Smaller agglutinated foraminifera from the *acanthicum* Limestone (Upper Jurassic), Eastern Carpathians, Romania

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ABSTRACT

The paper presents the first published account of smaller foraminifera with siliceous cement from Upper Jurassic (Kimmeridgian) limestones obtained by using a dilute acid. Based upon the wall structure of the test it is possible to recognize four new genera: *Haghimashella, Rashnovammina, Bicazammina, Pseudomorulaeplecta.* The main representatives of these assemblages are: *Thurammina tuberosa* Haeusler, *T. papillata* Brady, *Glomospirella pusilla* (Geinitz), *G. variabilis* (Kubler & Zwingli), *Haplophragmoides globigerinoides* (Haeusler), *Ammobaculites irregularis* (Gümbel), *Placopsilina cenomana* d'Orbigny, *Recurvoides pygmaeus* (Haeusler), *R. constrictus* (Haeusler), *R. universus* (Haeusler), *Thalmannammina atanasiui* Neagu & Neagu, n.sp., *Haghimashella arcuata* (Haeusler), *Bicazammina jurassica* (Haeusler), *Rashnovammina carpathica* Neagu & Neagu, n.gen.n.sp., *Trochammina rotundata* Seibold & Seibold, *Verneuilinella carpathica* Neagu & Neagu, n.sp., *Verneuilinoides favus* (Bartenstein), *Textularia jurassica* Gümbel, *Pseudomorulaeplecta franconica* (Gümbel).

INTRODUCTION

In the inner central part of the Eastern Carpathians deposits belonging to the Middle and Upper Jurassic stages are widely developed in the Haghimas Mountains (Lacul Rosu lake, Bicaz) in the north and in the Bucegi Mountains (Vama Strunga, Tataru, Rasnov) in the south. These deposits are also represented in the form of olistoliths with different dimensions in the Lower Cretaceous flysch area. Among the most important olistoliths are those from the Pelesului Valley (Cotal 100), and Ialomitza Valley (Galma Ialomitzei). Middle Jurassic (Dogger) deposits are very well exposed on the western slope of the Bucegi Mountains (Vama Strunga - Tataru area) and are represented by marls and marly limestones rich in macrofossils (solitary hexacorals - *Montlivaltia*; bivalves- *Pholadomya murchisoni*; and gastropods). Microfossil assemblages from these deposits are represented by Foraminiferida such as: *Spirophtalmidium infraooliticum, S. clarum, Citharina proxima, C. citharinella, Lenticulina muensteri, L. quenstedti, Planularia contracta, P. anceps, Epistomina regularis, E. coronata, E. nuda*; ostracods such as: *Cytherella perenis, Lophocythere scabra, Pleurocythere favosa, Ectyphocythere dierallenis, Preschuleridea subtrigonia intermedia,* and otoliths such as: *Otolithys (Lycopteroidarum) ornatus,* and *Otolithus tenuicostatus* (Neagu *et al.*, 1983).

The upper part of the Middle Jurassic and Upper Jurassic deposits are represented by sandstones, marly limestones, polycolour jaspers, and massive limestones. Using a very weak acid (10% solution of formic acid) it has been possible to recover from all kinds of calcareous sediments (different types of limestones) rich smaller agglutinated foraminiferal assemblages that display excellent preservation. The presence of numerous genera of great importance and significance for the Lower Cretaceous flysch deposits in all these assemblages (starting with Lower Kimmeridgian *acanthicum* beds, urged us to undertake a special study of this material. In the course of this study, we found in these assemblages all the important genera that have been among the only markers for biostratigraphical correlation of the Cretaceous flysch facies, which are more or less devoid of macrofossils. At the same time the Upper Jurassic smaller agglutinated foraminifera are very important from an evolutionary point of view. They offer us the possibility to select presumed ancestors and note evolutionary trends of certain taxa. In some cases, the evolutionary trends of post-Jurassic flysch genera can be established up to Recent time.

STRATIGRAPHIC CONSIDERATIONS

The Kimmeridgian deposits from the Haghimas - Lacul Rosu area start with cherry-coloured nodular limestones, followed by nodular clastic grey limestones corresponding to the uppermost part of the lower Kimmeridgian and the basal part of the upper Kimmeridgian (*Ortaspidoceras uhlandi* and *Aspidoceras acanthicum* zones). The smaller agglutinated foraminiferal assemblage from the nodular cherry-limestones is represented by *Tolypamminna vagans, Placopsilina cenomana, P. argoviensis* (attached specimens), *Ammodiscus siliceous, Glomospira variabilis, G. pusilla, Thurammina papillata, T. tuberosa, Reophax multilocularis, R. chrysalis, Ammobaculites incertus, Haplophragmoides globigerinoides, "Recurvoides" universus, "R" pygmaeus, Thalmannammina atanasiui* n.sp., *Haghimashella arcuata, Verneuilinoides favus, Uvigerinammina uvigeriniformis, Trochammina concava, T.*

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neoparva, T. rotundata, T. pulchra, T. carpathica, Tritaxis lobata, Textularia jurassica, Pseudomorulaeplecta franconica, and *Bicazammina jurassica*. Calcareous benthic foraminifera include: *Spirillina tenuissima, Patellina feifeli feifeli, Neotrocholina conica.* In addition there are sclerites of holothurians and teeth of Squaloidea.

