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# LATE CRETACEOUS MICROFAUNA OF THE OLĂNEŞTI VALLEY–CHEIA VALLEY BASIN; PALEOENVIRONMENTAL INTERPRETATIONS

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**Abstract.** In the Buila-Vânturarița Massif – Olăneşti basin area, Upper Jurassic reef limestones are covered by a thick blanket of Cretaceous deposits with molassic character. Unconformably and transgressively over the "Vânturarița limestones", represented by micrites and pelsparites with patch-reefs, there are molasse deposits dated paleontologically and micropaleontologically as Upper Cretaceous, mainly Senonian in age. The paleofauna of mollusks – *Inoceramus* – and foraminifers allows depositional and paleobiological inferences on the Turonian – Senonian paleoenvironment.
Favorability factors for fossil prelevation, as well as identification of stratinomical relationships and tectonical-structrural details, are determined by outcrops in the Olăneşti and Cheia valleys.
Some of the first studies of the Turonian-Maastrichtian planktonic and benthic foraminifers in this area were included into geological and paleontological syntheses and prospecting reports. In the geological studies, planktonic foraminiferal assemblages were presented as to support the age of the deposits. Some of these studies were conducted until 1985, in order to establish the age and draw the geological limits in some sectors of the geological maps sc. 1: 200.000 and 1: 50.000 (*Piteşti* and *Vânturarița* sheets).
Subsequently, some paleontological sections were reconsidered by the authors for their stratigraphical details. New biostratigraphical details evidentiate new depositional particularities in this area. The identification of certain structural relations for the Late Cretaceous can be used for correlations with other post-tectonic basins of the Getic Domain.

**Keywords**. Upper Cretaceous; molasse deposits; biostratigraphy; Foraminifera

## INTRODUCTION

The limestone deposits of the Buila–Vânturarița Massif are dated as Bathonian – Lower Aptian by Dragastan *et al*. (2000). These deposits present a carbonate cummulative character, mostly bioconstructed, with continuous passing from Bathonian to lower Aptian. In the area between Cheia and Olăneşti Valleys, over the organogenic limestone deposits which formed up until as late as the Aptian, there is a period of emersion during the Albian – Cenomanian interval. Waters reappear beginning with the Turonian.

A certain lithofacial variation is observed along the South – North direction, which can be observed on the profiles in the following valleys: Cheia, Olăneşti, Pânzele, Bacea. In the Stogu area the Lower Barremian – Aptian limestones are covered by transgressive and unconformable molasse deposits, paleontologically and micropaleontologically dated as belonging mainly to the Senonian. As an overall lithological feature, the presence of several distinct levels ("horizons") are noted, with local gradual facies transitions in between. A succesion of four such "horizons" was identified, from the basal contact with the limestones towards Olăneşti and Cheia, to the Eocene conglomerates (Fig. 1).

Generally, a poor microfauna is present, a common feature of molasse-type deposits. It is to be noticed that, in the group of predominant pelitic deposits from the upper part of the Cretaceous, there are foraminifers in a good state of preservation, practically with test whithout sedimentary material.

The presence of globotruncanids at different lithostrathigraphic levels, offer the possibility of dating for the respective deposits, as well as some interpretations in instances of reworked assemblages.

## LITHO–BIOSTRATIGRAPHIC CONSIDERATIONS

On the upper sector of Cheia Valley, based on information obtained from prospectors (team of Boldur *et al*., 1968) and a specimen of *Stoliczkaia* sp., found by Gr. Popescu and identified by D. Patrulius (this identification was accepted by Boldur *et al*., 1970 and Todiriță Mihăilescu, 1973, but was later *contested and cannot be checked in the present, as it cannot be any longer identified in the IGG collection),* L. Szasz figured a string of deposits dated as Vraconian-Cenomanian on the map sheet 126a Vânturarița (Olăneşti), scale 1:50.000. These deposits are represented by polimictic conglomerates, marly and silty clays with sandstone intercalations. We mention the fact that at least the Cretaceous deposits located East of the Stogu Peak – Cheia Valley alignment cannot be placed in the Vraconian-Cenomanian, due to the lack of a paleontological confirmation.

A basal conglomerate level, reported by previous authors, does not present a continuous developement in front of the Buila Massif – Stogu Peak limestones from Cheia Valley.

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The microfossil assemblage found by Popescu & Patrulius (1968) in the "red marls" inserted in conglomerates (in the Cheia Valley) includes *Globotruncana schneegansi* SIGAL, *G. lapparenti lapparenti* BROZEN, *G. lapparenti angusticarinata* (GANDOLFI), *G. renzi* GANDOLFI). Analyzing this fauna (found in the [*]L.P.B. collection), compared with the one we found in the base of the "lower sandstone-conglomerate level", we estimate an upper Turonian – Coniacian age for these deposits.

