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Inoceramid/foraminiferal succession of the Turonian and Coniacian (Upper Cretaceous) of the Briansk region (Central European Russia)

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ABSTRACT:

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An integrated inoceramid-foraminiferal zonation for the topmost Turonian and Lower Coniacian near Briansk, SW of Moscow is presented. The inoceramid fauna enables the application of the refined zonal scheme currently applied in central and western Europe. Three zones based on benthic foraminifera,.the *Gavelinella moniliformis*, *Ataxophragmium nautiloides* and *Stensioeina granulata granulata* zones; and three zones based on planktonic foraminifera, the *Whiteinella archaeocretacea*, *Marginotruncana pseudolinneiana* and *Marginotruncana renzi* zones, are distinguished. The Turonian/Coniacian boundary, defined by the first appearance of the inoceramid *Cremnoceramus deformis erectus* (MEEK, 1877), falls within the basal part of the *Stensioeina granulata granulata* Zone and the basal part of *Marginotruncana renzi* Zone. In foraminiferal terms the Turonian/Coniacian boundary interval is marked additionally by a sudden, short-lived increase in the plankton/benthos ratio, caused primarily by more abundant shallow-water morphotypes.

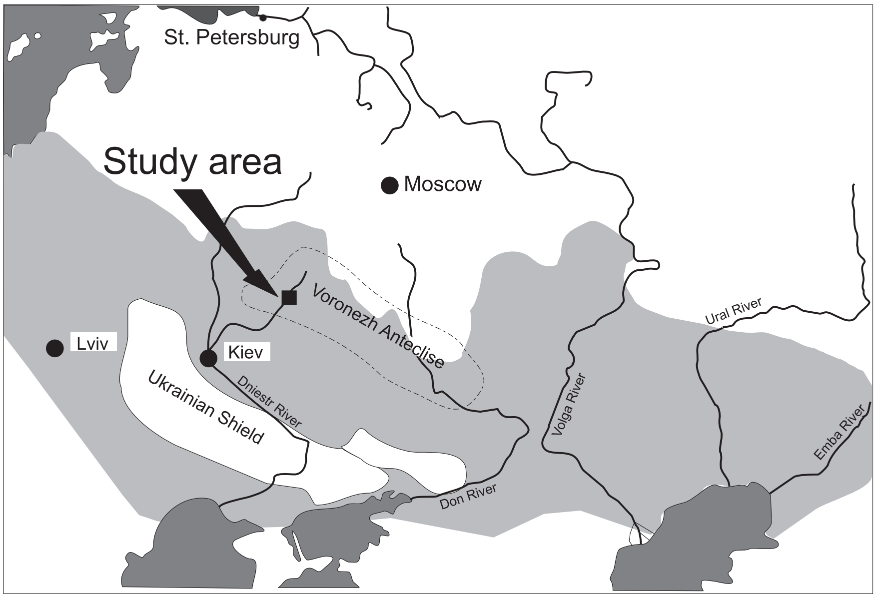
Key words: Turonian, Coniacian, Inoceramids, Foraminifera, Biostratigraphy, East European Platform, Russia.

INTRODUCTION

This paper presents the integrated inoceramid-foraminiferal biostratigraphy of the Upper Turonian and Lower Coniacian in the region of Briansk, central part of the East-European Platform (Voronezh anteclise). The study area is located about 350 km south-west of Moscow, and the material comes from both natural exposures and from shallow boreholes, located north of the town (Text-fig. 1).

The localities studied provided rich and diversified inoceramid material, which allowed a precise correlation with the best studied successions of central and western Europe. The foraminiferal assemblages are dominated by benthic forms, which enable zonation of the Turonian - Coniacian succession in the region (OLFERIEV & *al*. 1991, KOPAEVICH & *al*. 1995). Planktonic foraminifers are rare, but the distinct increase in the plankton/benthos ratio that is known elsewhere from around the Turonian/ Coniacian boundary, is also well represented and appears to be a very useful tool for recognition of the boundary.

The succession presented and its biostratigraphical interpretation are based on three exposures, i.e.



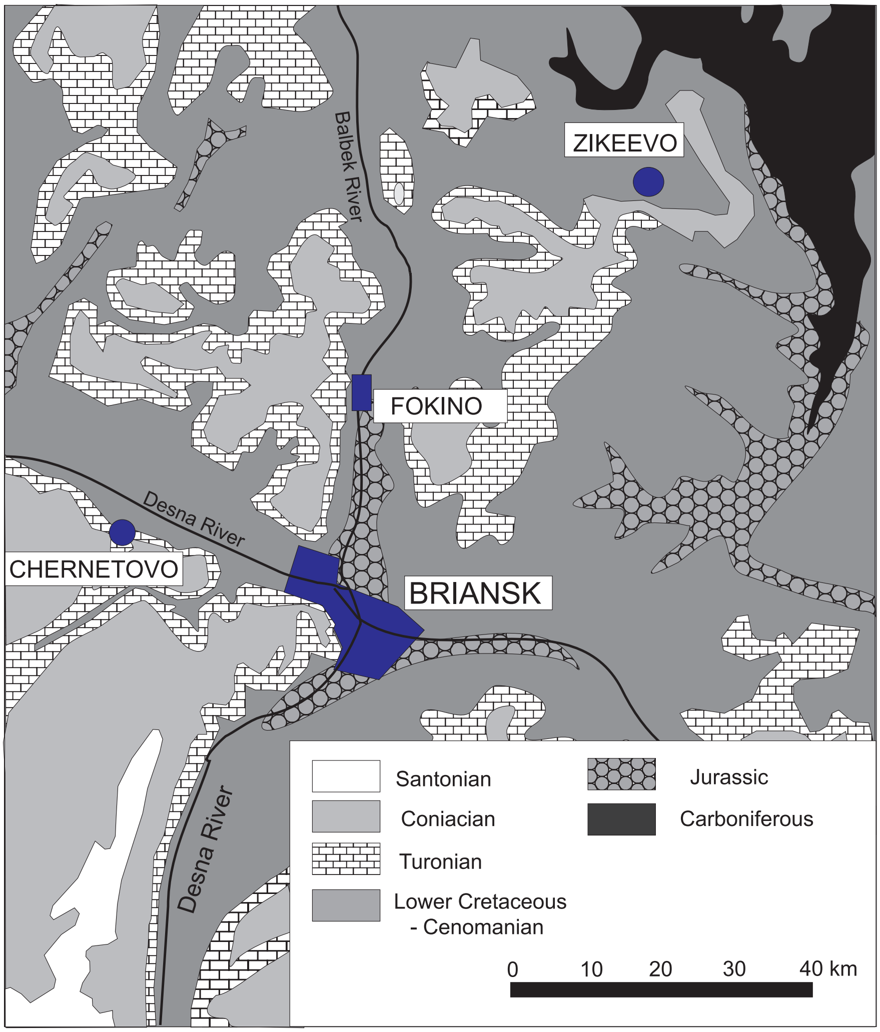


Fig. 1. Location of the study area on the East European Platform and its geological sketch-map