They grey nodular limestones representing the next sedimentary sequence contain a quite similar assemblage of smaller foraminifera to those from the cherty limestones, but differ in having several unique elements as follows:

- the presence of the genus *Thalmannammina* with a very rough wall;
- the dominant feature of the assemblage is the large frequency of *Trochammina neoparva.*

Kimmeridgian limestones are also exposed in some localities of the Bucegi Mountains. The following localities deserve mention (Fig. 1):

1. Rasnov village (along the Rasnov-Poiana Brasov road). This locality is also very rich in ammonites. The agglutinated foraminiferal assemblage is comprised of *Tolypammina vagans* (rare), *Ammodiscus siliceous, Glomospira variabilis, G. pussila, Reophax multilocularis, R. chrysalis, R. helveticus, Ammobaculites inconstans, A. suprajurassicum, "Recurvoides" universum, "R". pygmaeus, Haghimashella arcuata, Verneuilinoides favus, Verneuilinella carpathica* n.sp., *Rashnovammina carpathica* n.sp. (frequent), *Trochammina neoparva, T. pulchra* (rare), *Textularia jurassica,* and *Pseudomorulaeplecta franconica.* In this assemblage it is worth underlining the frequent presence of the species *Verneulinoides favus* and *Verneuilinella carpathica* n.sp.

2. Galma Ialomitzei (a large olistolith within the Aptian flysch deposits). Here, the lithology is similar to that in Rasnov, but ammonites are less common. Patrulius (1968) considered, based on macrofaunal assemblage, that the Kimmeridgian deposits start here with the uppermost part of the *acanthicum* biozone, continuing then until the *hybonotum* biozone of the Tithonian. Cherry-coloured compact limestones rich in smaller foraminiferal assemblages occur in the lowermost part of the outcrop. From the taxonomic point of view these are similar to the assemblages from the Rasnov. Nevertheless, they additionally contain numerous calcareous species such as *Patellina feifeli feifeli, P. feifeli,* and *Neotrocholina conica*, which suggests a more distal character of the environment. The upper part of this outcrop is represented by grey and white limestones. According to Patrulius (1968), these belong to the lower Tithonian. The agglutinated assemblage is dramatically reduced in terms of both abundance and numbers of species. Spirillinid and involutinid groups (not attacked by acid) appear in a high frequency. The assemblage in those limestones is represented by: *Tolypammina vagans* (without *Placopsilina*), *Thurammina papillata, T. tuberosa, Ammodiscus siliceous, A. inconstans, Glomospira variabilis, G. pusilla, Reophax chrysalis, R. multilocularis, Haplophragmoides globigerinoides, "Recurvoides" universus, "R". pygmaeus, Verneuilinoides favus, Verneuilinella carpathica* n.sp., *Haghimashella arcuata, Bicazammina jurassica, Tritaxis lobata, Trochammina pulchra* (rare), *Textularia jurassica, Pseudomorulaeplecta franconica, Rashnovammina carpathica* n.sp. Additionally, the following calcareous species are present: *Patellina feifeli feifeli, P. feifeli elongata,* and *Neotrocholina* cf. *conica* (frequent).

3. Vama Strunga - Tataru zone. This locality is situated on the western slope of the Bucegi area. This zone corresponds stratigraphically to the Galma Ialomitzei locality. Here, in the lower part of the grey and white limestones (with the casts of ammonites) the foraminiferal assemblage contains *Tolypammina vagans* (without *Placopsilina*), *Thurammina papillata, T.tuberosa, Reophax chrysalis, R. multilocularis, Glomospira variabilis, G. pusilla, Ammodiscus siliceous, A. irregularis, Haplophragmoides globigeriniformis, "Recurvoides" universus, Haghimashella arcuata, Textularia jurassica, T.* cf. *punguicula, Pseudomorulaeplecta franconica, Tritaxis lobata, Verneuilinoides favus, Verneulinella carpathica* n.sp. and the calcareous species: *Patellina feifeli feifeli, P. feifeli elevata, P. turbinella,* and *Neotrocholina conica.*

4. Pelesului Valley. This is another large olistolith included within the Aptian flysch deposits. At this locality, cherry-coloured nodular limestones lying on the polycoloured jasper contains the following assemblage: *Tolypammina vagans, Thurammina scruposa, Ammodiscus siliceous, Glomospira variabilis, Reophax multilocularis, R. chrysalis, Ammobaculites irregularis, Haplophragmoides globigerinoides, "Recurvoides" universus, Haghimashella arcuata, Rashnovammina carpathica* n.sp., *Verneuilinoides favus, Bicazammina jurassica, Trochammina rotundata, T. neoparva, Textularia jurassica and Patellina feifeli feifeli.* This assemblage lacks *Pseudomorulaeplecta franconica.* Instead, it contains numerous individuals of *Rashnovammina carpathica.* This assemblage closely resembles the Galma Ialomitzei locality where the deposits represent the upper Kimmeridgian *hybonotum* biozone.

