along the ventral part.

Dimensions (mm):

Specimen no.	H	h	L	l	s	VR	α	δ
DDI 103	85.5	87.0	51.2	50.2	22.4	35.5	108°	75°
DDI 102	44.5	44.5	31.2	26.5	22.1	36.5	115°	63°

DESCRIPTION: Medium- to large-size for genus, inequilateral, ?equivalved. Disc slightly to moderately inflated with maximum inflation dorso-central. Beak (umbo) erect, projecting above hinge line, curved antero-dorsally. Growth axis straight or slightly convex anteriorly. Anterior margin long, straight, or slightly to moderately convex. Ventral margin strongly rounded, curved in axial part, and slightly curved in postero-ventral parts. Posterior margin concave. Posterior auricle medium to large-sized, well separated from disc by posterior sulcus. Hinge line relatively long, and straight.

Ornament consisting of wide, low concentric rugae, and fine regular, sharp edged, and closely spaced concentric rings (growth lines). In adult part, growth lines disappearing progressively, with shell covered by only concentric rugae (see DDI 103). Concentric ornament elements (both ribs and rings) passing onto posterior auricle, curving markedly outward.

REMARKS: Specimen DDI103 displays typical features of *M. herbichi*, except for its bigger dimensions. DDI102 closely resembles *Mytiloides striatoconcentricus* (Gümbel), having similar shape of the shell and ornamentation. However it has a much larger posterior auricle, separated from the disc by an auricular sulcus, and is equivalve.

Walaszczyk and Szasz (1997, p. 775) discussed in detail Atabekian's species (Simionescu's variety). They considered that some of the specimens described previously by Walaszczyk (1992, p. 26, pl. 14, figs 1–6, 8; pl. 15, figs 1–3; 5–7) as *Mytiloides carpathicus* (Simionescu) represent in fact *Mytiloides herbichi* (Atabekian). *M. herbichi* and *M. carpathicus* (Simionescu) closely resemble each other. Both species are similar to *M. scupini* (Heinz). *M. carpathicus* and *M. scupini,* differ from *M. herbichi* in coarser ornamentation. In addition, the edges of the rugae and growth lines in *M. herbichi* are sharper.

OCCURRENCE: Uppermost Turonian/?lowermost Coniacian (Walaszczyk and Szasz 1997) of Europe (Romania, England, Germany, Poland), Asia (Caucasus) and the United States. In the study area it is known from the section in the village of Filipovtsi, bed 1, Marl-limestone Unit, Upper Turonian, *Mytiloides scupini* Zone.

Mytiloides incertus (Jimbo, 1894)
(Text-figs 4E, 5A–G, 6A–D)

part 1872-1875. *Inoceramus cuvieri* Sowerby; Geinitz, pl. 13, fig. 6.
1894. *Inoceramus incertus* Jimbo, p. 189, pl. 24, fig. 7.
1930. *Inoceramus inconstans inconstans* Woods; Fiege, p. 38, pl. 5, figs 16, 17, pl. 6, fig. 18.
part 1939-1940. *Inoceramus incertus* (Jimbo); Nagao and Matsumoto, p. 10, pl. 3, figs 1–3; pl. 10, fig. 2.
1967. *Inoceramus fiegei fiegei* Tröger, p. 105, pl. 11, fig. 3; pl. 13, figs 14, 15, 17, 20.
1974. *Inoceramus* cf. *fiegei* Tröger; Sornay, p. 32, pl. 2, fig. 7.
1976. *Mytiloides fiegei fiegei* (Tröger); Kauffman *et al*. p. 9, pl. 15, fig. 1; pl. 16, fig. 4.
1977. *Mytiloides fiegei fiegei* (Tröger); Kauffman, p. 244, pl. 11, fig. 1; p. 246, pl. 12, fig. 4.
1982. *Mytiloides fiegei fiegei* (Tröger); Keller, p. 110, pl. 7, fig. 5.
1984. *Mytiloides fiegei fiegei* (Tröger); Cobban, p. 9, pl. 1, fig. 10.
1984. *Mytiloides incertus* (Jimbo); Noda, p. 458, text-figs 7, 8, pl. 84, figs 1–10, pl. 85, figs 1, 2; pl. 86, figs 1–8.
1990. *Mytiloides incertus* (Jimbo); Kopaevich and Walaszczyk, p. 88, pl. 1, fig. 5.
1992. *Mytiloides incertus* (Jimbo); Walazczyk, p. 22, pl. 12. figs 11, 12.
1999. *Mytiloides incertus* (Jimbo); Noda and Matsumoto, p. 460, pl. 14, figs 1–5, pl. 15, figs 1–5.
2000. *Mytiloides incertus* (Jimbo); Walaszczyk and Cobban, p. 54, pl. 7, figs 1, 2, 6, 7; pl. 10, fig. 5; pl. 11, fig. 3; pl. 12, figs 1–12; pl. 13, figs 1–8, 10; pl. 14, fig. 5; text-fig. 16.
2005. *Mytiloides incertus* (Jimbo, 1894); Andrade, p. 80, pl. 7, figs 4–7.
2013. *Mytiloides incertus* (Jimbo, 1894); Walaszczyk *et al*., pl. 3A.

TYPE: The lectotype, by subsequent designation of Matsumoto and Noda (1983), is MM7535, one of Jimbo's unfigured syntypes from the River Pombets, Mikasa City, central Hokkaido, Japan.

MATERIAL: Numerous specimens represented by internal moulds of left and right valves. Several specimens

with shell fragment attached: DDI 17, DDI 19, DDI 14, DDI 5, DDI 6, DDI 16, DDI 25, DDI 15, NI 3, DDI 13, DDI 17, DDI 18, NI 12, NI 18, NI 20.