Chernetovo, Fokino, and Zikeevo, located along an approximately NE - SW transect, to the north and southwest of the town of Briansk (see Text-fig. 1). The most important section for recognition of the Turonian/Coniacian boundary is the Chernetovo section (see Text-fig. 2), about 30 km west of Briansk, which is represented by natural exposures in the high, south bank of the Desna River. Another important section is the Fokino section (Text-fig. 3). This section is represented by a working quarry situated on the north-eastern periphery of the town of Fokino, on the eastern bank of the Bolva river an eastern tributary of the Desna River, about 23 km north of Briansk (see Text-fig. 1). Both sections contain well-represented inoceramid assemblages spanning the Turonian/Coniacian boundary. The two other sections contain rather poor or biostratigraphically equivocal macrofaunas.

REGIONAL SETTING

Following the regional pattern, the mid-Cretaceous strata in the environs of Briansk are composed of relatively thin, discontinuity-bounded stratigraphical units, with the discontinuity surfaces associated usually with the stratigraphical gaps (see Text-figs 2-3). The mid-Cretaceous succession starts with terrigenous deposits of the Middle–Upper Albian and Cenomanian and is followed by the Turonian chalky unit.

The Cenomanian of the region is bipartite. Its lower part is represented by bioturbated, quartz-glauconitic, fine-grained non-carbonate sands with rare, dark brown phosphatic nodules, and is referred to the Polpino Formation. The sands are capped by a phosphatised hardground. Rare *Praeactinocamax primus primus* (ARKHANGELSKY) (reported from here by Prof. D.P. NAIDIN) date the unit as Early – Middle Cenomanian. The unit belongs to the *Gavelinella cenomanica* benthic foraminifer Zone.

The upper part of the Cenomanian is represented by the Dyatkovo Formation, comprising quartz-glauconitic carbonate sands with thin beds of phosphatic concretions. The formation is maximally 9 m thick (2.5 m in the Fokino section). The belemnite species *Praeactinocamax primus primus* (ARKHANGELSKY) and *P.* cf. *plenus longus* NAIDIN (determinations of D.P. NAIDIN), indicates its Middle–Late Cenomanian age. This unit belongs to the *Lingulogavelinella globosa* benthic foraminifer Zone (Text-figs 2-3).

The Cenomanian sands are overlain by Turonian chalk of the Tuskar Formation. The basal part of the formation is composed of redeposited sands with phosphatic

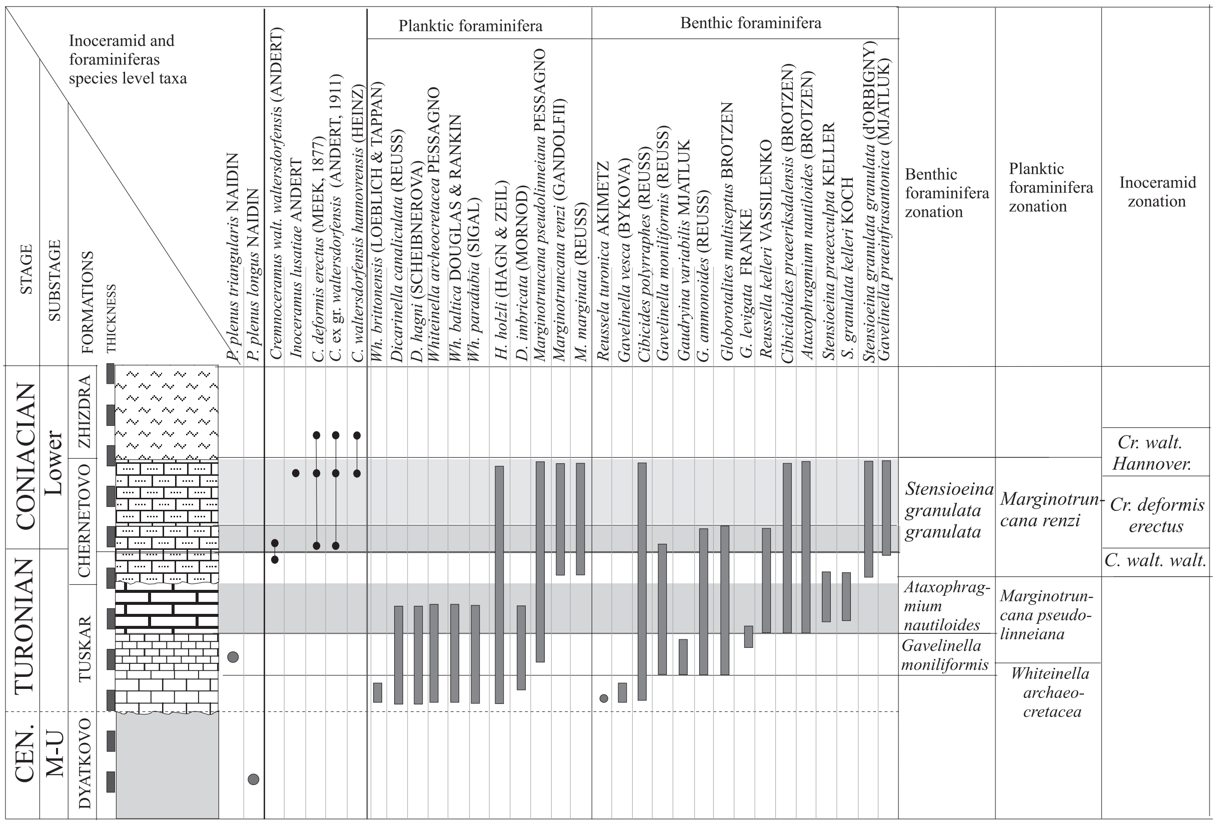


Fig. 2. Geological column, stratigraphy and vertical distribution of inoceramid and foraminiferal species level taxa in the Chernetovo section

nodules and rostra of *Praeactinocamax plenus triangulus* NAIDIN, passing upwards into sandy chalk (see Chernetovo section). The latter yielded (according to D.P. NAIDIN) *Goniocamax intermedius* (ARKHANGELSKY) (Fokino section), which dates it as Middle and Late Turonian. Benthic and planktonic foraminifera are also well represented (see Text-figs 2-3),and indicate an Early Turonian age for the basal part of the Tuskar Formation. The main, chalky part of the formation is composed of pure, white chalk. It represents the Middle and Late Turonian *Gavelinella moniliformis* benthic foraminifer Zone (see Text-figs 2-3, 8).