Paleobiological considerations

The smaller agglutinated foraminifera listed above represent a typical foraminiferal assemblage from an epicontinental environment of warm, shallow water depths of normal salinity. This represents the environment from which populations of agglutinated foraminifera migrated after the opening and subsidence of the Lower Cretaceous Carpathian Flysch Basin. In this way it is possible to explain the remarkable occurrence of genera which subsequently became marker elements (due to the lack of planktonic or calcareous genera) useful in the biostratigraphy of deep-sea Lower Cretaceous sediments. In this situation the following genera occur: *Haplophragmoides, "Recurvoides", Thalmannammina, Uvigerin-*

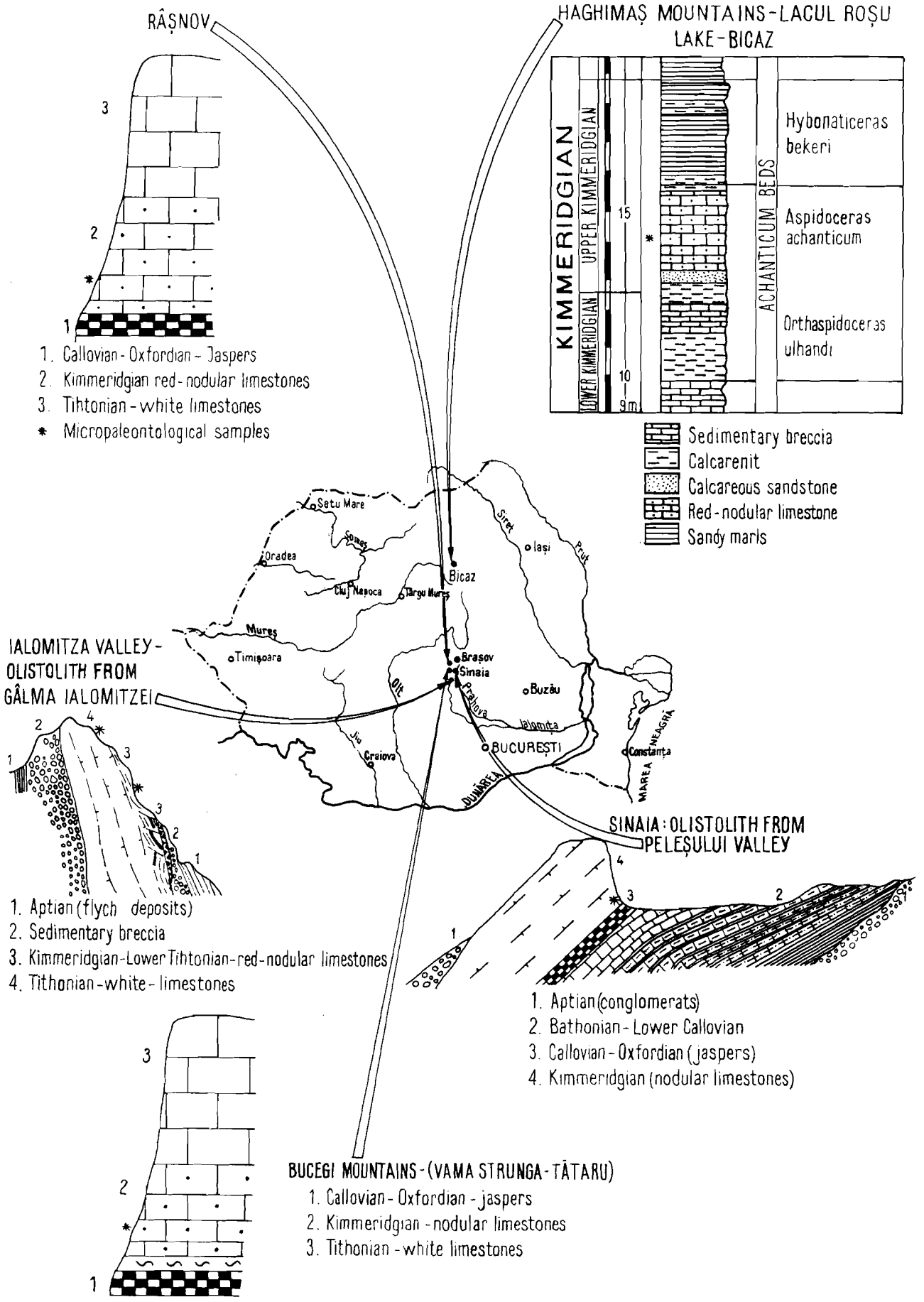

Figure 1. Stratigraphic sections containing Upper Jurassic Limestones sampled in this study.

ammina, Verneuilinoides, not to mention the other more simple genera as *Ammodiscus, Glomospira*, etc.

Also, the high level of evolutionary development of these genera becomes explainable. These taxa acquired a more and more complex degree of the chamber coiling through geological time. Among them are: *Uvigerinammina* and the calcareous genus *Falsogaudryinella* (Kaminski *et al.*, this volume) as well as *Plectorecurvoides* and *Pokornyammina* (Neagu & Platon, 1994) which were well-developed during the Cretaceous.

A very interesting example is offered by the genus *"Recurvoides"* which was described by Earland, 1934 from the Recent. The original diagnosis (fide Cushman, 1950) reads: " test free...coils of the early portion planispiral, later ones nearly at right angle to the earlier ones". Taking into account the high abundance of this group in the Romanian Kimmeridgian assemblages we assume that taxonomically speaking, its evolution started not later than during the Early Jurassic. What we consider as belonging to this genus is far from the original diagnosis. Only two morphological chracteristics differentiate *Recurvoides* from *Haplophragmoides* and *Trochamminoides*. These are the mode of coiling, which slightly deviates from planispiral enrolment in the case of *Recurvoides*, and the position of the aperture, which is areal on the last formed chamber. Gradually during the Late Jurassic to Recent time interval, the Jurassic ancestor became atypical *Recurvoides* (*sensu* Earland). As a logical conclusion, it is inevitable that all the intermediate stages of this long evolution must be recorded as distinct taxa (but not before clearing up the original diagnosis of the Earland's genus). If we consider the number of species assigned to this genus in its present conception, it is clear that the rate of evolution can justify more than one genus. For the genus *Thalmannammina*, which is so frequent in the Cretaceous flysch deposits, the coiling is almost exclusively represented by chambers grouped in "U" shaped planes, perpendicular to one another. However, a certain irregularity of chambers, which probably are trochospirally arranged, is still visible on the early stages of the Kimmeridgian specimens. Also, it is interesting to point out the fact that the degree of selection of the quartz grains and the quantity of cement have increased during the Cretaceous. A similar phenomenon also appears within the genus *Uvigerinammina*. The Kimmeridgian specimens reveal a difference of grain selection between the early and the later stages. The early stages are made by larger grains and the later chambers are comprised of more delicate grains. The coiling is largely trochospiral but the apertural tubes forming the chamber connections already exist. All these structures became more and more compact during the Cretaceous. The genus *Verneuilinoides*, present in the Upper Kimeridgian assemblages (*acanthicum* biozone), evolved in the Cretaceous flysch sediments only by means of increasing its overall size.