The field study allowed the identification in the Cheia Valley, at approx. 120 m from the Lower Cretaceous limestones, of yellow shaly marls with inoceramids and echinids from the "*cortestudinarium*" group, indicating a Coniacian – Santonian age. This yellow marly facies is found on the Piatra Tăiată ridge and further, with a thickness of approx. 20 m of unfossiliferous marls, in the Olăneşti Valley. The microfauna of the Piatra Tăiată Ridge does not have planctonic foraminiferae (we have identified only *Dorothya oxycona* (REUSS), *Spiroplecammina longa* LALICKER, which is conformable with the dating based on macrofauna). Further, in the Olăneşti Valley, the unfossiliferous yellow marls are covered by a level of black sandy marls, with inoceramides which support a Turonian-Coniacian age, suddenly passing to conglomerates, described as "*the lower sandstone-conglomerate level".*

**The lower shaly marl level** (Middle and Upper Coniacian – Lower Campanian)

In the upper part of the conglomerate stack there is a gradual passing to dark grey marls and clays, very micaferous in the terminal part, with large-sized inoceramids. These dark marls show frequent alternances with cm-dm thick orange marly limestones and sandstones. Within this level, there is a rich microfauna in the Olăneşti Valley, while it is slighly poorer in the Cheia Valley. The lack of marker planktonic species does not allow a firm dating. We have identified the following species:

- *Rhabdammina discreta* BRADY, *Bathysiphon dubius* (WHITE), *B. brosgei* TAPPAN, *Hyperammina gaultina* DAM, *Ammodiscus cretaceus* (REUSS), *Lituotuba incerta* FRANKE, *Kalamopsis grzybowskii* (DYLAZANKA), *Hormosina ovulum* (GRZYBOWSKI), *Spiroplectammina flexuosa* (REUSS), *S. longa* LALICKER, *Gaudryina cretacea* (KARRER) *Dorothia oxicona* (REUSS), *Nodosaria limbata* d'ORBIGNY, *N. filiformis* REUSS, *N. cylindrica* (ALTH.), Dentalina annulata REUSS, D. acuminata REUSS, D. constricta (FRANKE), *Pseudonodosaria mutabilis* (REUSS), *P. obesa* (L. & T.), *Textularia plummerae* LALICKER, *Frondicularia frankei* CUSHMAN, *Lagena apiculata* (REUSS), *Lenticulina velascoensis* WHITE, *Planularia liebusi* BROZEN, *Pyrulina cylindroides* (ROEMER), *Praeorbulina stokesi* (CUSHMAN & RENZ), *Pleorostomella velascoensis* CUSHMAN, *Allomorphina cretacea* REUSS, *Quadrimorphina allomorphinoides polycamerata* NEAGU, *Gavelinella clementiana* (d'ORBIGNY).

All members of the assemblage have an extended stratigraphic range. It is to be noticed, however, the sudden outburst of the *Textularia plummerae* LALICKER species, with a large number of specimens, at the upper part of lower shaly marl level, in the Olăneşti Valley and the Piatra Tăiată Ridge. This species ranges from the Campanian to the Lower Maastrichtian. Except for *Gaudryina cretacea,* all the other species are mentioned for the first time in this region.

We estimate for this marl-clay package an age between the Middle-Upper Coniacian and the Lower Campanian.

**The upper sandstone-conglomerate level** (Middle and Upper Campanian – Lower Maastrichtian)

The upper sandstone-conglomerate level appears suddenly with the Campanian transgression. Locally, towards south, the conglomerates are placed directly on top of the Lower Cretaceus limestones. In the studied area these deposits are placed in slight angular discordance over the lower marls. Beforehand, they were mapped based on lithological considerations and dated by superposition.

In the base of the conglomerates there are decimetric-metric blocks of highly micaferous black marls, a lithofacies identified in place at lower stratigraphic level on the main valleys: Olăneşti, Bacea, Cheia. Very seldom small clasts (10 cm) of grey-green marl also occur; they are fine-grained, apparently tuffitic and without mica. *These marls are reworked from a level which does not appear in the studied area.*

- The micropaleontological samples collected from the black micaferous marls allowed the identification of numerous specimens of *Textularia plummerae* LALICKER, thus confirming, together with the lithological aspect, their provenance from the level previously discussed, being reworked form a nearby shoreline.
- In the green marl blocks, along with numerous inoceramid prisms, an exceptionally rich and well preserved fauna of planctonic foraminiferous was found, with: *Globotruncana lapparenti lapparenti* BROZEN, *G. lapparenti angusticarinata* (GANDOLFI), *G. renzi* GANDOLFI, microfauna which indicates an age from the Late Turonian up until Middle-Late Santonian

Towards the upper part of these coarse-grained detritic deposits (which can become conglomerates with large blocks), the fauna identified in the marly intercalations is represented by:

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- *Textularia plummerae* LALICKER, *Praeorbuluina stokesi* (CUSHMAN&RENZ), *Spiroplectammina longa* LALICKER, *Reophax splendidus* GRZYBOWSKI, *Pleurostomella velascoensis* CUSHMAN, *Nodosaria cylindrica* (ALTH.), *Gaudryna cretacea* (KARRER), *Allomorphina cretacea* REUSS. This association generally indicates the Middle-Upper Campanian – Lower Maastrichtian.

Results from these data that the oldest acceptable age for the basal part of the conglomerate stack is post – Late Santonian. By correlating these interpretations with the age indicated by the reworking of the black micaferous marles, it can be suggested that the transgression of the conglomerates (*in this northern sector, after Lower Campanian* – it is very probable that in the studied area us part of this floor has no representation) began in the Middle-Upper Campanian.

On paleontological grounds, as discussed for the underlying deposits for the fauna in the reworked marl blocks, and based on the foraminifers from the upper marly intercalations, the age of this *upper sandstone-conglomerate level* should be between the Middle Campanian and the Early Maastrichtian.

**Upper shaly marl level** (Middle-Upper Maastrichtian)

On top of the conglomerates described above, which in the Olăneşti Valley form spectacular gorges, there is a transitional sequence of approx. 120 m thick sandstones and sandy marls, followed by a predominantly marly succession continuing up to the sudden contact with the Eocene conglomerates from Olăneşti – Băi and the Dracului Valley, not present in outcrops, but shown by a sharp geomorphological to the cliff-forming coarse detritics.