The chalk of the Tuskar Formation is capped by a hardground, which is usually strongly silicified. The overlying series of grey, bedded or massive, bioturbated, siliceous marls, represents the Chernetovo Formation,

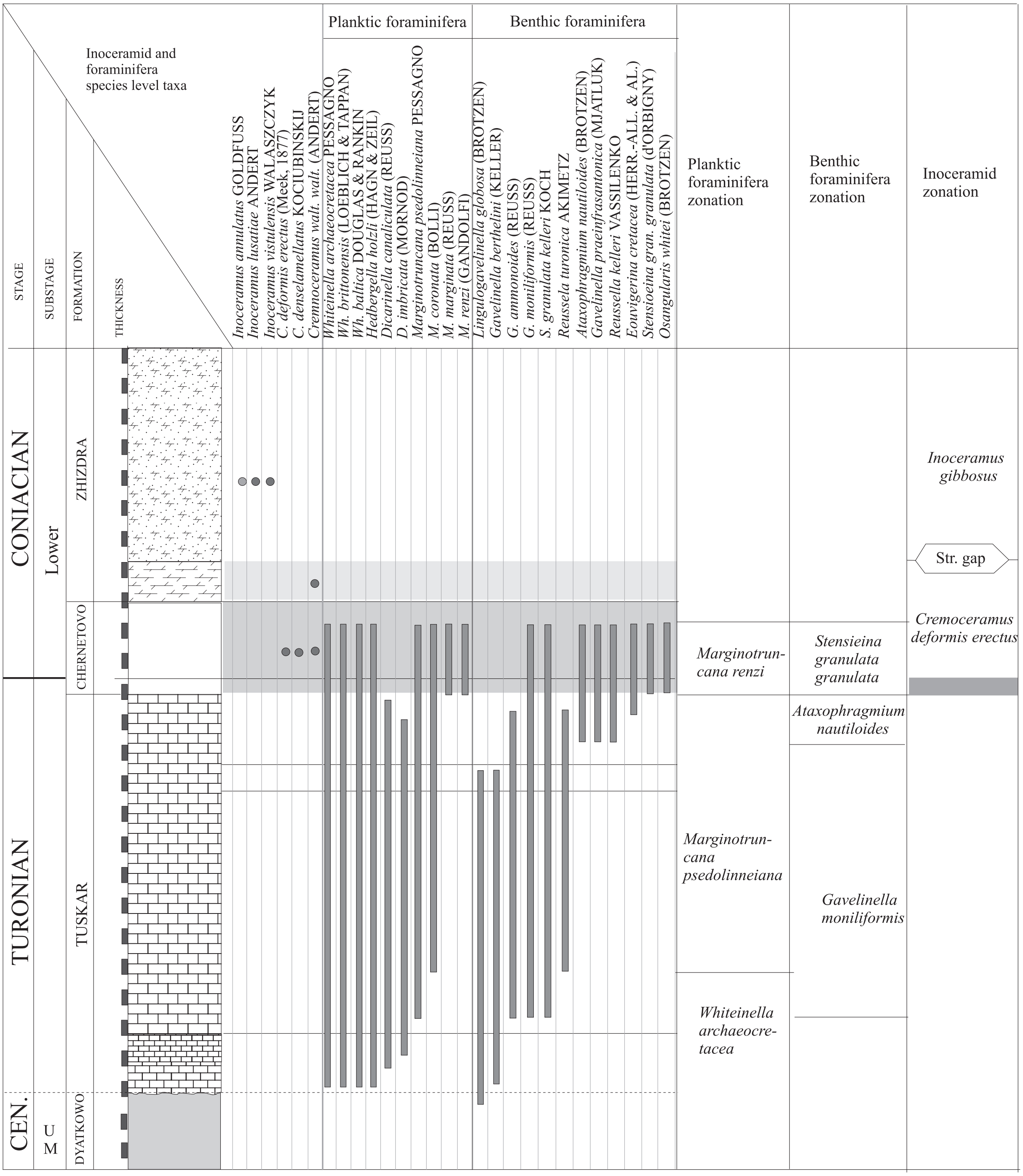


Fig. 3. Geological column, stratigraphy and vertical distribution of inoceramid and foraminiferal species level taxa in the Fokino section

which, as demonstrated by the common inoceramids and confirmed by the abundant foraminifera, spans the topmost Turonian and the Lower Coniacian.

The marls of the Chernetovo Formation pass upwards into the non-carbonate, siliceous rocks of the Zhizdra Formation. These deposits are light brown tripoli, massive, clayey in parts. Locally they pass into soft opokas. In some sections, the opokas and tripolis form more or less distinct rhythms, five to ten cm thick. The relatively common inoceramids indicates a late Early Coniacian age for at least the basal part of the formation.

THE TURONIAN/CONIACIAN BOUNDARY SUCCESSION

The currently widely recognised inoceramid zonation in the Upper Turonian and Lower Coniacian of central and western Europe (WOOD & *al*. 1984, WALASZCZYK & WOOD 1999 and in NIEBUHR & *al*. 1999; WALASZCZYK 2000) is shown in Text-fig. 8. To a large extent this scheme is also applicable in the US Western Interior (WALASZCZYK & COBBAN 2000). Based on the inoceramid record of the Chernetovo and Fokino sections, and partly on the Zikeevo and Betovo sections, the applicability of this scheme in the Briansk region, at least in the latest Turonian – Early Coniacian interval, is here confirmed.

The latest Turonian – Early Coniacian zonation is composed of 6 interval range zones, based primarily on the *Cremnoceramus* lineage, the evolutionary history of which is quite well understood (WALASZCZYK & WOOD 1999 and in NIEBUHR & *al*. 1999), and consequently the zonal boundaries are represented by well constrained evolutionary appearances of the index taxa. Two zones that are less well understood and still require intensive reasearch are the *Cremnoceramus waltersdorfensis* and the *Inoceramus gibbosus* zones. The latest Turonian C. *waltersdorfensis* Zone possesses an excellent record, but the nature of the sudden appearance of its index taxon remains unclear. The *I. gibbosus* Zone, the latest Early Coniacian zone, defined as the interval from the LO (last occurrence) of *Cremnoceramus* to the FO (first occurrence) of the Middle Coniacian *Volviceramus*, is known hitherto from a single locality, the Staffhorst shaft section in northern Germany (NIEBUHR & *al*. 1999), and consequently knowledge of it is very limited.