Dimensions (mm):

Specimen no.	H	h	L	l	s	VR	α	δ
DDI 7	–	–	–	50.0	–	–	–	–
DDI 19	–	–	–	–	25.8	25.5	88°	42°
DDI 14	–	–	–	–	–	32.0	–	–
DDI 5	–	65.1	67.2	32.5	55.0	–	130°	47°
DDI 6	61.9	79.1	66.6	57.4	25.8	40.7	103°	56°
DDI 16	39.0	–	–	–	24.7	26.9	109°	40°
DDI 25	51.9	52.0	52.3	52.0	26.4	35.5	120°	60°
DDI 15	–	–	–	–	18.7	20.5	120°	53°
DDI 17	–	–	–	–	–	19.0	–	–
DDI 13	45.0	50.0	43.9	–	–	25.6	97°	62°
DDI 18	–	–	–	–	–	31.3	120°	60°

DESCRIPTION: Valves small- to medium-sized for genus, inequilateral, equivalved, weakly inflated with maximum disc inflation dorso-central. Valve outline ovate to subrounded. Valve outline occasionally elongated parallel to growth axis and markedly oblique. Beak slightly to moderately pointed and projected above hinge line. Growth axis straight or slightly convex anteriorly. Anterior margin convex, exceptionally straight and short, and rarely longer than usual. Anteroventral margin long and broadly convex. Ventral margin rounded. Posterior margin usually short, straight or slightly convex. Hinge line straight, relatively short. Posterior auricle small and well-separated from disk.

Ornamentation consisting of regularly and subevenly spaced concentric rugae, rarely with sharp edges. Sometimes, rugae poorly-preserved and visible (DDI 6, DDI 13, DDI 18, DDI 19). Rugae and inter-rugae spaces covered with distinct raised growth lines. Growth lines evenly spaced on disc, including pallial part.

REMARKS: *Mytiloides incertus* (Jimbo) was discussed thoroughly by Noda (1984) who emphasized the high variability of the species in general shape of the disc, shell outline and surface ornamentation. These observations agree with the Bulgarian specimens collected at Izvor, particularly specimens DDI 13 and DDI 18. The morphology of some of the examples is somewhat unusual for the species; specimen DDI 25 has a long anterior margin, hinge line, and sharp-edged concentric rugae; specimens DDI 5 and DDI 6 are similar in shell outline and external concentric ornamentation to *Mytiloides hercynicus* (Petrascheck).

The specimens from Izvor closely resemble these illustrated by Noda (1984, text-fig 7, pls 84, 85, 86), and by Noda and Matsumoto (1999, fig 5, pl. 14).

Small-sized *M. incertus* are difficult to distinguish from juveniles of *M. ratonensis* Walaszczyk and Cobban, 2000, which are characterized by closely spaced sharp-edged concentric rugae and rings with rugae interspaces increasing in adult stages.

Large-sized *M. incertus* (DDI 25, DDI 6, DDI 7), closely resemble *M. hercynicus* (Petrascheck).

Walaszczyk and Cobban (2000) illustrated and described numerous *M. incertus* from the Western Interior Basin of the United States. Most of the specimens are elongated along the disc growth axis, and display different ornamentation; sharp-edged rugae with wide (or narrow) flat-floored interspaces. Some specimens have an ovate outline of the disc (pl. 13, figs 3, 6, 7, 10).

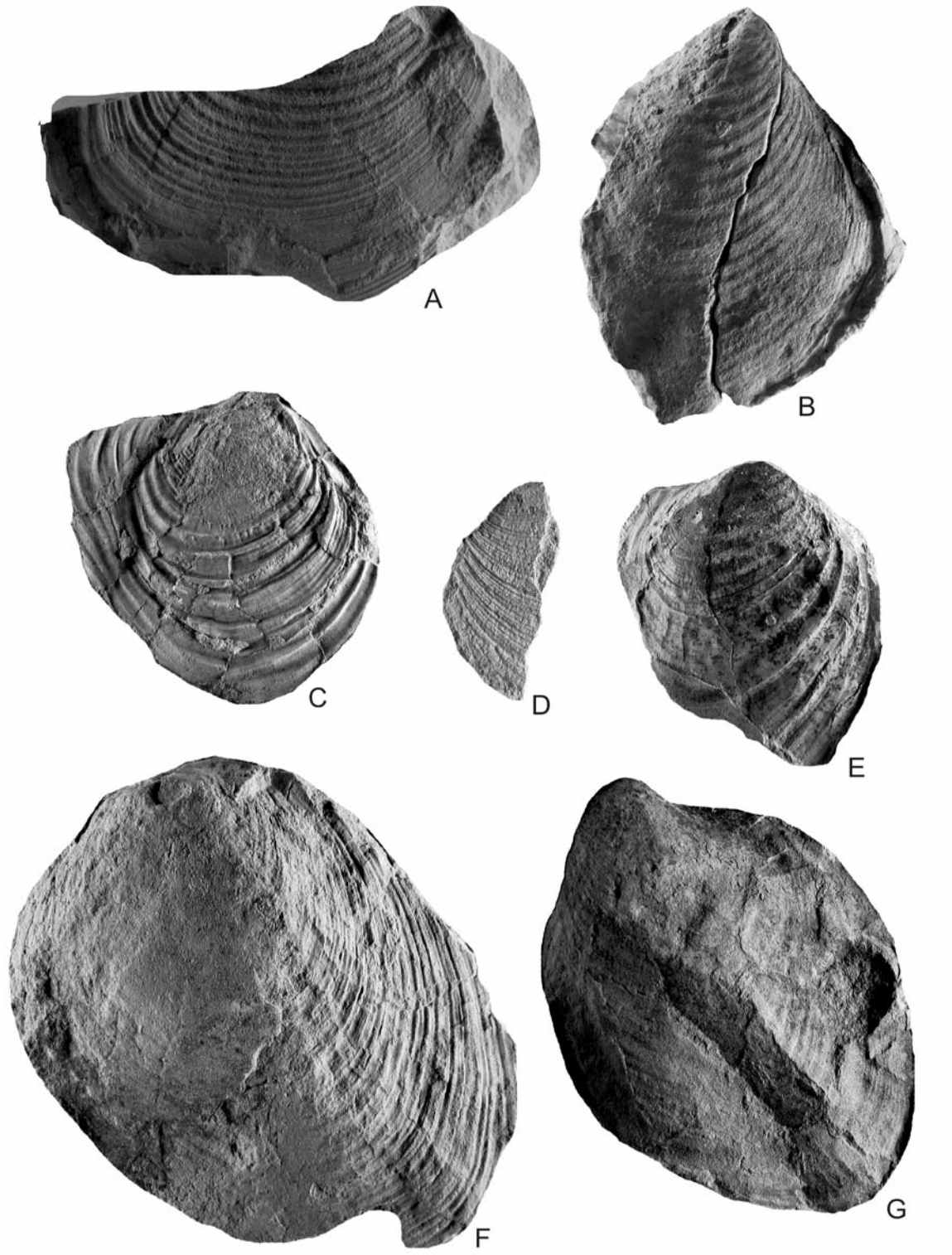
OCCURENCE: Upper Turonian of the United States (Western Interior Basin), South America (Brazil), Asia (Japan, Afghanistan, Kazakhstan) and Europe (Russia, Poland, Germany, Czech Republic, England, Spain, France, Romania). In the study area it is known from the Izvor section, beds 17, 22, Marl-limestone Unit.