The samples collected from this level have revealed an assemblage characteristic for the Middle-Upper Maastrichtian. The planktonic foraminifer fauna is represented by: *Abathomphalus mayaroensis* (BOLLI), *Globotruncana arca* (CUSHMAN), *G. contusa* (CUSHMAN), *G. rugosa* (MARIE), *G. stuarti-stuarti* (LAPPARENT), *G. stuarti stuartiformis* (DALBIEZ), *G. gansseri* Bolli, *G. havanensis* Voorwijk, *Rugoglobigerina rugosa rugosa* (Plummer), *R. rugosa rotundata* (BRÖNNIMANN), *Bolivinoides draco–draco* (MARSSON), *Heterohelix striata* (EHRENBERG), *H. planata* (CUSHMAN), *H. moremani* (CUSHMAN), *Pseudoguembelina striata* (EHRENBERG*), Pseudotextularia elegans* (RZEHAK), *Planoglobulina acervulinoides* (EGGER), *P. glabrata* (CUSHMAN), *Pseudoguembelina palpebra* BRÖNNIMANN & BROWN, *association which probes the presence of the Maastrichtian, including its terminal part.*

The faunal list is completed with the following benthic species: *Bathysiphon brosgei* TAPPAN, *Saccammina complanata* (d'ORBIGNY), *Kalamopsis grzybowskii* (DYLAZANKA), *Hormosina ovulum* (GRZYBOWSKII), *Cribrostomoides trinitatensis* CUSHMAN & JARWIS, *Spiroplecammina flexuosa* (REUSS), *S. semicomplanata* (CARSEY), *S. longa* LALICKER, *Textularia plummerae* LALICKER, *Gaudryina cretacea* (KARRER), *Heterostomella faveolata* (MARSSON), *Matanzia varians* (GLAESSNER), *Nodosaria filiformis* REUSS, *N. zippei* REUSS, *N. cylindrica* (ALTH.), *N. vertebralis* (BATSCH), *Dentalina legumen* REUSS, *D. marcki* REUSS, *D. commutata* REUSS, *D. catenula* REUSS, *D. acuminata* REUSS, *D. raristriata* (CHAPMAN), *D. stephensoni* (CUSHMAN), *Lagena appiculata* REUSS, *Lenticulina comptoni* (SOWERBY) *L. ovalis* (REUSS), *L. velascoensis* WHITE, *L. pseudovortex* MARIE, *Praebulimina ovulum* (REUSS), *P. stokesi* (CUSHM. & RENZ), *Bolivina subincrassata* CHALILOV, *Daviessina fleuriausi* (d'ORBIGNY), D. ornamentata HOFKER, *Eponides broennimanni* CUSHMAN & RENZ, *E. premegastoma* MJATLIUK, *Pleurostomella velascoensis* CUSHMAN, *Ellipsoglandulina conncina* OLBERTZ, *Ellipsoidella divergens* (STORM), *E. kugleri* (CUSHMAN & RENZ), *Aragonia ouezzanensis* REY, *Allomorphina cretacea* REUSS, *Quadrimorphina minuta* (CUSSHMAN), *Q. allomorphinoides polycamerayta* NEAGU, *Pullenia crretacea* CUSHMAN, *P. jarvisi* CUSHMAN, *P. minuta*, CUSHMAN, *P. reussi* CUSHMAN & TODD, *Globorotalitea michelinianus* (d'ORBIGNY), *Gyroidinoides globosus* (HAGENOV), *G. depressa* (ALTH.), *G. quadratus* (CUSHMAN & CHURCH), *Gavelinalla bembix* (MARSSON), *G. pertusa* (MARSSON).

- The entire microfauna list is presented for the first time in this region.
- The underlined species are cosmopolitan for this time interval
- The *Daviesina fleuriausi* and *D. ornamentata* species are encountered for the first time in Romania.

**MICRO-BIOSTRATIGRAPHIC ZONATION**

Because of the very wide lithofacial variation in the Cheia and Olăneşti valley profiles, as well as to the lack of outcrops with a clear micropaleontologic content, the identification of the classical micropaleontological intervals is not possible for the basal deposits of the Upper Cretaceous. Considering the international micropaleontological zoning (e.g. Caron, 1985), the following micro-biostratigraphical zones were identified, allowing age determinations (see Fig. 1):

– In the *lower sandstone – conglomerate level and lower shaly marl level*, of Late Turonian – Early Conician age:

1. ***Marginotruncana sigali* Zone**
2. ***Dicarinella primitiva* Zone**

– In the upper sandstone-conglomerate level zone differentiations are no longer possible. Based

| Chronostratigraphy | | *Lithostratigraphy* *Lithology* | *Biostratigraphy* Foraminifera zone (after Caron, 1985) |
|---|---|---|---|
| **E o c e ne** | | Conglomerates | |
| **U p p e r C r e t a c e o u s** (molase deposits) | **Ma** | Upper shaly marl level | ***Abatomphalus mayaroensis* Zone** ($Ma_3$) |
| | | | ***Gansserina gansseri* Zone** ($Ma_2$ –½$Ma_3$) |
| | | | ***? Globotruncana aegiptica* Zone** ($Ma_{2-3}$) |
| | | | ***Globotruncanella havanensis* Zone** ($Cp_3$-Ma) |
| | **$Ma_1$– $Cp_{2+3}$** | Upper sandstone-conglomerate level | |
| | **$Cp_1$– $Co_{2+3}$** | Lower shaly marl level | |
| | **$Co_1$– $Tu_3$ *(?Cm)** | Lower sandstone-conglomerate level | ***Dicarinella primitiva* Zone** ($Co_1$–$Co_2$) |
| | | | ***Marginotruncana sigali* Zone** ($Tu_{2-3}$–Co) |
| **Lower Aptian** / **Getic crystalline** | | Limestones 30 – 40 m | |

**Fig. 1.** Lito-microbiostratigraphic zoning of Upper Cretaceous deposits in the Cheia – Olăneşti valleys area.
* The Cenomanian – possible; probably present after Boldur *et al*. (1970), Popescu & Patrulius (1968); mapped on the map sheet – Vânturarița, scale 1:200.000 by Szasz (in Lupu *et al*., 1978)

on the mentioned arguments, the age of this level must be between the Middle Campanian and the Lower Maastrichtian.