Inoceramid record

The Chernetovo section (Text-fig. 2) offers the best inoceramid record across the Turonian/Coniacian boundary of the sections studied. The boundary succession is represented here by 3-m thick marls belonging to the Chernetovo Formation. The stratigraphically oldest inoceramids come from the lowermost part of these marls (bed 4 – see Text-fig. 2), and are represented invariably by relatively well preserved, small-sized *Cremnoceramus waltersdorfensis waltersdorfensis* (ANDERT, 1911) (see Text-figs 4.4, 5.1-2, 5.4 and 5.7). The abundant occurrence of this species at this level suggest an interval equivalent to the *waltersdorfensis* Event that is well documented in the topmost Turonian in numerous sections throughout the Euramerican biogeographical region (e.g. WOOD & *al*. 1984, this paper; KÜCHLER & ERNST 1989, WIESE 1997, WALASZCZYK 1992, 2000; WALASZCZYK & COBBAN 2000; WOOD & *al.*, this volume).

In the succeeding interval (bed 3 in Text-fig. 2), *Cremnoceramus deformis erectus* (MEEK, 1877)(Text-fig. 5.6) first appears. This is the correct name for *C. rotundatus* sensu TRÖGER non Fiege (see WALSZCZYK & WOOD 1998 and WALASZCZYK & COBBAN 2000), the inoceramid marker taxon for the base of the Coniacian stage, as accepted during the Brussels symposium (KAUFFMAN & *al*. 1996). This species is accompanied by rare *C. waltersdorfensis*.

Still higher, in the topmost bed of the Chernetovo Formation (bed 2 in Text-fig. 2), as well as in the lower part of the succeeding Zhizdra Formation, the inoceramids are dominated by *Cremnoceramus waltersdorfensis hannovrensis* (HEINZ, 1932) (see Text-fig. 4.6) and rare *Inoceramus lusatiae* ANDERT, 1911. This assemblage indicates the *C. waltersdorfensis hannovrensis* Zone of the Lower Coniacian.

Although most of the material to hand comes from the Fokino section (Text-fig. 3) it is not a bed-by-bed collection, and only two samples representative of the two successive intervals are available. The lower sample was obtained from marls of the Chernetovo Formation (bed 4 – see Text-fig. 3), whereas the upper sample spans the lower part of the Zhizdra Formation (beds 2 and 3 of the section - see Text-fig. 3). The two assemblages are quite distinct in their taxonomic composition. The lower one is represented mostly by *C. waltersdorfensis hannovrensis*, *C*. ex gr. *waltersdorfensis* (ANDERT, 1911), *Inoceramus lusatiae* (see Text-fig. 4.3), and rare *Cremnoceramus deformis erectus* (see Text-fig. 4.7). Such a taxonomic composition suggests that the lower fauna of the Fokino section may represent an interval spanning the *C. deformis erectus* and the *C. waltersdorfensis hannovrensis* zones of the Lower Coniacian, and ranging possibly down to the *C. waltersdorfensis waltersdorfensis* Zone of the topmost Turonian.

The taxonomic composition of the upper sample is quite distinct. Apart from a single specimen of a form comparable with *C*. ex gr. *waltersdorfensis*, cremnoceramids disappear completely, and the material belongs almost entirely to the genus *Inoceramus*. It comprises