CONCLUSIONS

The biostratigraphical study of these smaller agglutinated foraminifera has a direct meaning in offering the micropaleontological possibility of correlating the Upper Jurassic limestones. The indirect meaning resides in explaining the origins of the similar benthic assemblages of the Lower Cretaceous flysch sediments. It is clear now that the Lower Cretaceous smaller agglutinated foraminifera have their origins among the epicontinental upper Jurassic assemblages. By migrating and progressively accommodating to their new environmental conditions of life in new ecological niches created by the opening of a large area of flysch sedimentation starting in some areas during the Tithonian, the appearance of new taxa became possible. The evolution of these assemblages was evidently conditioned and supported by new environmental conditions in which the phenomena of turbidity prevailed, eliminating totally or nearly totally the life conditions necessary for the calcareous benthonic taxa. These assemblages have also the merit to put in a new light the evolution of smaller foraminifera, whose dispersion appears now clearly determinated as a normal and natural consequence of palaeogeographical and palaeoecological change.

SYSTEMATICS

Taxa are arranged systematically according to Loeblich & Tappan (1987). The specimens illustrated in this paper are deposited in the Laboratory of Paleontology, University of Bucharest, and paratypes of the new species are deposited in the micropalaeontological collections of the Natural History Museum (London).

Suborder TEXTULARIINA Delage & Herouard, 1896
Supefamily ASTRORHIZACEA Brady, 1881
Family SACAMMMINIDAE Brady, 1884
Subfamily Thurammininae Mikluho-Maklay, 1962
Genus ***Thurammina*** Brady, 1879

Thurammina tuberosa Haeusler, 1883

Thurammina tuberosa Haeusler, 1883, p. 262, pl. 8, figs. 15-16, 20, 30. - Seibold & Seibold, 1960, p. 317, pl. 8, fig. 19. - Oesterle, 1968, p. 708, textfig. 7.

Location: Haghimas Massif, Lacul Rosu lake, Rasnov.
Stratigraphic distribuion: Kimmeridgian.
Hypotypes: L.P.B.IV.11 136

Thurammina papillata Brady, 1879

Thurammina papillata Brady, 1879, p. 45, pl. 5, figs. 4-8. - Haeusler, 1883, p. 60, pl. 4, figs. 10-13; p. 262, pl. 8, figs. 1-14, 17-19, 21-29, 31-33. - Oesterle, 1968, p. 707, textfig. 6 (c-h).

Location: Haghimas Massif, Lacul Rosu lake, Rasnov.
Stratigraphic distribution: Kimmeridgian.
Hypotypes: L.P.B. IV 11 137

Superfamily AMMODISCACEA Reuss, 1862
Family AMMODISCIDAE Reuss, 1862

Subfamily Tolypammininae Cushman, 1928
Genus ***Tolypammina*** Rhumbler, 1895

Tolypammina vagans (Brady, 1879)

Hyperammina vagans Brady, p. 33, pl. 5, fig. 3. - Haeusler, 1883, p. 58, pl. 3, figs. 7-10.
Tolypammina vagans (Brady). - Oesterle, 1968, p. 712, textfig. 11.

Location: Haghimas Massif, Lacul Rosu lake; Bucegi Massif (Tataru); Rasnov; Ialomitza valley (Galma Ialomitzei olistolith).
Stratigraphic distribution: Kimmeridgian.
Hypotypes: L.P.B.IV 11 138

Subfamily Ammovertelininae Saidova, 1981
Genus ***Glomospira*** Rzehak, 1885

Glomospira pusilla (Geinitz, 1848)
Pl. 1, Figs. 15-17

Trochammina pusilla (Geinitz). - Haeusler, 1882, p. 56, pl. 4, figs. 27-30.
Glomospira cf. *jurassica* Said & Barakat. - Oesterle, 1968, p. 712, textfig. 10 (e-f).
Ammodiscus gordialis Jones & Parker. - Haeusler, 1885, p. 24, pl. 3, figs. 14-15, not figs. 10-13, 16-22, 31.