– In the *upper shaly marl level,* dated as Maastrichtian:

– in the lower part of the sequence, including the lower and middle Maastrichtian:

***3. Globotruncanella havanensis* Zone**

***4. ?Globotruncana aegiptica* Zone** (this zone has not been positively identified, but, being framed by two zones that were probed, the lack of index genera is probably due to incomplete sampling).

***5. Gansserina gansseri* Zone**

– in the upper part of the sequence, representing the Upper Maastrichtian:

***6. Abatomphalus mayaroensis* Zone**

## PALEOECOLOGICAL CONSIDERATIONS

The comparative quantitative study regarding the participation of various foraminiferal groups in the fossil fauna, allows some paleoecological interpretations (Fig. 2).

- The Lituolaceaea occur with the highest percentage (3,4%). Among these, the Ataxophragmiidae represent 10.6%, the Hormosinidae 6.3 % and the Textulariidae 4.2%.
- The Nodosariida, with the largest generic and specific diversity, represent 14.1%. Among these, *Nodosaria*, *Dentalina* and *Lenticulina* give most of diverse genera.
- A poor participation for the planktonic foraminifera is noticed, representing only 6.4%. Among these, the globotruncanids, although make up only 5.0%, is the most diverse group. At the family level, the planktonics represent 6.1%, at genus level 0.7%; however, the large number of the species identified makes this ratio to rise to 14.6% at the species level.
- The ratio of the heterohelicid and planktonic foraminifers vs. the total of the benthics (21.6% to 78.4%) represent an index that allows estimating the relative character of the sedimentation. From a bathymetric and paleoecological point of view, the Late

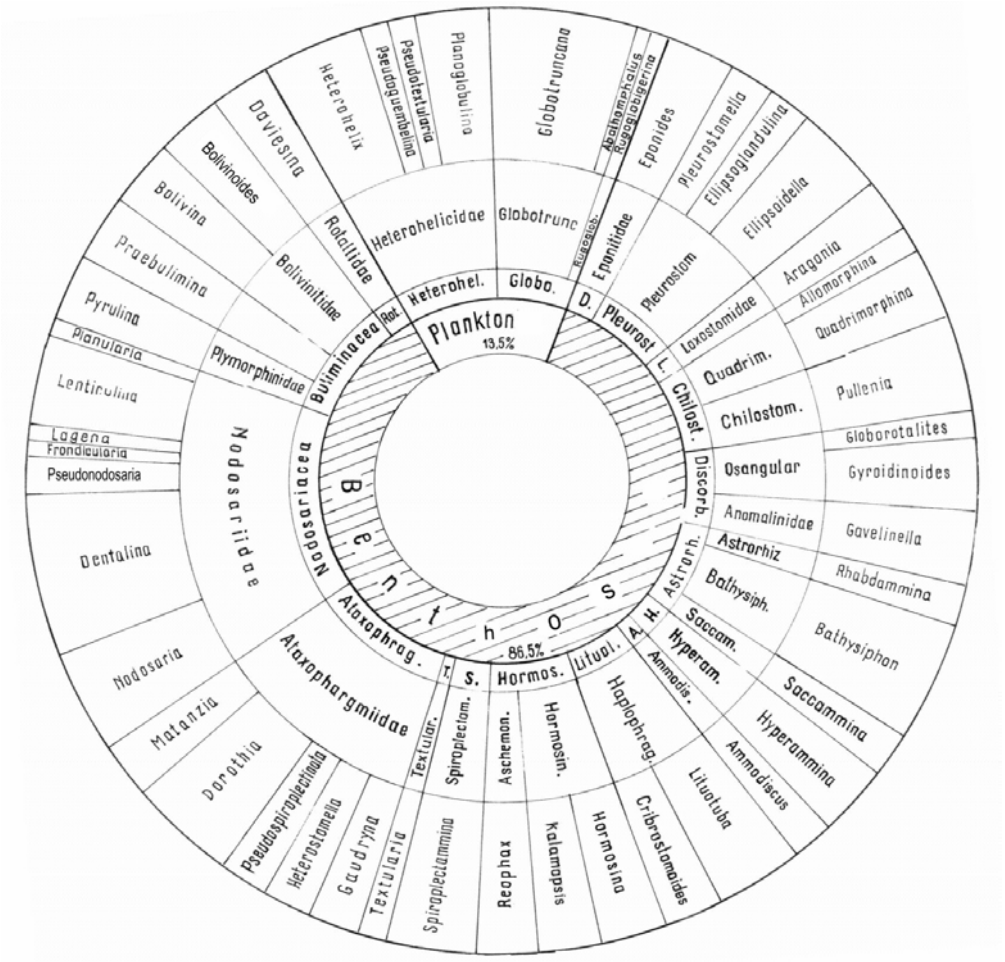


**Fig. 2.** Percentage distribution of the foraminifera in the Upper Cretaceous deposits of the Olăneşti – Cheia valley basin

Cretaceous foraminifer assemblage suggests the presence of the upper bathial zone, with transition to the outer shelf (180-500 m to 100-150 m depth).