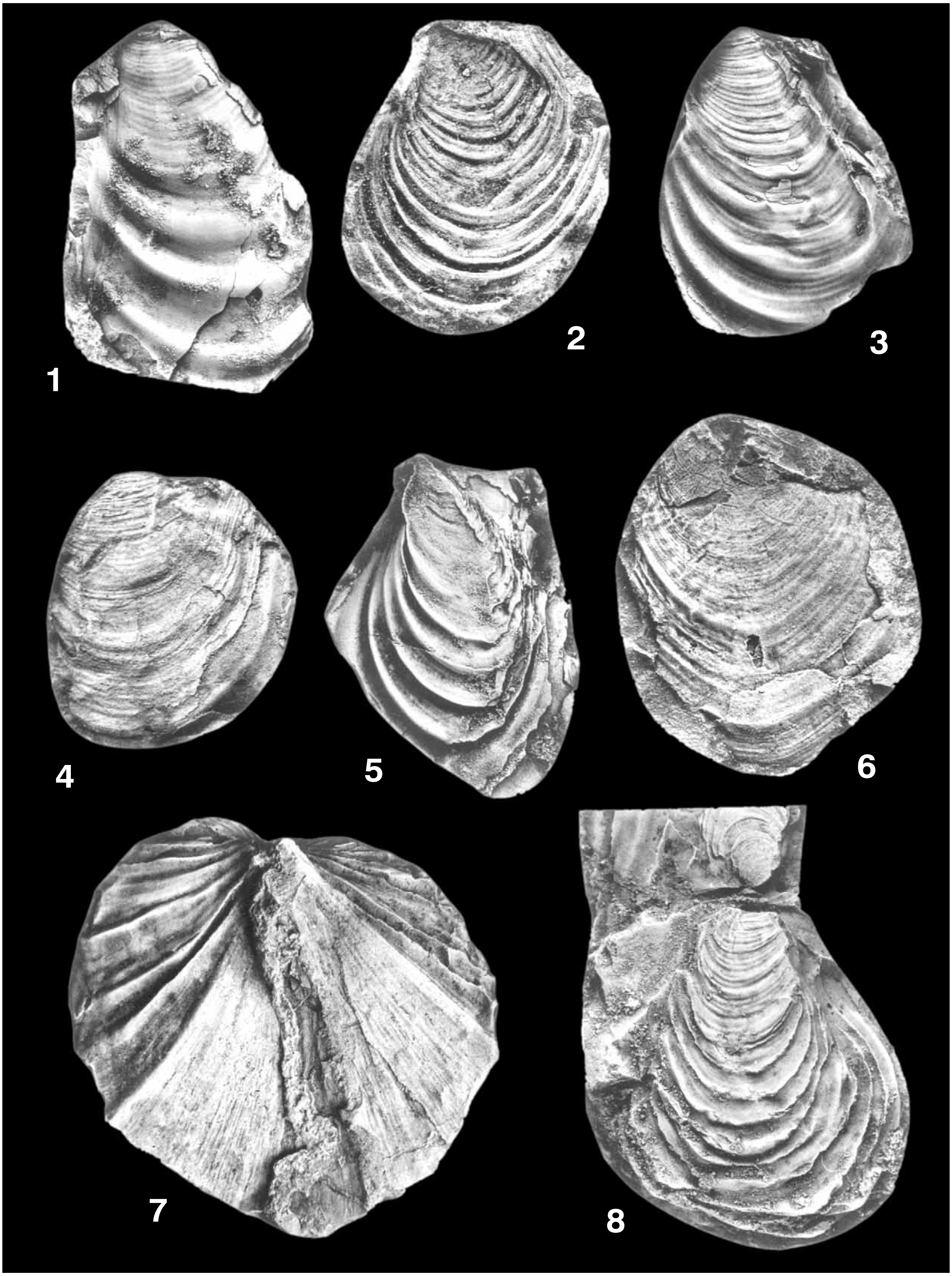


Fig. 4. Inoceramids of the topmost Turonian and Lower Coniacian; 1, 2, 5 – Inoceramus lusatiae Andert, 1911; 1 – F-29, Fokino section, 3 – F-24, Fokino section, 5 – F-28, Fokino section; all × 1. 2, 8 – *Inoceramus vistulensis* WALASZCZYK, 1992; 2 – Cz-10, Chernetovo section, 8 – F-36, Fokino section; both × 1. 4 – *Cremnoceramus waltersdorfensis waltersdorfensis* (ANDERT, 1911), Cz-8, Chernetovo section, × 1. 6 – *Cremnoceramus waltersdorfensis hannovrensis* (HEINZ, 1932), Cz-12, Chernetovo section, × 1. 7 – *Cremnoceramus deformis erectus* (MEEK, 1877), F-9, Fokino section, × 1.

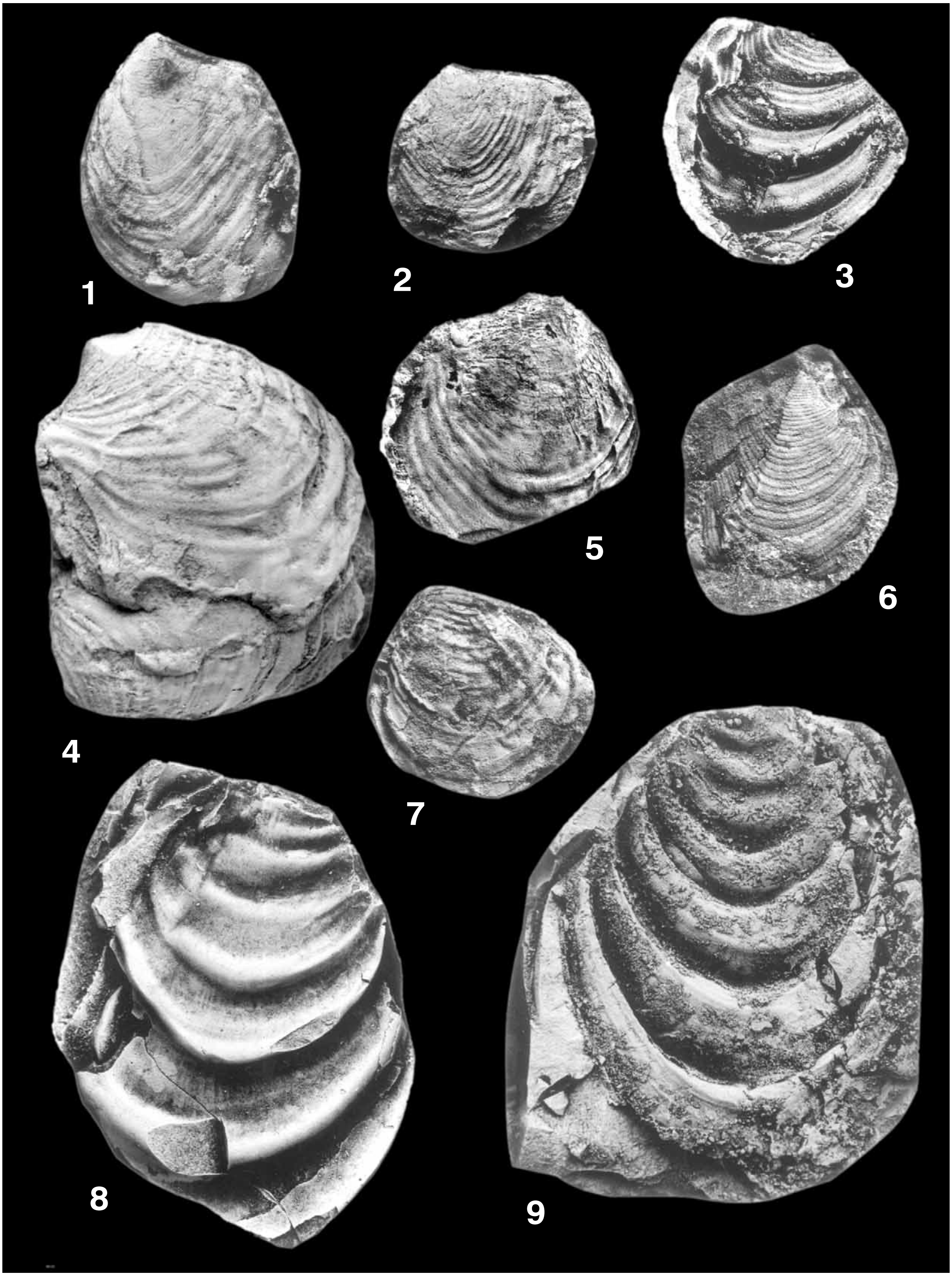


Fig. 5. Inoceramids of the topmost Turonian and Lower Coniacian 1-2, 4-5, 7 – *Cremnoceramus waltersdorfensis waltersdorfensis* (ANDERT, 1911); 1 – Cz-10, Chernetovo section, × 1, 2 – Cz-8, Chernetovo section, × 1, 4 – Cz-11, Chernetovo section, × 1, 5 – F-15, Fokino section, × 1, 7 – Cz-8, Chernetovo section, × 1. 3, 8 – *Inoceramus lusatiae* ANDERT, 1911; 3 – Z-18, Zikeevo section; 8 – F-40 – Fokino section; both x 1. 9 – *Inoceramus annulatus* GOLDFUSS, 1836, F-33, Fokino section, × 1.