Mytiloides scupini (Heinz, 1930)
(Text-figs 6E–H)

1911. *Inoceramus frechi* Flegel; Andert, p. 51, pl. 1, fig. 8; pl. 7, fig. 6.
part 1928. *Inoceramus stillei* Heinz; p. 73.
1930. *Inoceramus stillei* var. *scupini* n. var.; Heinz, p. 26.
part 1964. *Inoceramus* aff. *I. perplexus* Whitfield; Scott and Cobban, pl. 2, fig. 1 (non p. 2, figs 2–5).
1934. *Inoceramus frechi* Flegel; Andert, p. 120. pl. 5, figs 5–9, pl. 6, fig. 1.
1982. *Inoceramus frechi* Flegel; Keller, pp. 96–98, pl. 7, fig 1.
part 1986. *Inoceramus longealatus* Tröger; Scott *et al*., figs 6a–e, g–i.
part 1992. *Mytiloides carpathicus* (Simionescu); Walaszczyk, p. 26, pl.15, fig. 4.
1996. *Mytiloides scupini* (Heinz); Walaszczyk and Tröger, p. 400, fig. 3C–E.
? 1997. *Mytiloides frechi* (Flegel); Kauffman, p. 240, pl. 9, fig. 21.
? 1998. *Mytiloides frechi* (Flegel); Kauffman *et al*., pl. 13, fig. 21.
1999. *Mytiloides scupini* (Heinz); Walaszczyk and Wood, p. 425, pl. 1, fig. 10.
2000. *Mytiloides scupini* (Heinz); Walaszczyk and Cobban, p. 64, pl. 16, figs 1–8, 10, 11; pl. 17, figs 1–8; pl. 18, figs 10–13.
2004. *Mytiloides*? *scupini* (Heinz); Wood *et. al*., pl. 1, figs 3, 5.

2005. *Mytiloides scupini* (Heinz); Andrade, p. 85, pl. 9, figs 3–5, 7, 8.
2013. *Mytiloides scupini* (Heinz, 1930); Walaszczyk *et al*., pl. 6A.

TYPE: The holotype, by original designation of Heinz (1930), is the original of Andert (1911, pl. 1, fig. 8; pl. 7, fig. 6) is from Sonnenberg (Zittauer Gebirge) near Waltersdorf, Germany, uppermost Turonian.



Text-fig. 5. **A-G** – *Mytiloides incertus* (Jimbo, 1894), DDI 12, DDI 14, DDI 25, DDI 17, DDI 15, DDI 7, DDI 6, section in the village of Izvor, beds 17 and 22, Upper Turonian; all figures are natural size

MATERIAL: Four specimens preserved as internal moulds and one as an external mould – DDI 30, DDI 107, DDI 104, NFW 8.

Dimensions (mm):

Specimen no.	H	h	L	l	s	VR	α	δ
DDI 30	–	–	–	–	–	19.1	–	–
DDI 107	–	–	30.5	29.0	15.8	25.5	110°	62°
DDI 104	–	–	–	–	17.2	21.8	116°	55°
DDI 108	52.1	55.0	37.9	33.5	21.3	24.4	120°	62°

DESCRIPTION: Medium-sized; inequilateral, equivalved. Valve outline ovate to subrectangular, elongated and parallel to growth axis. Valve slightly inflated, with maximum inflation dorso-central. Beak pointed, projecting above hinge line. Anterior margin straight and slightly concave below umbo, of moderate length (rarely up to 60 % of valve's height), passing into rounded ventral margin. Antero-ventral margin long and slightly rounded. Postero-ventral margin rounded, posterior margin of moderate length, slightly concave. Hinge line straight and moderately long. Growth axis straight. Posterior auricle moderately large to large, flat, and subtriangular, with slightly concave posterior margin, separated from disc, with distinct or indistinct auricular sulcus.