It is suggested by:

- The dominance of the Lituolaceaea, of relatively large size (today present in the bathial zone);
- The relatively large frequency of the nodosariids, as a deep-water population, with some scarce planktonic foraminifers;
- The total absence of the Miliolides, which are very rare in this bathial basinal sector.

The lack of planktonics at some stratigraphic levels could have been also caused by currents actioning along the shoreline, which removed their empty tests and piled them up together with the macrofauna (*in nearshore environment the turbid waters affects adversely the presence of the planktonics).*

(It is to be noticed that there are some instances in which a larger number of planktonics occur, together with macrofaunal elements, represented mainly by inoceramids and echinids. But these particular situations can be interpreted as cummulative niches, associated to sectors with lower bathymetry.)

In the upper shaly marl level of the Cretaceous, dated as Maastrichtian, the presence of a population with hollow tests indicates a fine sedimentation, good sorting of the paleontological material and a current-mediated transport. The reduction of the plankton can be suggested through the presence of high water turbulence, associated with the decrease of light breakthrough depth; leading to the decrease of number of algae, thus that of the available food. Different species of *Textularia* and *Ammodiscus* are specific for these environments, species which have an acme of abundance in the upper part of the lower shaly marl level. The high turbulence allowed the foraminifers (with a lower density than the mineral fraction of the same size) to remain in suspension. In the muddy sediments, these foraminifers got burried and died easily, while in the sandy ones the burrying depth should have been 5-6 times the diameter of the test in order to got trapped inside the sediment. These burial conditions are also suggested by the sulphure deposition on the test walls, chambers filled with pyrite and even pyrite casts of foraminifers.

Pyritization also evidentiates another aspect of the paleoenvironment – the presence of reductive, oxygen-poor conditions. This hypothesis is supported by observations such as extreme thinness of the test walls and the existence of numerous pyrite nodules, up to centimetric dimensions in the sediments.

The identification of a foraminiferal population made up of species with very flat test (adapted to sliding), such as the lenticulinides and pponides, in the fine-grained deposits in the Olăneşti and Ursului valleys, suggests a dominantly muddy bottom.

On the other hand, a quartz sandy bottom is indicated by specimen-poor populations of small individuals, living in near-shore environments, affected by current action with sorting effect (the foraminifers are found in highly sandy marls). Such deposits are present in the Cheia Valley in the Maastrichtian, in a sector which was included into the sedimentation area only later. To the north-east, in the Dracului Valley there is a finer-grained lithofacies, with larger-sized individuals, suggesting a more distant depositional facies.

Variations in the foraminiferal test structure, noticed in the research area, can be interpreted through modifications of the water depth. Thus, a test with simple structure is observed in *Saccammina*, probably restricted to a a gulf or estuary, while the test present in *Rhabdammina*, *Textularia*, *Reophax* characterize the inner shelf zone. The more complex test could probe the passing to the bathial zone, being represented by the apparition of globular types, such as *Pullenia* and small specimens of *Eponides.* The deeper facies of the upper bathial zone is also characterized by *Bolivina costata*, typical for these depths.

## CONCLUSIONS

The studied sector, east of the Vânturarița Massif – Stogu Peak area, can be described as a gulf sedimentary environment, bordered by the Cozia and Lotru crystalline massifs. At different time intervals tectonic events have determined oscillations of the bottom. Indications of shallower water facies are present in the openings in the valleys: Olăneşti, Cheia, Dracului.

In the Olăneşti Valley the passage from massive, polimictic conglomerates, forming spectacular gorges, through a sandy-marly alternance (flyschoidal facies – Upper Campanian – Lower Maastrichtian) to the fine-grained facies of the Maastrichtian, which concludes the suite of Upper Cretaceous deposits, can be followed.

Micropaleontological sampling and the analysis of the microfauna allowed the confirmation and/or attribution of new ages for the Upper Cretaceous detritic deposits, and especially the identification of the base of the Maastrichtian. The Late Cretaceous fauna from the upper shaly marl level (in the uppermost part of the succession) documents micropaleontologically the Middle-Upper Maastrichtian. We consider that, due to the current outcropping condition of the deposits, there is no real possibility to paleontologically establish the presence of the Paleocene, respectively that of a continuous sedimentation at the Cretaceous – Paleogene boundary. One must also consider the position, in slight angular unconformity, of the conglomerates from Olăneşti and Cheia, dated as Eocene. Furthermore, towards the south-west, in the Otăsău Valley, the Eocene conglomerates lie above the upper shaly marl level – dated as Maastrichtian in the Olăneşti Valley; while in the southern part, towards the Arnota Monastery, they come into direct contact with Mezozoic limestones outcropping along the Costeşti Valley, at the Bistrița Quarry.

The highest sampless with a conclusive microfauna (coming from outcrops opened in the current year) have been collected approx. 35 m stratigraphic thickness below the Eocene conglomerates; A. mayaroensis, which testifies the presence of the Upper Maastrichtian, already appears at approx. 120 m beneath the conglomerates. As in the local Senonian deposits, as a general observation, the biostratigraphic boundaries do not correlate with the lithological ones, while the recurrence of coarse-grained sedimentary episodes, separated by fine-grained passages seems to be a rule; it is conceivable that the last marly deposits could contain a Paleocene microfauna.

The analysis of the procentual participation of various foraminiferal groups and that of the morphological features of the test have lead to a series of paleoecological interpretations concernig the water depth, substratum and oxygen level.