Inoceramus lusatiae (see Text-figs 4.1, 4.5 and 5.8), *I. annulatus* GOLDFUSS, 1836 (see Text-fig. 5.9), and rare specimens referred questionably to *Inoceramus vistulensis* WALASZCZYK, 1992 (see Text-fig. 4.8). The precise stratigraphical location of the upper sample is not entirely clear. However, its position clearly above the well documented *C. hannovrensis* Zone, the predominance of the *Inoceramus* species, and the lack of Middle Coniacian forms, such as *Volviceramus koeneni* or *Platyceramus mantelli*, suggests that this sample may represent the *Inoceramus gibbosus* Zone of the upper Lower Coniacian. *I. gibossus* is a provisional zonal name for a late Early Coniacian, *Cremnoceramus*-free interval proposed by WALASZCZYK & WOOD (in NIEBUHR & *al*. 1999), based on observations in the Staffhorst shaft section, northern Germany. The lack in the studied successions of the Briansk region, of evolutionarily late representatives of the genus *Cremnoceramus*, such as *C. deformis deformis* (MEEK, 1877) and *C. crassus crassus* (PETRASCHECK, 1903), may suggest a stratigraphical gap between the marls of the Chernetovo Formation and the succeeding Zhizdra Formation.

The inoceramid samples from the two other sections studied, i.e. from the Zikeevo and Betovo sections, are much less reliable. Not only was the material collected from relatively thick intervals, but it is also not particularly well preserved. In any case, the inoceramid sample from the Zikeevo section, from the middle part of the Zhizdra Formation, is equivalent to the upper sample from the Fokino section. The inoceramids from the Betovo section most probably represent the *C. waltersdorfensis waltersdorfensis* fauna.

Foraminifera

The foraminifera in the sections studied are known exclusively from the marls and chalks of the Tuskar and Chernetovo Formations (Text-figs 2-3). The higher parts of the sections, represented by the lower Zhizdra Formation, are devoid of calcareous microfauna. As in the whole area of the East European Platform, the upper Turonian and lowermost Coniacian foraminiferal assemblages in the region are dominated by benthic forms. The planktonic foraminiferal assemblages, when compared to those from areas farther to the south (Caucasus, Crimea), are markedly reduced in taxonomic diversity. The biostratigraphically most important species are missing. However, it is noteworthy that there is a sharp increase in the diversity of the planktonic foraminfera and of the plankton/benthos ratio close to the Turonian/Coniacian boundary, a phenomenon well known over wide areas of the European continent.

Foraminiferal zonations

Analysis of the stratigraphical distribution of the benthic fauna in the Fokino and Chernetovo sections (Text-figs 2-3, 6) enabled the recognition of three benthic foraminiferal assemblages, defining four corresponding interval zones.

Gavelinella moniliformis Zone. The base of the zone is defined by the FO of *Gavelinella moniliformis* (REUSS), and its top by the FO of *Ataxophragmium nautiloides* (BROTZEN). The index taxon is accompanied by *G. ammonoides* (REUSS), *Globorotalites multiseptus* BROTZEN, *Gaudryina variabilis* MJATLIUK, and the first small-sized *Stensioeina granulata kelleri* KOCH. The assemblage also includes several species of gavelinelids which continue from below, such as *Gavelinella berthelini* (KELLER), *Lingulogavelinella globosa* (BROTZEN) and *Cibicides polyrraphes* (REUSS) (see Text-figs 2, 3).

Ataxophragmium nautiloides Zone. The base of the zone is defined by the FO of the index taxon, and its top by the FO of *Stensioeina granulata granulata*. It may be accompanied by rare, but biostratigraphically very important, *Gavelinella praeinfrasantonica* (MJATLIUK) and *Reussella kelleri* (VASSILENKO). *G. pareinfrasantonica* corresponds not only to the original description (VASSILENKO & MJATLIUK, 1947) but also with data of HRADECKA (1996, description and pictures on pl. 5, fig.7). This species is constitutes transient link between *G. schloenbachi* and *G. vombensis.* In the Briansk region, this zone is characterized by a moderate increase in the ratio between the agglutinated and calcareous benthic foraminifera. This interval zone equates with the upper part of the regional *Gavelinella moniliformis* Zone of the scheme for the East-European Platform (OLFERIEV & ALEKSEEV 2002, 2003).

Stensioeina granulata granulata Zone. The FO of typical *Stensioeina granulata granulata* (OLBERTZ), rare *Gavelinella kelleri* (MJATLIUK) and the appearance of the genus *Osangularia* define the base of the zone. *Gavelinella moniliformis* (REUSS) occurs sporadically. This interval zone equates with the lower part of the regional *Gavelinella kelleri* Zone, which comprises the entire Lower Coniacian interval (OLFERIEV & ALEKSEEV 2002, 2003).

Three planktonic foraminiferal assemblages, and corresponding biozones, can also be distinguished (Text-figs 2-3, 7).

Whiteinella archaeocretacea Zone. This zone is the oldest stratigraphically. It is characterized by the occurrence of the index taxon, together with *Wh. baltica* (DOUGLAS & RANKIN), *Wh. brittonensis* (LOEBLICH & TAPPAN), *Wh. paradubia* (SIGAL) and *Hedbergella holzli* (HAGN & ZEIL). *Dicarinella canaliculata* (REUSS), *D.*