Ornament composed of distinct, irregular (rarely regular), and sharp-edged concentric rugae. Inter-rugae spaces increasing toward ventral part of disc. Umbonal part sometimes covered by growth lines (concentric rings) or low irregular indistinct rugae. Concentric elements passing onto posterior auricle, and curved outward on posterior part of auricle.

REMARKS: Walaszczyk and Tröger (1996) discussed *Mytiloides scupini* (Heinz) in detail and compared it to *Inoceramus frechi* Flegel. These species have very similar shell outlines and ornamentation and different authors have determined and described *Mytiloides scupini* as *Inoceramus frechi* (see Walaszczyk and Tröger 1996). However, both species possess very different features. *M. scupini* has a more slender and erect shell than *I. frechi*. Moreover, *M. scupini* possesses a less inflated disc and irregular ornamentation. *I. frechi* has a posteriorly extended large posterior auricle that is well separated from the disc along a well-developed auricular sulcus, whereas the posterior auricle in *M. scupini* is not very well separated, as observed in some of Heinz's specimens.

M. scupini (Heinz) is very similar to *Inoceramus vistulensis* Walaszczyk 1992, but the ornamentation in the latter species is composed of closely spaced growth lines (concentric rings), and it has a straight growth axis, whereas *M. scupini* has an anteriorly curved growth axis.

M. scupini (Heinz) resembles *Mytiloides ratonensis* Walaszczyk and Cobban, 2000. However, the anterior margin of *M. scupini* is straight, while in *M. ratonensis* it is convex. Moreover, the concentric elements in *M. scupini* have sharp edges in contrast to the rounded edges of these elements in *M. ratonensis*.

OCCURRENCE: Upper Turonian in England, Spain, Poland, Romania, Russia, Germany, Czech Republic, and the Western Interior Basin, USA. In the study area it is known from the section in the village of Izvor, bed 23, Marl-limestone Unit, upper part of Upper Turonian, *Mytiloides scupini* Zone; section in the village of Filipovtsi, bed 1, Marl-limestone Unit, uppermost Turonian, *Mytilodes scupini* Zone.

Mytiloides labiatoidiformis (Tröger, 1967)
(Text-figs 6I, J, 7A)

1967. *Inoceramus dresdensis*? *labiatoidiformis* n. sp., Tröger, p. 125–127, pl. 10, figs 5, 6.
1974. *Inoceramus striatoconcentricus* Gümb. *sabzakensis* subsp. nov; Sornay, p. 32, pl. 2, figs 5, 6.
non 1977. *Inoceramus dresdensis*? *labiatoidiformis* Tröger; Kauffman, p. 240, pl. 10, fig. 2.
non 1982. *Mytiloides labiatoidiformis* (Tröger); Keller, pp. 100–103, pl. 5, figs 5, 7.
non 1986. *Mytiloides* aff. *labiatoidiformis* Tröger; Scott *et al.*, fig. 6h, j.
1990. *Mytiloides labiatoidiformis* (Tröger); Kopaevich and Walaszczyk, p. 89, pl. 2, fig. 4.
1992. *Mytiloides labiatoidiformis* (Tröger); Walaszczyk, p. 21, pl. 12, figs 1, 2.
1999. *Mytiloides labiatoidiformis* (Tröger, 1967); Walaszczyk and Wood, p. 426, pl. 1, figs 1, 2, 6, 8, ?12.
2005. *Mytiloides labiatoidiformis* (Tröger, 1967); Andrade, p. 83, pl. 7, fig. 10; pl. 8, figs 1–4.

TYPE: The holotype is the specimen F1010, illustrated by Tröger (1967, pl. 10, fig. 5), from the Upper Turonian limestones of the Dresden-Strehlen abandoned quarries, Germany.

MATERIAL: 3 specimens represented by internal moulds of single valves: DDI 120, DDI 24, and DDI 21.

Dimensions (mm):

Specimen no.	H	h	L	l	s	VR	α	δ
DDI 20	44.9	44.8	28.2	27.0	16.0	29.9	85°	45°
DDI 24	48.4	48.0	33.9	30.0	–	31.0	–	35°
DDI 21	39.2	39.0	27.5	23.5	17.5	23.0	94°	51°

DESCRIPTION: Medium to large-sized, inequilateral, probably equivalved. Valves weakly inflated with maximum inflation antero-dorsal. Growth axis weakly curved anteriorly. Anterior margin long, straight or weakly convex, passing into rounded ventral margin. Beak usually not projected above hinge line. Umbo weakly projected above hinge line. Posterior auricle small, and well-separated from disc by auricular sulcus. Hinge line short and straight.

Ornament in the umbonal part consisting of densely spaced and raised growth lines. Growth lines disappearing ventralward, being replaced by asymmetrical concentric rugae with sharp edges. Adult rugae regularly spaced, but inter-rugae spaces sometimes increasing gradually towards the venter.

REMARKS: This species displays the typical mytiloid form and ornamentation that is characteristic of most of the inoceramids of Late Turonian age. The specimens described above differ from Tröger's holotype (Tröger 1967, pl. 10, fig. 5), in the longer and narrower valve outline. In shell form (long and straight or slightly convex) and anterior margin, *M. labiatoidiformis* resembles *M. striatoconcentricus* (Gümbel). It differs from the latter in ornament. *M. striatoconcentricus* possesses dense, sharp-edged, uniformly spaced concentric rings, whereas *M. labiatoidiformis* has raised non-symmetrical concentric rugae in the adult stage.