As it was mentioned, on sheet *126a* Vânturarița a belt of Vraconian-Ceromanian deposits is mapped, represented by polimictic conglomerates and silty marls and clays with sandy intercalations. East of the Stogu Peak –Cheia Valley alignment, there is no micropaleontological or macropaleontological confirmation for this age. In the firs marly deposits overlying the Lower Cretaceous limestones, identified in new outcrops (created during maintenance activities for the forrest road in Cheia and Olăneşti valleys), there are inoceramids and echinide. *The age of these deposits must be Conician-Santonian.* This interpretation must lead, from the cartographical point of view, to the modification of the Olăneşti – Năruțu fault line (a longitudinal fault, palallel to the front of the limestone massif, traced in front of the Stogu Peak, by Boldur *et al*., 1970 and still retained on later maps).

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**PLATE CAPTIONS**

(All figures are drawn at *camera lucida* by R. Damian)

**PLATE I**

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**PLATE II**

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**PLATE IV**
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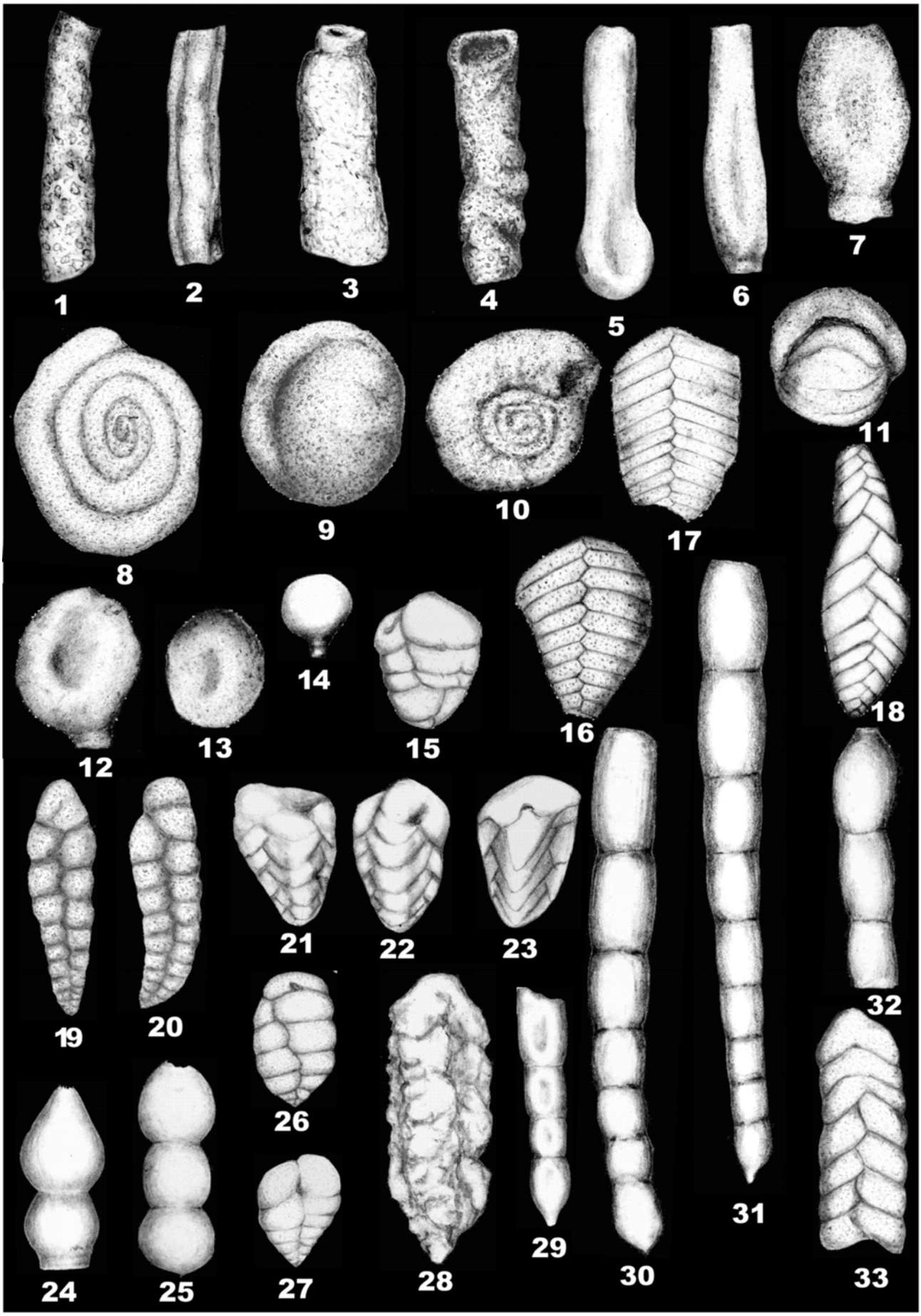
Figure 40 *Quadrimorphina allomorphinoides polycamerata* NEAGU, x40, Olăneşti Valley