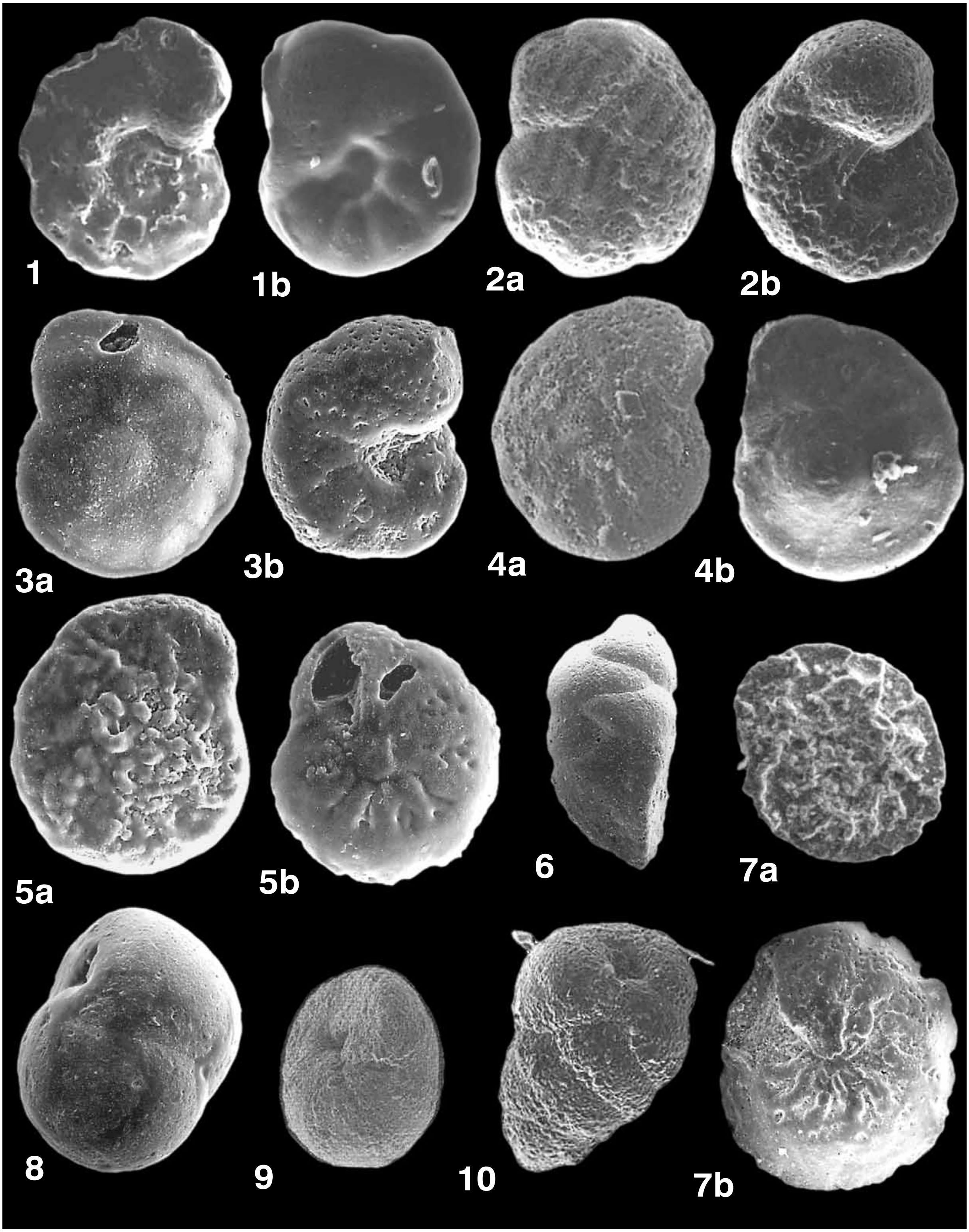
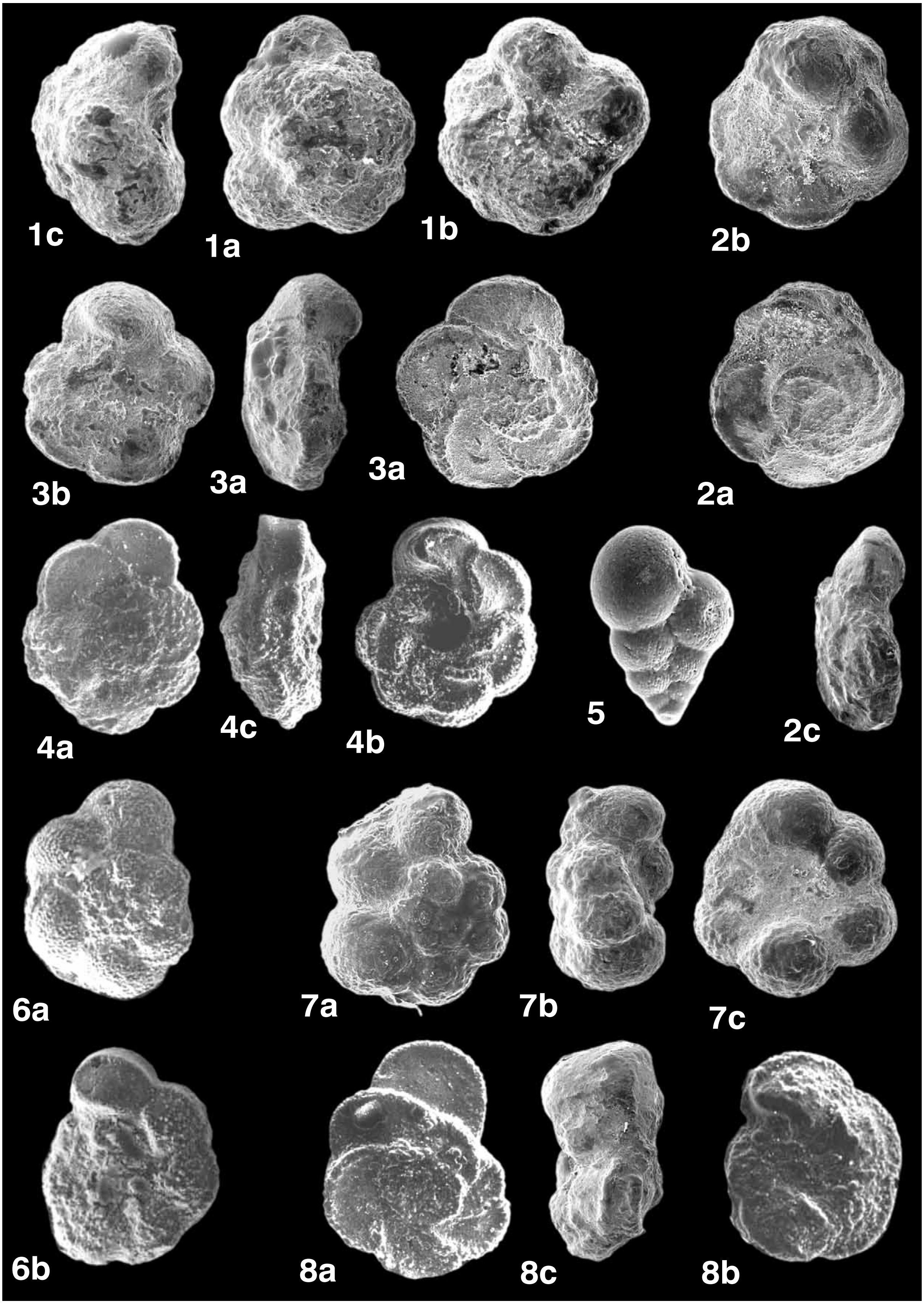


Fig. 6. Foraminifera from the middle Cretaceous of the studied sections 1 – *Gavelinella cenomanica* (BROTZEN); a – spiral view, b – umbilical view; Middle Cenomanian, Fokino section, × 80. 2 – *Gavelinella moniliformis* (REUSS); a – spiral view, b – umbilical view; Middle Turonian, Fokino section, × 80. 3 – *Gavelinella kelleri* (MJATLIUK); a – spiral view, b – umbilical view; Lower Coniacian, Fokino section, × 80. 4 – *Gavelinella praeinfrasantonica* (MJATLIUK); a – dorsal view, b – umbilical view; Upper Turonian, Fokino section, × 100. 5 – *Stensioeina granulata granulata* OLBERTZ; a – spiral view, b – umbilical view; Lower Coniacian, Chernetovo section, × 100. 6 – *Gaudryina laevigata* FRANKE; Upper Turonian, Chernetovo section, × 50. 7 – *Stensioeina praeexculpta* KELLER; a – spiral view, b – umbilical view; Lower Coniacian, Chernetovo section, × 120. 8 – *Eggerellina* cf. *brevis* MARIE; lower part of the Turonian; Fokino section, × 80. 9 – *Ataxophragmium nautiloides* BROTZEN; Upper Turonian, Fokino section, × 70. 10. *Arenobulimina presli* (REUSS); Upper Turonian; Fokino section, × 70.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hagni (SCHEIBNEROVA) and *D. imbricata* (MORNOD) are also represented in this interval.