M. labiatoidiformis also resembles *M. ratonensis* Walaszczyk and Cobban 2000, and has the same elongated disc and beak-umbo projecting above the hinge line. However, the ornament of *M. ratonensis* is represented by more or less closely spaced rugae with superimposed raised *incertus*-like growth lines.

M. mytiloidiformis is similar to *M. labiatoidiformis* in shell-form, disc elongation, and in the beak-umbo which projects above the hinge line, but differs in the *incertus*-like ornament.

OCCURRENCE: Upper Turonian of Europe and western Central Asia. In the study area it is known from Izvor, bed 21 of the marl-limestone unit; upper Upper Turonian, *Mytiloides incertus* Zone

Mytiloides cf. *carpathicus* (Simionescu, 1899)
(Text-fig. 7C)

Compare:

1997. *Mytiloides carpathicus* (Simionescu); Walaszczyk and Szasz, p. 771, fig. 3j, 5e, f.

TYPE: The lectotype designated by Walaszczyk and Szasz (1997, fig. 5e, f) is UMCN 5752H, the original of Simionescu (1899, pl. 2, fig. 1), from the uppermost Turonian/?Lower Coniacian of Ürmös, Transylvania, Romania.

MATERIAL: One specimen preserved as internal mould, without umbo and posterior auricle, and half of the ornamentation (DDI 105).

Dimensions (mm):

Specimen no.	H	h	L	l	s	VR	α	δ
DDI 105	71.0	71.0	37.0	37.0	–	37.5	–	–

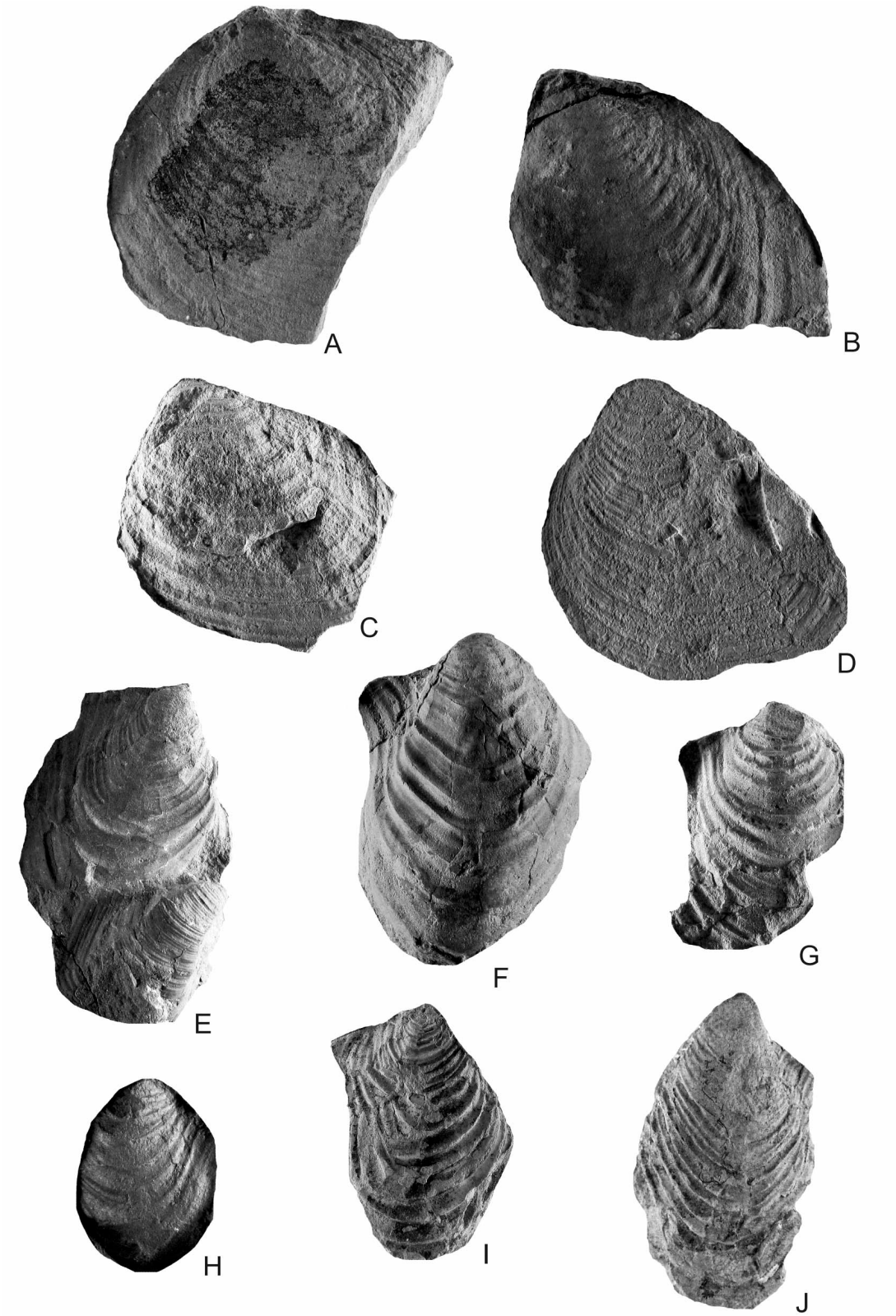
DESCRIPTION: Medium- to large sized, inequilateral. Disc moderately inflated, with maximum inflation central. Beak-umbo badly preserved, but visibly pointed and clearly extended above hinge-line. Anterior margin very long and straight, passing into short anteroventral margin. Ventral and posteroventral parts of disc rounded. Posterior auricle and hinge line not observed. Growth axis straight.

