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

**DOCHO DOCHEV**

*Department of Geology, Paleontology and Fossil fuels, Faculty of Geology and Geography, Sofia University “St. Kliment Ohridski”, 15 Tsar Osvoboditel Blvd, 1504 Sofia, Bulgaria.*

**E-mail:** dochev.su@gmail.com

**ABSTRACT:**


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 Srednogorie 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-beded limestone (sandy, clayey, bioclastic, glauconitic) and thin- to medium-beded 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 labiatooidiformis (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 (Walsaszczyk 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. 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 woolgari* (Mantell) indicates the uppermost part of the *M. mytiloides* Zone, which ranges into the basal Middle Turonian, *C. woolgari* 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. woolgari* and *Collignoniceras* sp., came from bed 7. A rich collignoniceratid assemblage, with *C. woolgari* woolgari (Haas), *Collignoniceras* cf. *jorgenseni* Kennedy et al., *Collignoniceras carolimun* (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. woolgari* 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).

<table>
<thead>
<tr>
<th>Stage</th>
<th>Substage</th>
<th>Ammonite zonation</th>
<th>Inoceramid zonation</th>
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<td>Mytiloides labiatus</td>
<td>Mytiloides mytiloides</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mytiloides kossmati</td>
<td>Mytiloides kossmati</td>
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<tr>
<td></td>
<td></td>
<td>Mytiloides hattini</td>
<td>Mytiloides pueblensis</td>
</tr>
<tr>
<td>Middle</td>
<td>Collignoniceras woodi</td>
<td>Inoceramus costellatus</td>
<td>Mytiloides incertus</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Mytiloides scupini</td>
</tr>
<tr>
<td>Upper</td>
<td>Subproceratites neglecti</td>
<td>Inoceramus incertus</td>
<td>Mytiloides incertus</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td>C. waltersdorffensis</td>
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<td></td>
<td></td>
<td>waltersdorffensis</td>
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<tr>
<td></td>
<td></td>
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<td>Mytiloides scupini</td>
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</tbody>
</table>

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 *Cremnoceramus 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).

**SYSTEMATIC PALAEOENTOLOGY**

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.

**OCCURRENCE:** 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); Kauffman 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,  

1984. *Mytiloides 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); 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. 2, 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)*

<table>
<thead>
<tr>
<th>Specimen no.</th>
<th>H</th>
<th>h</th>
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<th>l</th>
<th>s</th>
<th>VR</th>
<th>α</th>
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<td>DDI 111</td>
<td>85.5</td>
<td>41.2</td>
<td>82.0</td>
<td>42.5</td>
<td>49.5</td>
<td>53.0</td>
<td>98°</td>
<td>40°</td>
</tr>
</tbody>
</table>

*DESCRIPTION:* Medium-sized for the genus, inequilateral, equivalved. Shell outline oval, prosocline, markedly elongated axially (with $\delta=40°$). 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.

*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.


1997. *Mytiloides herbichi* (Atabekian, 1969); Walaszczyk and Szasz, p. 774, figs 3a, g; 5h.


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 Úrmos, 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):

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<th>Specimen no.</th>
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<th>VR α</th>
<th>δ</th>
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<td>22.4</td>
<td>35.5</td>
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<td>DDI 102</td>
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<td>31.2</td>
<td>26.5</td>
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<td>36.5</td>
<td>115°</td>
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</table>


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 *Mytiloides 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.
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 Walaszczyn, p. 88, pl. 1, fig. 5.
1992. *Mytiloides incertus* (Jimbo); Walaszczyn, p. 22, pl. 12, figs 11, 12.
2000. *Mytiloides incertus* (Jimbo); Walaszczyn 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.
2013. *Mytiloides incertus* (Jimbo, 1894); Walaszczyn 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):

<table>
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<td>103°</td>
<td>56°</td>
</tr>
<tr>
<td>DDI 16</td>
<td>39.0</td>
<td>–</td>
<td>–</td>
<td>24.7</td>
<td>26.9</td>
<td>109°</td>
<td>40°</td>
<td></td>
</tr>
<tr>
<td>DDI 25</td>
<td>51.9</td>
<td>52.0</td>
<td>52.3</td>
<td>52.0</td>
<td>26.4</td>
<td>35.5</td>
<td>120°</td>
<td>60°</td>
</tr>
<tr>
<td>DDI 15</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>18.7</td>
<td>20.5</td>
<td>120°</td>
<td>53°</td>
<td></td>
</tr>
<tr>
<td>DDI 17</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>19.0</td>
<td>–</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>DDI 13</td>
<td>45.0</td>
<td>50.0</td>
<td>43.9</td>
<td>–</td>
<td>–</td>
<td>25.6</td>
<td>97°</td>
<td>62°</td>
</tr>
<tr>
<td>DDI 18</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>31.3</td>
<td>120°</td>
<td>60°</td>
<td></td>
</tr>
</tbody>
</table>


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 those 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).