Marginotruncana pseudolinneiana Zone. This zone is defined as the interval from the FO of representatives of the genus *Marginotruncana* to the upper boundary of an interval with an increased plankton/benthos ratio and the appearance of *Marginotruncana ren zi*. It is characterized by the presence of *Marginotruncana pseudolinneiana* PESSAGNO, *M. marginata* (REUSS), and very rare *M. coronata* (BOLLI). The taxonomic diversity of the assemblage in this interval is not very high but the most characteristic feature is the increase in the plankton/benthos ratio, from the usual 5-10%, to 25-30% in the topmost part of the zone.

Marginotruncana renzi Zone*.* It is characterized by the presence of index taxon and by a distinct increase in the taxonomic diversity of the planktonic foraminifera. There is also an initially sharp, followed by a more gentle decrease in the plankton/benthos ratio from the high values noted in the peak at the top of the underlying zone, with maximum values not exceeding 15%.

INTEGRATED INOCERAMID AND FORAMNIFERAL SUCCESSION ACROSS THE TURONIAN-CONIACIAN BOUNDARY

As currently documented in the Salzgitter-Salder and Słupia Nadbrzeżna sections (WALASZCZYK & WOOD 1999; and WOOD & *al*., this volume) the topmost Turonian through Lower Coniacian can be subdivided into six successive inoceramid interval zones, in ascending order: the latest Turonian *Cremnoceramus waltersdorfensis* and *Inoceramus* aff. *glatziae* zones, and the zones of *C. deformis erectus*, *C. waltersdorfensis hannovrensis*, *C. crassus inconstans*, *C. deformis deformis* +*C. crassus crassus*, and *I. gibbosus*, in the Lower Coniacian. Although not ideal, the Chernetovo, Fokino, and Zikeevo sections clearly document the inoceramid succession recognised in the German and the Polish sections, and allow the refined zonal scheme to be applied for the prediction of stratigraphical gaps (see Text-fig. 2-3). The Briansk area also seems to be one of the rare cases of an area with a record of the topmost Lower Coniacian *I. gibbosus* Zone; usually this interval is missing. The rest of the Turonian is devoid of inoceramids.

Foraminifers posses relatively good record throughout the Turonian and the Coniacian, allowing the zonal subdivision of both stages. In foraminiferal terms, the Turonian/Coniacian boundary in the study area, as defined by inoceramids, is close to the appearance of the foraminiferal species *Marginotruncana renzi* and typical *Stensioeina granulata granulata*; they first appear at the base of the *Cremnoceramus waltersdorfensis waltersdorfensis* Zone, the entrance level of cremnoceramids. It is an equivalent level to more southerly lying areas, such as Mangyshlak (NAIDIN & *al.* 1984a; BENIAMOVSKIJ & KOPAEVICH 1995; KOPAEVICH & *al*. 1995) and the Crimea (KOPAEVICH & WALASZCZYK 1990). In the case of *M. renzi* it is much later, however, than in central Poland, where this form is firstly noted from the base of Upper Turonian (WALASZCZYK & PERYT 1998). More or less coeval first appearances are also noted for some other forms, as e.g. *Gavelinella praeinfrasantonica* (MJATLIUK), *Reussella kelleri* (VASSILENKO), or small *Stensioeina* spp. They are also known to appear in the Late Turonian *Subprionocyclus neptuni* Zone in England, France and in Bohemian Basin (BAILEY & *al*. 1983, ROBASZYNSKI & *al*. 1980, HRADECKA, 1996). Some descrepancies in the time of their appearance are most probably ecologically controlled.

Based on the general facies characteristics, the very low P/B ratio, and the almost complete lack of keeled forms among the planktonic foraminifera, a shallow or very shallow environment may be postulated for the succession in the Briansk area. It is noteworthy that here, as in other areas, the terminal Turonian is characterized by a distinct peak in the P/B ratio (see Text-fig. 5). This event, which is of at least regional importance, is confined to the latest Turonian and earliest Coniacian, is well recognized throughout Europe. It is the "Zone a Grandes *Rosalines*" of SIGAL (1977) and the level of a significant increase in keeled foraminifers *Marginotruncana paraventricosa* (HOFKER) in sections in Lower Saxony, Germany [e.g. Salzgitter-Salder] recorded by BRÄUTIGAM (1962). Further to the east, this increase was reported from the Crimea, the Pericaspian area, and from Mangyshlak (NAIDIN & *al*. 1980; KOPAEVICH 1989, 1995). In all cases studied, where ammonite and/or inoceramid data are available for biostratigraphical control, this event is in an identical stratigraphical position

Fig. 7. Planktonic foraminifera from the middle Cretaceous of the sections studied; – *Whiteinella brittonensis* (LOEBLICH & TAPPAN), a – spiral view, b - umbilical view, c – profile view, lower part of the Turonian, Fokino section, × 100. 2 – *Dicarinella hagni* (SCHEIBNEROVA); a – spiral view, b - umbilical view, c – profile view, Upper Turonian, Chernetovo section, x 100. 3 – *Dicarinella imbricata* (MORNOD); a – spiral view, b - umbilical view, c – profile view; Upper Turonian, Cherentovo section, × 100. 4 – *Marginotruncana coronata* (BOLLI); a – spiral view, b - umbilical view, c – profile view; Lower Coniacian, Chernetovo section, × 70. 5 - *Heterohelix reussi* (CUSHMAN), Turonian, Chernetovo section, × 150. 6 – *Marginotruncana marginata* (REUSS), a – dorsal view, b – umbilical view, Lower Coniacian, Chernetovo section, x 100. 7 – *Whiteinella archaeocretacea* (PESSAGNO), a – spiral view, b - umbilical view, c – profile view, lower part of the Turonian, Fokino section, × 100. 8 – *Marginotruncana renzi* (GANDOLFI); a – dorsal view, b – umbilical view, c – profile view; Lower Coniacian, Betovo section, × 100

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