# PLATE I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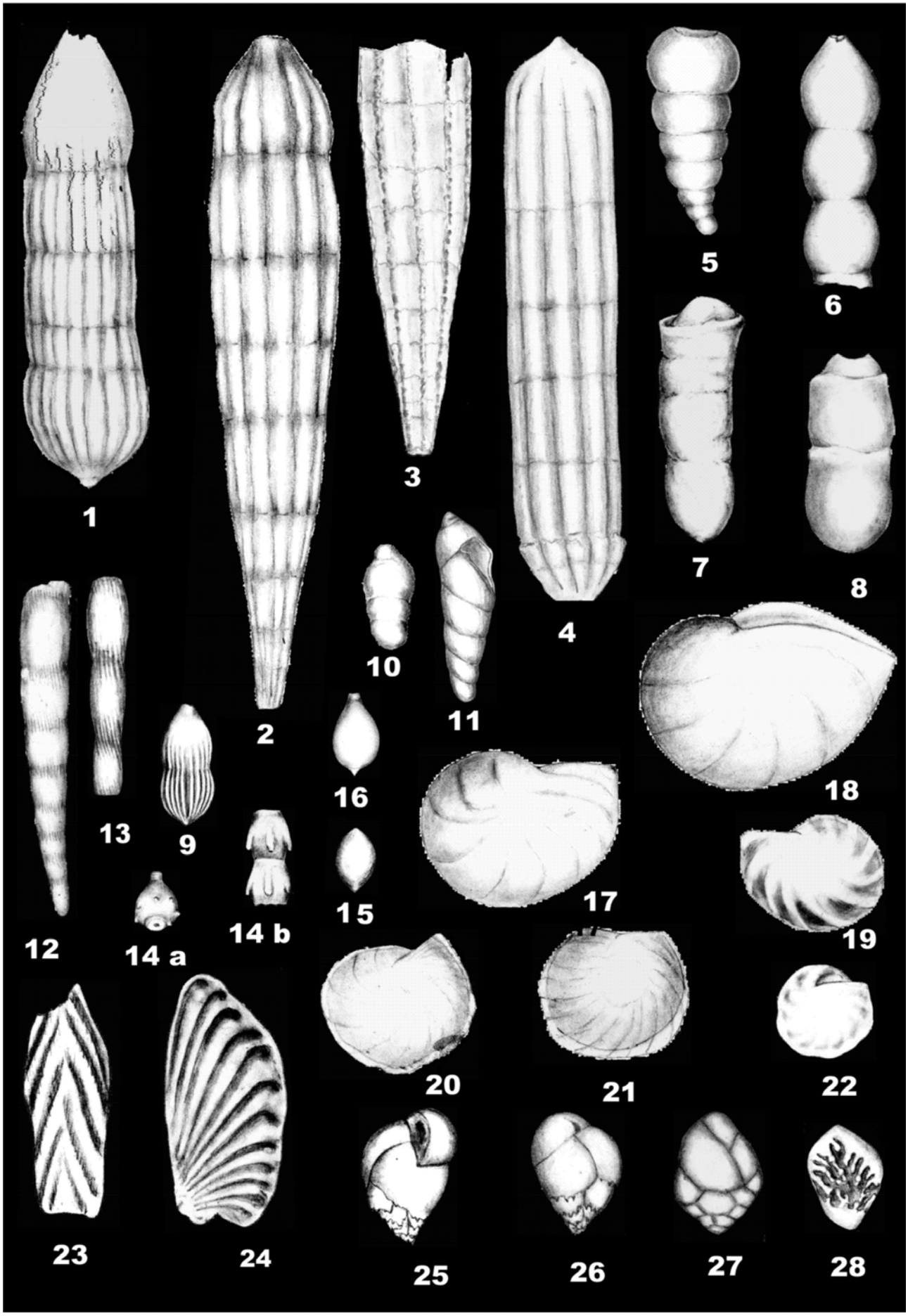
# PLATE II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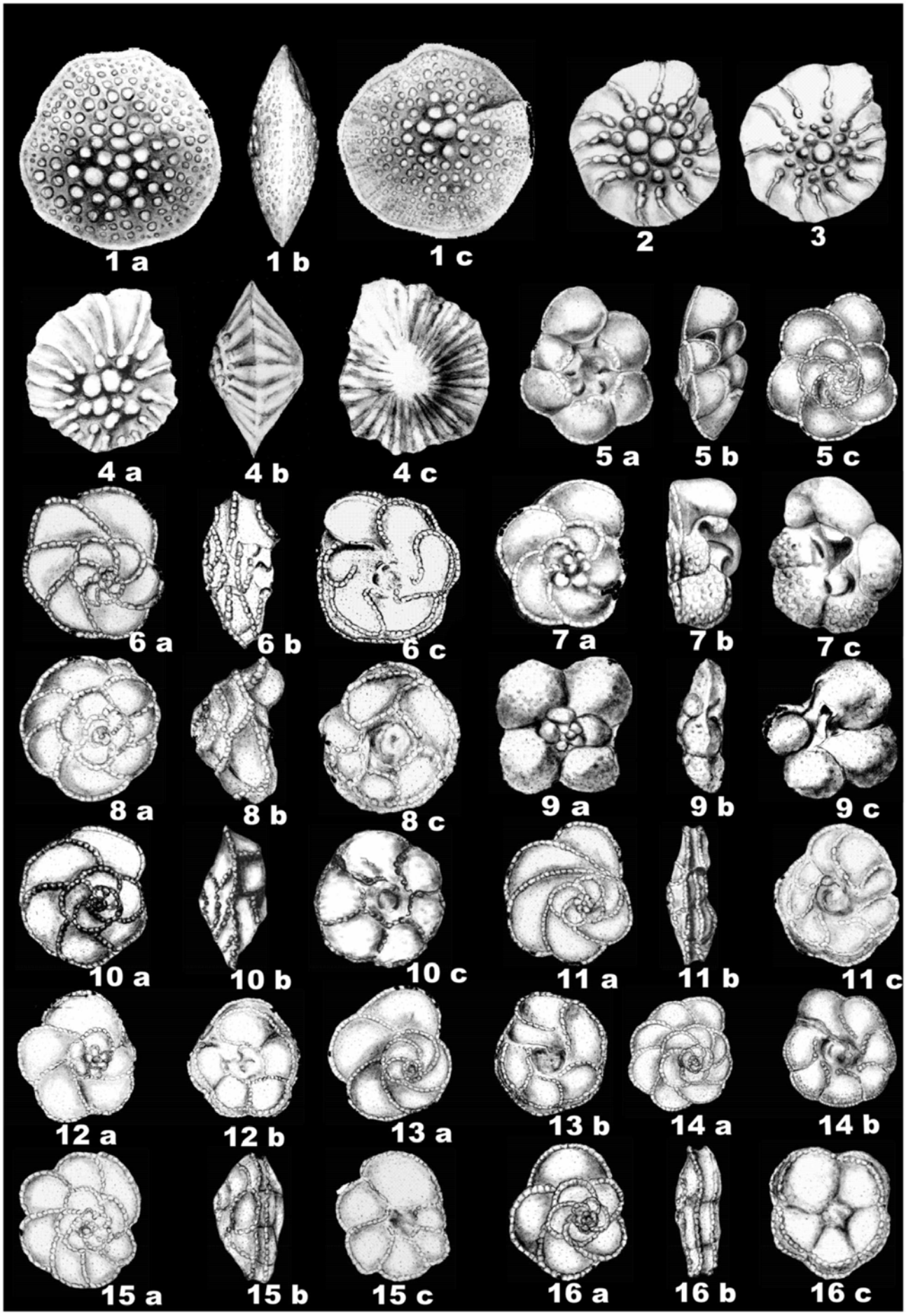