OCCURRENCE: 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.
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.
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):**

<table>
<thead>
<tr>
<th>Specimen no.</th>
<th>H</th>
<th>h</th>
<th>L</th>
<th>l</th>
<th>s</th>
<th>VR</th>
<th>α</th>
<th>δ</th>
</tr>
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<tbody>
<tr>
<td>DDI 107</td>
<td>30.5</td>
<td>29.0</td>
<td>15.8</td>
<td>25.0</td>
<td>55°</td>
<td>110°</td>
<td>62°</td>
<td></td>
</tr>
<tr>
<td>DDI 104</td>
<td>17.2</td>
<td>21.8</td>
<td>55°</td>
<td>55°</td>
<td>30.5</td>
<td>33.5</td>
<td>21.3</td>
<td>24.4</td>
</tr>
<tr>
<td>DDI 108</td>
<td>52.1</td>
<td>55.0</td>
<td>37.9</td>
<td>33.5</td>
<td>21.3</td>
<td>24.4</td>
<td>120°</td>
<td>62°</td>
</tr>
</tbody>
</table>

**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) resembles *Mytiloides ratonensis* Walaszczyk and Cobb, 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, *Mytiloides scupini* Zone.

*Mytiloides labiatoidiformis* (Tröger, 1967)

(Text-figs 6I, J, 7A)


1977. *Inoceramus dresdensis*? *labiatoidiformis* Tröger; Kaufman, p. 240, pl. 10, fig. 2.


1986. *Mytiloides aff. labiatoidiformis* Tröger; Scott et al., fig. 6h, j.

1990. *Mytiloides labiatoidiformis* (Tröger); Kopaeveich and Walaszczyk, p. 89, pl. 2, fig. 4.

1992. *Mytiloides labiatoidiformis* (Tröger); Walaszczyk, p. 21, pl. 12, figs 1, 2.

1999. *Mytiloides labiatoidiformis* (Tröger); 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):**

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

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 Úrmós, Transylvania, Romania.

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

Dimensions (mm):

<table>
<thead>
<tr>
<th>Specimen no. H</th>
<th>h</th>
<th>L</th>
<th>l</th>
<th>s</th>
<th>VR</th>
<th>α</th>
<th>δ</th>
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<tr>
<td>DDI 105</td>
<td>71.0</td>
<td>71.0</td>
<td>37.0</td>
<td>37.0</td>
<td>–</td>
<td>37.5</td>
<td>–</td>
</tr>
</tbody>
</table>

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 posterovenral 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 labiatoelliformis* (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 Mat-  
sumoto, p. 10, pl. 3, fig. 4.

1967. Inoceramus fiegei mytiloidiformis Tröger, p. 108,  
pl. 11, fig. 4, pl. 13, figs 16, 18.
1977. Mytiloides fiegei mytiloidiformis (Tröger); Kauff-  
man, p. 240, pl. 10, fig. 4.
1978. Mytiloides fiegei mytiloidiformis (Tröger); Kauff-  
man et al., p. 9, pl. 14, fig. 4.
1979. Inoceramus fiegei mytiloidiformis  
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 (Giümeli), 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

TURONIAN (CRETACEOUS) INOCERAMID BIVALVES FROM BULGARIA

Turonian (Cretaceous) Inoceramid Bivalves from Bulgaria

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1984. *Mytiloides fiegei* mytiloidiformis (Tröger); Cobban, p. 9, pl. 1, figs 8, 9, 11, 12.


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):**

<table>
<thead>
<tr>
<th>Specimen no.</th>
<th>H</th>
<th>h</th>
<th>l</th>
<th>s</th>
<th>VR</th>
<th>α</th>
<th>δ</th>
</tr>
</thead>
<tbody>
<tr>
<td>DDI 22</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>19</td>
<td>22.7</td>
<td>96°</td>
</tr>
</tbody>
</table>

**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.

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1982. *Inoceramus striatoconcentricus* Gümbel, (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.

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.


1997. *Mytiloides striatoconcentricus* Gümbel; Leckie et al., fig. 36H–L.

1999. *Mytiloides striatoconcentricus* (Gümbel); Walaszczzyk and Wood, p. 1, fig. 11.

2000. *Mytiloides striatoconcentricus* (Gümbel); Walaszczzyk 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):

<table>
<thead>
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<th>Specimen no.</th>
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<th>h</th>
<th>L</th>
<th>l</th>
<th>s</th>
<th>VR</th>
<th>α</th>
<th>δ</th>
</tr>
</thead>
<tbody>
<tr>
<td>DDI 4</td>
<td>42.3</td>
<td>45.2</td>
<td>36.7</td>
<td>29.7</td>
<td>–</td>
<td>23.3</td>
<td>95°</td>
<td>52°</td>
</tr>
<tr>
<td>DDI 106</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>20.9</td>
<td></td>
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</tbody>
</table>

**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 collection, 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 Iqvor 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.

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.

**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 Iqvor 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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**REFERENCES**


Noda, M. and Matsumoto, T. 1998. Paleontology and stratigraphy of the inoceramid species from the mid-Turonian


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