Ornamentation consisting of distinct, regular concentric rugae, increasing in size ventralward. Rugae of juvenile and medium parts of disc with sharp edges. Inter-rugae spaces covered by concentric rings (growth lines).

REMARKS: Walaszczyk and Szasz (1997) studied and redetermined Simionescu's inoceramid collection and assigned many of the taxa identified by him to different genera: *Mytiloides* Brongniart, *Cremnoceramus* Cox and *Inoceramus* Sowerby. In particular, they raised Simionescu's variety *Inoceramus labiatus* var. *carpathica* to full specific status as *Mytiloides carpathicus* (Simionescu, 1899). It should be noted that most of the specimens described by Walaszczyk (1992, pls 14, 15) as *Mytiloides carpathicus* (Simionescu, 1899) fall into the synonymy of *Mytiloides herbichi* (see Walaszczyk and Wood, 1999).

Both species, *M. carpathicus* and *M. herbichi*, possess a very similar shell outline and ornamentation on the disc. *M. herbichi* has concentric rings (growth lines) which disappear on the adult part of the disc, while the concentric rugae in *M. carpathicus* are retained on the pallial part on the shell. The *M. carpathicus* specimens are larger in average.

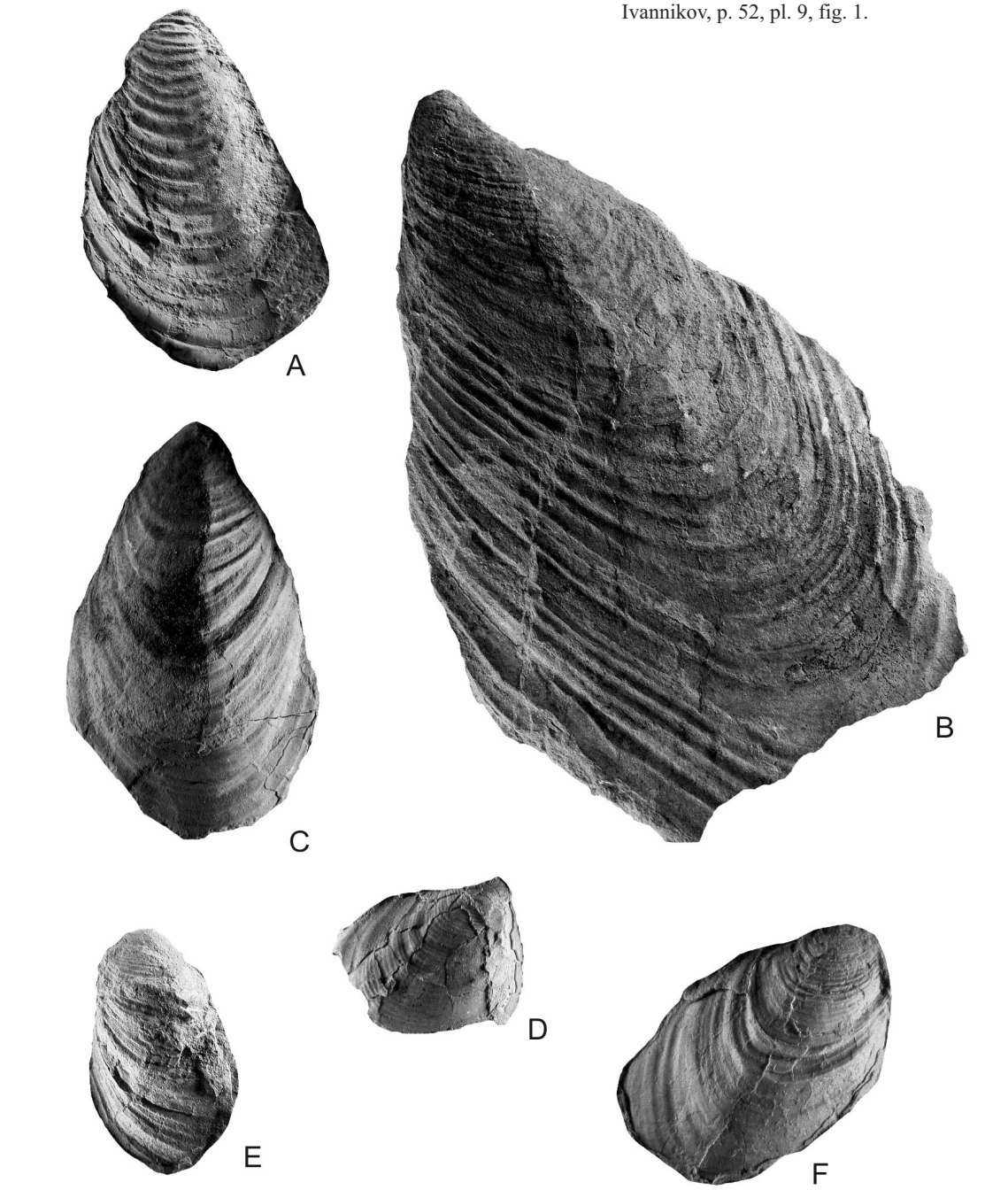
OCCURRENCE: Upper Turonian–?lowermost Coniacian of Romania and Bulgaria. In the study area it is known from the section in the village of Filipovtsi, bed 1, Marl-limestone Unit, upper part of Upper Turonian, *Mytiloides scupini* zone.