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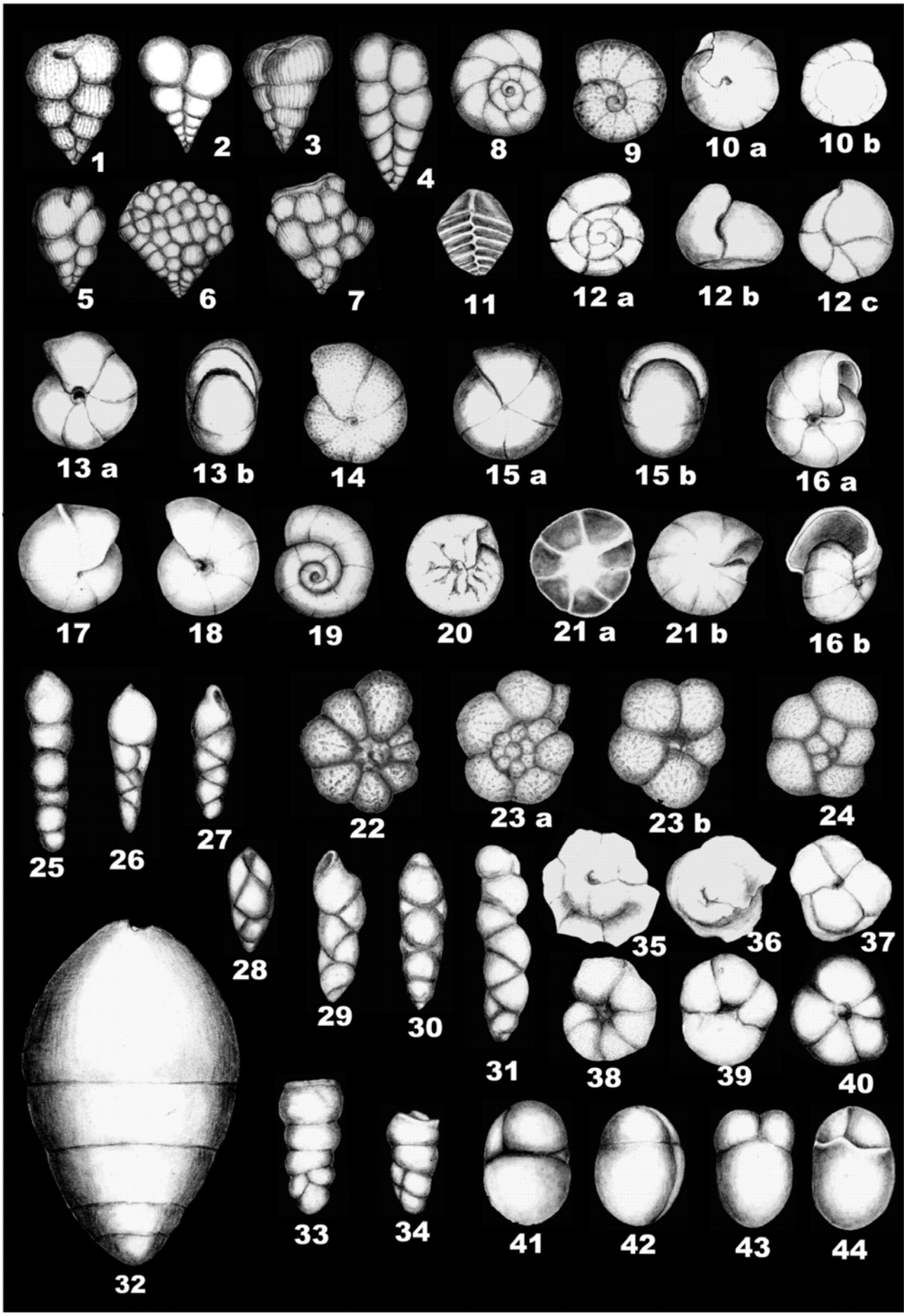
# PLATE IV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