Dimensions: Length 0.26-0.39 mm, breadth 0.14-0.21 mm.
Location: Haghimas Massif, Lacul Rosu lake, Bucegi Massif (Tataru); Ialomitza Valley (Galma Ialomitzei olistolith); Rasnov.
Stratigraphic distribution: Kimmeridgian-Tithonian.
Hypotypes: L.P.B. IV 11088-11090

Glomospira variabilis (Kubler & Zwingli, 1870)
Pl. 1, Figs. 3-14, Pl. 6, Figs. 15-21

Cornuspira variabilis Kubler & Zwingli, 1870, p. 33, pl. 41, fig. 4.
Trochammina incerta irregularis Kubler & Zwingli. - Haeusler, 1882, p. 54, pl. 3, figs. 4-7.
Trochammina charoides Jones & Parker. - Haeusler, 1882, p. 56, pl. 4, fig. 21.
Trochammina gordialis Jones & Parker. - Haeusler, 1882, p. 55, pl. 3, figs. 8-20.
Ammodiscus gordialis Jones & Parker. - Haeusler, 1885, p. 24, pl. 3, figs. 11-13, 16-20, 31, not figs. 10, 14-15, 21-22.
Ammodiscus minutus Paalzow, 1932, p. 93, pl. 4, figs. 10-11.
Glomospira variabilis (Kubler & Zwingli). - Seibold & Seibold, 1960, p. 324, textfig. 2 (q-s). - Oesterli, 1968, p. 711, textfigs. 8, 9, 10 (a-d).

Dimensions: Diameter (small) 0.17-0.19 mm, (large) 0.17-0.21 mm.
Location: Haghimas Massif, Lacul Rosu lake, Bucegi Massif (Tataru); Ialomitza Valley (Galma Ialomitzei olistolith); Rasnov.
Stratigraphic distribution: Kimmeridgian-Tithonian.
Hypotypes: L.P.B. IV 11091-11092

Superfamily LITUOLACEA de Baliville, 1827
Family HAPLOPHRAGMOIDIDAE Maync, 1952
Genus ***Haplophragmoides*** Cushman, 1910

Haplophragmoides globigerinoides (Haeusler, 1882)
Pl. 3, Figs. 1-8

Trochammina globigerinoides Haeusler, 1882, p. 352, pl. 15, figs. 18-19.
Haplophragmoides globigerinoides Haeusler. - Seibold & Seibold, 1960, p. 326, textfig. 5f, pl. 7, fig. 12. - Oesterle, 1968, p. 727, textfigs. 23, 24, 28b.

Dimensions: Diameter 0.24-0.26 mm, thickness 0.17 mm.
Location: Haghimas Massif, Lacul Rosu lake, Bucegi Massif (Tataru), Rasnov; Ialomitza Valley (Galma Ialomitzei olistolith).
Stratigraphic distribution: Kimmeridgian.
Hypotypes: L.P.B. IV 11095-11096

Family LITUOLIDAE de Blainville, 1827
Subfamily Ammomarginulininae Podobina, 1978
Genus ***Ammobaculites*** Cushman, 1910

Ammobaculites irregularis (Gümbel, 1862)
Pl. 3, Figs. 39-44

Marginulina irregularis Gümbel, 1862, p. 220, pl. 3, figs. 15a-b, 17-18.
Ammobaculites irregularis (Gümbel). - Seibold & Seibold, 1960, p. 329. - Oesterle, 1968, p. 735, textfig. 31.

Dimensions: Length 0.39-0.65 mm, thickness 0.13-0.39 mm (figured specimens).
Location: Haghimas Massif, Lacul Rosu lake, Bucegi Massif (Tataru); Ialomitza Valley (Galma Ialomitzei olistolith); Rasnov.
Stratigraphic distribution: Kimmeridgian.
Hypotypes: L.P.B. IV 11097-11098

Superfamily HAPLOPHRAGMIACEA Eimer & Fickert, 1899
Family AMMOSPHAEROIDINIDAE Cushman, 1937
Subfamily Recurvoidinae Alekseychik-Mitskevich, 1973

Genus ***Recurvoides*** Earland, 1934

Recurvoides pygmaeus (Haeusler, 1881)
Pl. 3, Figs. 24-38

Rotalina pygmaea Haeusler, 1881, p. 40, pl. 2, fig. 69.
Haplophragmoides pygmaeus (Haeusler). - Oesterle, 1968, p. 731, textfigs. 25c, 28d, 29a-d.

Dimensions: Diameter (small) 0.19-0.21 mm; (large) 0.24-0.29 mm (figured specimens).
Location: Haghimas Massif, Lacul Rosu lake, Bucegi Massif (Tataru).
Stratigraphic distribution: Kimmeridgian-Tithonian.
Hypotypes: L.P.B.IV 11102

Recurvoides universus (Haeusler, 1881)
Pl. 3, Figs. 9-23

Rotalina universa Haeusler, 1881, p. 28, pl. 2, fig. 38.
Haplophragmoides universus (Haeusler). - Oesterle, 1968, p. 734, textfigs. 28e, 30a-c.

Dimensions: Diameter (small) 0.17-0.9 mm, (large) 0.21 mm (figured specimens).
Location: Haghimas Massif, Lacul Rosu lake, Bucegi Massif (Tataru); Rasnov; Ialomitza Valley (Galma Ialomitzei olistolith).
Stratigraphic distribution: Kimmeridgian.
Hypotypes: L.P.B.IV 11103

Genus ***Thalmannammina*** Pokorny, 1951

Thalmannammina atanasiui Neagu & Neagu, **n.sp.**
Pl. 6, Figs. 23-37

Description: Coarsely agglutinated test with angular grains of quartz and siliceous cement (insoluble in acid), globulous chambers (3-5 per whorl) with a typical thalmannamminiform streptospiral coiling ("U" shape of coiling planes making different angles among them but not 90°). Aperture areal, elliptical, not far from the base of the apertural face, with a very finely agglutinated lip.
Dimensions: Holotype diameter (small) 0.26 mm, (large) 0.29 mm; paratypes diameter (small) 0.26-0.36 mm, (large) 0.29-0.39 mm.
Material: 100 specimens.
Type Locality: Haghimas Massif, Lacul Rosu lake, gray clastic limestone with ammonites.
Stratigraphic distribution: Kimmeridgian.
Derivation of Name: This species is dedicated to Prof. Ion Atanasiu, a Romanian Geologist who carried out his doctoral research in the Haghimas area.
Holotype: LPB IV 11.104
Paratypes: LPB IV 11.105. Additional specimens are deposited in the micropalaeontological collections of the Natural History Museum (London), PF 53010.