Text-fig. 6. **A-D** – *Mytiloides incertus* (Jimbo), DDI 18, DDI 19, DDI 16, DDI 13, section in the village of Izvor, package 22, Upper Turonian; **E-H** – *Mytiloides scupini* (Heinz, 1930), DDI 107, DDI 108, DDI 104, section in the village of Filipovtsi, bed 1, Upper Turonian; DDI 30, section in the village of Izvor, bed 23; **I, J** – *Mytiloides labiatoidiformis* (Tröger, 1967), DDI 21, DDI 20, section in the village of Izvor, bed 21, Upper Turonian; all figures are natural size

Mytiloides mytiloidiformis (Tröger, 1967)
(Text-figs 7B, D)

1930. *Inoceramus inconstans inconstans* Woods; Fiege, p. 38, pl. 6, fig. 19.
1940. *Inoceramus incertus* Jimbo; Nagao and Matsumoto, p. 10, pl. 3, fig. 4.
1967. *Inoceramus fiegei mytiloidiformis* Tröger, p. 108, pl. 11, fig. 4, pl. 13, figs 16, 18.
non 1977. *Mytiloides fiegei mytiloidiformis* (Tröger); Kauffman, p. 240, pl. 10, fig. 4.
non 1978. *Mytiloides fiegei mytiloidiformis* (Tröger); Kauffman *et al*, p. 9, pl. 14, fig. 4.
non 1979. *Inoceramus fiegei mytiloidiformis* Tröger; Ivannikov, p. 52, pl. 9, fig. 1.



Text-fig. 7. **A** – *Mytiloides labiatoidiformis* (Tröger, 1967), DDI 24, section in the village of Izvor, bed 21 Upper Turonian; **B, D** – *Mytiloides mytiloidiformis* (Tröger, 1967), DDI 22, DDI 23, section in the village of Izvor, bed 22, Upper Turonian; **C** – *Mytiloides* cf. *carpathicus* (Simionescu, 1899), DDI 105, section in the village of Filipovtsi, Upper Turonian; **E, F** – *Mytiloides striatoconcentricus* (Gümbel), DDI 106, section in the village of Filipovtsi, bed 1, Upper Turonian; DDI 104, section in the village of Izvor, bed 17, Upper Turonian; all figures are natural size

1984. *Mytiloides fiegei mytiloidiformis* (Tröger); Cobban, p. 9, pl. 1, figs 8, 9, 11, 12.
1984. *Mytiloides* sp. aff. *M. mytiloidiformis* (Tröger); Noda, p. 467, pl. 86, fig. 9.
1997. *Mytiloides mytiloidiformis* (Tröger): Walaszczyk and Szasz, p. 775, fig. 5, g.
1999. *Mytiloides mytiloidiformis* (Tröger); Noda and Matsumoto, pl. 15, figs 6, 7.
2000. *Mytiloides mytiloidiformis* (Tröger); Walaszczyk and Cobban, p. 58, pl. 10, figs 1, 2, 4; pl. 14 figs 2, 3, 7, 8, 10, 11, 13.
2005. *Mytiloides mytiloidiformis* (Tröger, 1967); Andrade, p. 87, pl. 9, fig. 9.

TYPE: The holotype, by original designation, is the original of Fiege (1930, pl. 6, fig. 19), re-illustrated by Tröger (1967, pl. 11, fig. 4) and by Walaszczyk and Cobban (2000, pl. 10, fig. 1) from the Upper Turonian of Lengerich, Germany.

MATERIAL: Two internal moulds of single left and right valves: DDI 22 and DDI 23.

Dimensions (mm):

Specimen no.	H	h	L	l	s	VR	α	δ
DDI 22	–	–	–	–	19	22.7	96°	37°

DESCRIPTION: Specimen DDI 22 is better preserved and larger than DDI 23.It is inequilateral, equivalved. The valve is almost flat (slightly inflated), with maximum inflation in the dorso-ventral part of the disc. The shell is prosocline, slightly oval, markedly elongated axially. The growth axis is curved anteriorly. The beak is projected. The anterior margin is short, the posterior long and straight. The other margins, posterior auricle and hinge line are not preserved. Two types of ornamentation exist. In the umbonal part at 48 mm axial length, the ornament is represented by low, round-edged concentric rugae and less visible concentric rings. The remaining part of the valve is covered by irregular, sharp-edged, and relatively distant concentric rugae. Growth lines are not observed.

The second specimen DDI 23, has a prosocline shell with inclined growth axis. The valve is moderately inflated with maximum inflation in the dorso-central part of the disc. The beak is marked, and slightly projected above the hinge line, which is long, and straight. The anterior margin is straight to slightly convex; the posterior margin is straight. The other margins are not preserved. The ornament consists of low, and round-edged concentric rugae. The inter-rugae spaces and the rugae are covered by regularly spaced growth lines.

REMARKS: Specimen DDI 22 is not a typical representative of *Mytiloides mytiloidiformis*. It has the typical shell form and outline for the genus, but a different type of ornamentation. The sculpture in the umbonal part is typical of *M. mytiloidiformis* (round-edged concentric rugae with growth lines), but then it changes to ornamentation that is characteristic of *M. labiatoidiformis* (sharp-edged concentric rugae, without growth lines). A similar change of ornamentation is observed in one specimen illustrated by Noda (1984, pl. 86, fig.9).