Superfamily SPIROPLECTAMMINACEA Cushman, 1927
Family TEXTULARIOPSIDAE Loeblich & Tappan, 1982

Genus ***Haghimashella*** Neagu & Neagu, **n.gen.**

Type species: *Haghimashella arcuata* (Haeusler, 1890)
Derivation of name: from the Haghimas Mountains.
Description: Test free, finely agglutinated, smooth with siliceous cement (insoluable in acid). A short biserial early stage followed by a lax-uniserial adult stage, with 1-7 glandular-globulose chambers, and deep oblique sutures. Aperture terminal, circular or elliptical, supported by a short neck. Wall compact, non-canaliculate.
Remarks: The chambers in the adult portion of the test are not wholly uniserial, but are loosely uniserial or sprawling (lax-uniserial) as in the calcareous genus *Pleurostomella*. Because of this, the sutures in the adult part are not perpendicular to the axis of growth. This genus differs from *Bigenerina* d'Orbigny, 1826 by its compact non-canaliculate wall structure; from *Aaptotoichus* Loeblich & Tappan, 1982 by its smooth wall and the aspect of the adult uniserial chambers; and from *Pseudobolivina* Wiesner, 1931 in its terminal aperture.

Haghimashella arcuata (Haeusler, 1890)
Pl. 2, Figs. 1-11

Bigenerina arcuata Haeusler, 1882, p. 227 (nomen nudum).
Bigenerina arcuata Haeusler, 1890, p. 73.
Gaudryinella deceptoria (Haeusler). - Siebold & Siebold, 1960, p. 335, textfig. 4 (d,o), pl. 8, fig. 12.
Bigenerina arcuata Haeusler. - Oesterle, 1968, p. 742, textfigs. 37-39.

Dimensions: 0.14-0.62 mm, thickness 0.096-0.14 mm.
Location: Haghimas Massif, Lacul Rosu lake; Bucegi Massif (Tataru); Ialomitza valley (Galma Ialomitzei olistolith); Pelesului Valley (Cota 1100 olistolith); Rasnov.
Stratigraphic distribution: Kimmeridgian-Lower Tithonian.
Hypotypes: L.P.B. IV 11.106-11.108

Genus ***Bicazammina*** Neagu & Neagu, **n.gen.**

Type species: *Bicazammina jurassica* (Haeusler, 1890)
Derivation of name: from the town of Bicaz.
Description: Test free, moderate to roughly agglutinated, biserial in the early stage, becoming lax-uniserial to nearly uniserial. Chambers globular with depressed sutures. Aperture areal with an elliptical or circular outline, Wall siliceous, compact, non-canaliculate.
Remarks: This genus is strongly homeomorphic with *Bigenerina* d'Orbigny; however it differs from the latter in its non-canaliculate wall structure.

Bicazammina jurassica (Haeusler, 1890)
Pl. 2, Figs. 44-53

Pleurostomella jurassica Haeusler, 1890, p. 77, pl. 12, figs. 14-22.
Bigenerina jurassica (Haeusler). - Oesterle, 1968, p. 745, textfigs. 40-42.
Bigenerina arcuata (Haeusler). - Seibold & Siebold, 1960, p. 333, textfig. 8(f).

Remarks: The specimens illustrated by Riegraf and Luterbacher (1989) as *Bigenerina jurassica* also most likely belong in *Bicazammina* if further study proves that they possess a siliceous, non-canaliculate wall.
Dimensions: Length 0.48-0.60 mm, breadth 0.14-0.17 mm.
Location: Haghimas Massif, Lacul Rosu lake.
Stratigraphic distribution: Lower Kimmeridgian.
Hypotypes: L.P.B. IV 11.109

Genus ***Rashnovammina*** Neagu & Neagu, **n.gen.**

Type species: *Rashnovammina carpathica* Neagu & Neagu, **n.gen.n.sp.**
Derivation of name: from the village of Rasov.
Description: Test free, fine to moderate agglutinated with siliceous cement (insoluble in acid), textulariiform, biserial with a tendency to become lax-uniserial in the last third part of the test, slightly globulous chambers with straight and depressed sutures. Aperture areal to terminal, elliptical or circular in outline, supported by a short neck. Wall compact, non-canaliculate.
Remarks: This genus differs from *Plectinella* Marie, 1956 to which it is homeomorphic externally, by its circular or elliptic aperture which is areal in position, supported by a short neck rather than an elliptical slit as in *Plectinella*. It differs from *Bimonilina* Eicher, 1960 (another homeomorph) by its areal circular or ellip-

tical aperture supported by a neck rather than having a slit-like aperture.

Rashnovammina carpathica Neagu & Neagu, **n.gen.n.sp.**
Pl. 2, Figs. 12-27

Description: Test free, biserial, with the last part of the test become lax-uniserial, sutures straight and depressed, the twisted aspect of the test is extremely rare and slightly visible on the early stage, aperture terminal elliptical or circular in outline supported by a short neck, moderate to smoothly finished agglutinated wall, compact non-canaliculate with siliceous cement.
Dimensions: Holotype: length 0.39 mm, breadth 0.14 mm; paratypes: length 0.21-0.39 mm, breadth 0.072-0.14 mm.
Type Locality: Rasnov, Bucegi Massif (Tataru), Ialomitza valley (Galma Ialomitzei olistolith).
Stratigraphic distribution: Kimmeridgian- Lower Tithonian.
Holotype: L.P.B. IV 11.112
Paratypes: L.P.B. IV 11.111. Additional specimens are deposited in the micropalaeontological collections of the Natural History Museum (London), PF 53011.

Superfamily TROCHAMMINACEA Schwager, 1877
Family TROCHAMMINIDAE Schwager, 1877
Subfamily Trochammininae Schwager, 1877

Genus ***Trochammina*** Parker & Jones, 1859
Trochammina rotundata Seibold & Seibold, 1960
Pl. 2, Figs. 4-9

Trochammina rotundata Seibold & Seibold, 1960, p. 345, textfig. 5 (s-u), pl. 8, fig. 13. - Oesterle, 1968, p. 751.

Dimensions: Diameter (small) 0.21-0.29 mm; (large) 0.31-0.34 mm.
Location: Haghimas Massif, Lacul Rosu lake, Rasnov.
Stratigraphic distribution: Lower Kimmeridgian.
Hypotypes: L.P.B. IV 11.114-11.115

Trochammina pulchra Ziegler, 1959
Pl. 4, Figs. 1-13

Trochammina pulchra Ziegler, 1959, p. 94, pl. 2, figs. 6-8.
Trochammina pulchra Ziegler. - Oesterle 1968, p. 751, textfig. 45f.

Dimensions: Diameter (small) 0.21-0.39 mm, (large) 0.29-0.48 mm.
Location: Haghimas Massif, Lacul Rosu lake, Rasnov.
Stratigraphic distribution: Lower Kimmeridgian.
Hypotypes: L.P.B. IV 11.118-11.119

Trochammina neoparva Oesterle, 1968
Pl. 5, Figs. 19-30

Trochammina parva Seibold & Seibold, 1960, p. 344, textfig. 5 (n-r), pl. 7, fig. 19.
Trochammina neoparva Oesterle (*nomen novum*), 1968, p. 748, textfig. 45(d).

Dimensions: Diameter (small) 0.19-0.34 mm, (large) 0.21-0.43 mm.
Location: Haghimas Massif, Lacul Rosu lake, Rasnov.
Stratigraphic distribution: Lower Kimmeridgian.
Hypotypes: L.P.B. IV 11.117

Trochammina concava Seibold & Seibold, 1960
Pl. 4, Figs. 14-18, Pl. 5. Figs. 1-3

Trochammina concava Seibold & Seibold, 1960. p. 342, textfig. 5 (h-k), pl. 8, fig. 8.

Dimensions: Diameter (small) 0.26-0.40 mm, (large) 0.34-0.48 mm.
Remarks: This species differs from *T. pulchra* Zeigler by more globulous aspect of the chambers, and its depressed umbilical side with a deep umbilicus.
Location: Haghimas Massif, Lacul Rosu lake.
Stratigraphic distribution: Lower Kimmeridgian.
Hypotypes: L.P.B. IV 11.120

Trochammina rumana Neagu & Neagu, **n.sp.**
Pl. 5, Figs. 10-18

Description: Test small with a conical shape (like *Globorotalites*). Spiral side flat, umbilical side high conical, with a (crateriform) umbilicus. Seven to nine chambers in the last whorl, which increases rapidly in height (evidently heteromorphic with Lower Cretaceous species of the genus *Globorotalites*). Aperture a small, umbilical arcuate slit bordered by a small lip. Wall moderate agglutinated with siliceous cement.
Dimensions: Holotype 0.24 mm small diameter, 0.31 mm large diameter, 0.19 mm height. Paratypes 0.26 - 0.29 mm in diameter, 0.17-0.19 mm in height.
Remarks: This species is very clearly delimited by its homeomorphy with the genus *Globorotalites*.
Type Locality: Haghimas Massif, Lacul Rosu lake, Rasnov.
Stratigraphic distribution: Lower Kimmeridgian.
Derivation of name: from the country Romania.
Holotype: L.P.B. IV 11.112
Paratypes: L.P.B. IV.11.122

Genus ***Tritaxis*** Schubert, 1921

Tritaxis lobata Seibold & Seibold, 1960
Pl. 6, Figs. 38-39

Tritaxis heusleri Galloway, 1933, p. 212 (*nomen nudum*).
Valvulina lobata Seibold & Seibold, 1960, p. 336, textfig. 4(f-g), pl. 8, fig. 11.
Tritaxis lobata (Seibold & Seibold). - Oesterle, 1968, p. 752.