A similar change of the sculpture is illustrated by Noda (1984, pl. 84, fig. 6). in one representative of *Mytiloides incertus.*

OCCURRENCE: Upper Turonian of the United States (Western Interior Basin), Europe (England, Germany, Romania, Poland, Russia, Ukraine), and Asia (Kazakhstan, Afghanistan, Japan). In the study area it is known from Izvor, bed 22 of the marl-limestone unit; upper Upper Turonian *Mytiloides incertus* Zone.

Mytiloides striatoconcentricus (Gümbel, 1868) (Text-figs 7E, F)

1928. *Inoceramus striato-concentricus* Gümb., var. aff. *carpathica* Sim.; Heinz, p. 34, pl. 1, fig. 3.
1930. *Inoceramus inaequivalis* Schlüter; Fiege, p. 84, pl. 5, fig. 2.
non 1959. *Inoceramus striato-concentricus* Gümbel; Dobrov & Pavlova, p. 135, pl. 2, figs 1, 2.
1967. *Inoceramus striatoconcentricus striatoconcentricus* Gümbel; Tröger, p. 84, pl. 9, figs 11–15, 17.
? 1971. *Inoceramus striato-concentricus* (Gümbel); Pergament, p. 59, pl. 8, fig. 2.
non 1971. *Inoceramus* cf. *striato-concentricus* (Gümbel); Pergament, p. 59, pl. 8, fig. 3.
1982. *Inoceramus striatoconcentricus striatoconcentricus* Gümbel; Keller, p. 105, pl. 7, fig 4.
part 1992. *Mytiloides striatoconcentricus* (Gümbel) Walaszczyk, p. 24, pl. 13, figs 4, 6.
non 1997. *Mytiloides striatoconcentricus* (Gümbel); Leckie *et al*., fig. 36H–L.
1999. *Mytiloides striatoconcentricus* (Gümbel); Walaszczyk and Wood. pl. 1, fig. 11.
2000. *Mytiloides striatoconcentricus* (Gümbel); Walaszczyk and Cobban, p. 68, text. fig. 17.
2004. *Mytiloides striatoconcentricus* (Gümbel); Wood *et al.*, p. 545, pl. 2, fig. 10.
2005. *Mytiloides striatoconcentricus* (Gümbel, 1868); Andrade, p. 78, pl. 7, figs 1–4.

2013. *Mytiloides striatoconcentricus* (Gümbel, 1868); Walaszczyk *et al*., pl. 3E, pl. 4A–O.

TYPE: The neotype, designated by Dacqué (1939, p. 209, pl. 17, fig. 5), is a specimen in Gümbel's collection from the Upper Turonian (?Lower Coniacian) of the Großbergschichten (Regensburger Oberkreide), Germany.

MATERIAL: Two specimens preserved as internal moulds and core – DDI 4, DDI 106.

Dimensions (mm):

Specimen no.	H	h	L	l	s	VR	α	δ
DDI 4	42.3	45.2	36.7	29.7	–	23.3	95°	52°
DDI 106	–	–	–	–	–	20.9	–	–

DESCRIPTION: DDI 4 is of moderate size, inequilateral, ?equivalved. Its shell is ovate, prosocline, clearly elongated parallel to the growth axis. The growth axis is curved anteriorly. The valve is slightly inflated, with maximum inflation dorso-central. The moderately long anterior margin is almost straight to slightly convex. The antero-ventral margin is long, nearly straight to slightly convex. The dorso-ventral margin is long and straight; the posterior margin is short, slightly concave. The hinge line and the posterior auricle are not preserved.

The ornament in the umbonal part consists of fine, equal, and raised growth lines. Two raised, sharp-edged concentric rugae with raised inter-rugae spaces in the central part of the disc are observed. The remaining disc is covered by fine and equal growth lines of lesser relief.

REMARKS: The diagnostic features of this species are the clear inflation of the disc, and the characteristic ornamentation of regular raised growth lines (concentric rings). Tröger (1967, pl. 9, fig. 17) and later Walaszczyk and Wood (1999, pl. 1, fig. 11), reillustrated Gümbel's original of *Inoceramus striatoconcentricus striatoconcentricus*, which displays these features. The neotype of Gümbel's colection, designated by Dasqué (1939, pl. 17, fig. 5), differs from the original specimen in having a coarser sculpture. The same type of ornament is developed in the specimen from the Izvor section and it is very similar to the specimen illustrated by Walaszczyk from the Central Polish Uplands (1992, pl. 13, fig. 4).

On the other hand, specimen DDI 106 (pl. 4, fig. 5), from the lower part of the Filipovtsi section, displays very fine ornamentation consisting of fine concentric growth lines on the whole disc, which are characteristic of Gümbel's original.

Additionally, *M. striatoconcentricus* from the section in the village of Filipovtzi was found in the *Mytiloides scupini* zone. Walaszczyk and Cobban (2000, p. 70) reported that the characteristic occurrence of this species is in the *Scaphites whitfieldi* ammonite Zone = the *Inoceramus dakotensis* zone.

M. striatoconcentricus is very similar to *M. bellefourchensis* Walaszczyk and Cobban, 2000, from which it differs in having a more ovate shell-form and coarser ornamentation. *M. striatoconcentricus* differs from the closely similar *M. herbichi* (Atebekian), in having a more erect and projecting beak, but possessing an identical sculpture pattern.

OCCURRENCE: Upper Turonian of the United States (Western Interior Basin), Europe (Germany, France, Czech Republic Romania, Poland, Russia) and Asia (Kazakhstan). In the study area, it is known from the Izvor section, bed 17 of the marl-limestone unit, and from the Filipovtsi section, bed 1 of the marl-limestone unit; both from the upper Upper Turonian *Mytiloides scupini* Zone.

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