Dimensions: Diameter 0.21-0.74 mm, height 0.14-0.46 mm
Location: Haghimas Massif, Lacul Rosu lake, Rasnov; Ialomitza Valley (Galma Iaolimtzei olistolith).
Stratigraphic distribution: Kimmeridgian.
Hypotypes: L.P.B. IV 11.123

Superfamily VERNEUILINACEA Cushman, 1911
Family: PROLIXOPLECTIDAE Loeblich & Tappan, 1985

Genus *Verneuilinella* Tairov, 1956

Verneuilinella carpathica Neagu & Neagu, **n.sp.**
Pl. 6, Figs. 1-10

Description: Test small, with a conical aspect, four chambers per whorl, growing gradually in dimensions, and arranged in a high trochospiral coil. Sutures slightly depressed. Wall compact, non-canaliculate, moderately agglutinated, with siliceous cement. Aperture interiomarginal on the basal part of apertural face of the last chamber, with an arched shape.
Dimensions: Holotype: length 0.2 mm, thickness 0.17 mm. Paratypes: length 0.19-0.24 mm; thickness 0.12-0.17 mm.
Remarks: This species clearly differs from *Verneuilinoides favus* Bartenstein found in the same assemblage by its quadriserial disposition of the chambers.
Type Locality: Rasnov, Ialomitza valley (Galma Ialomitzei olistolith).
Stratigraphic distribution: Kimmeridgian.
Derivation of name: from the Carpathian Mountains.
Holotype: L.P.B. IV 11.128
Paratypes: L.P.B. IV. 11.129-11.130. Additional specimens are deposited in the micropalaeontological collections of the Natural History Museum (London), PF 53009.

Family VERNEUILINIDAE Cushman, 1911
Subfamily Verneuilinoidinae Suleymanov, 1973
Genus *Verneuilinoides* Loeblich & Tappan, 1949

Verneuilinoides favus (Bartenstein, 1937)
Pl. 3, Figs. 45-51

Verneuilina favus Bartenstein & Brand, 1937, p. 183, textfig. 18.

Dimensions: length 0.17-0.34 mm, thickness 0.096-0.14 mm.
Location: Haghimas Massif, Lacul Rosu lake, Bucegi Massif (Tataru), Ialomitza Valley (Galma Ialomitzei olistolith); Rasnov.
Stratigraphic distribution: Kimmeridgian.
Hypotypes: L.P.B. IV 11.124-11.127

Genus *Uvigerinammina* Majzon, 1943

Uvigerinammina uvigeriniformis (Seibold & Seibold, 1960)
Pl. 2, Figs. 28-43, Pl. 6, Figs. 11-14

Gaudryina uvigeriniformis Seibold & Seibold, 1960, p. 34, textfig. 8, pl. 7, fig. 4.

Dimensions: Length 0.29-0.36 mm, thickness 0.14 mm.
Location: Haghimas Massif, Lacul Rosu lake.
Stratigraphic distribution: Lower Kimmeridgian (*acanthicum* biozone).
Hypotypes: L.P.B. IV.11.131

Superfamily TEXTULARIACEA Ehrenberg, 1838
Family TEXTULARIIDAE Ehrenberg, 1838
Subfamily Textulariinae Ehrenberg, 1838
Genus *Textularia* Defrance, 1826

Textularia jurassica Gümbel, 1862
Pl. 1, Figs. 1-2

Textularia jurassica Gümbel, 1862, p. 228, pl. 4, fig. 17a-b.
Textularia jurassica Gümbel. - Seibold & Seibold, 1953, p. 43, pl. 4, fig. 2. - Seibold & Seibold, 1960, p. 98, textfig. 2, pl. 13, fig. 1. - Oesterle, 1968, p. 741.

Dimensions: Length 0.43-0.96 mm, breadth 0.14-0.12 mm.
Remarks: Transversal sections through the test show the presence of a canaliculate wall. The biserial arrangement of the chambers demonstrate the affiliation of the Jurassic material to the genus *Textularia*. Even Loeblich & Tappan (1987) considered this genus to range only from Palaeocene.
Location: Haghimas Massif, Lacul Rosu lake, Rasnov; Ialomitza Valley (Galma Ialomtzei olistolith); Bucegi Massif (Tataru).
Stratigraphic distribution: Kimmeridgian-Tithonian.
Hypotypes: L.P.B. IV.11.133

Genus *Pseudomorulaeplecta* Neagu & Neagu, **n.gen.**

Type species: *Pseudomorulaeplecta franconica* (Gümbel, 1862).
Derivation of name: from its resemblance to the genus *Morulaeplecta* Höglund, 1947.
Description: Typical biserial textularoid test in the adult stage, a short low trochospirally coiled early stage with a bulbaceous aspect. Aperture interiomarginal, textularoid the basal part of the last formed chamber. Wall canaliculate, fine to moderately agglutinated wall with siliceous cement.
Remarks: This genus differs from *Textularia* Defrance, 1826 (with which it is homeomorphic) by its early low trochospirally coiled stage. It differs from *Morulaeplecta* Höglund, 1947 by its canaliculate wall structure.

Pseudomorulaplaecta franconica (Gümbel, 1862)
Pl. 1, Figs. 23-32

Textilaria franconica Gümbel, 1862, p. 229, pl. 4, fig. 18a-b.

Dimensions: Length 0.25-0.96 mm, thickness 0.12-0.21 mm.
Remarks: Taking into consideration Seibold & Seibold's (1955) observations (Revision der Foraminiferen Bearbeitung C.W. Gümbel, 1862), Gumbel's originals were destroyed during the Second World War. Seibold attempted to designate neotypes from the type locality, but 21 of Gumbel's species were not found. The specimens they figured and described as a neotype for *Textularia jurassica* did not include (in our opinion) *T. franconica*, which differs from *T. jurassica* (as Gümbel pointed out) by its "shorter size, thicker and especially by the early chambers more robust ". In our opinion *T. franconica* is a valid name. Its "robust early chambers" represent the short trochospiral early stages. *Textularia franconica* is here

designated the type-species of the new genus *Pseudomorulaeplecta*.

Location: Haghimas Massif, Lacul Rosu lake, Rasnov.

Stratigraphic distribution: Lower Kimmeridgian.

Hypotypes: L.P.B. IV. 11.134.

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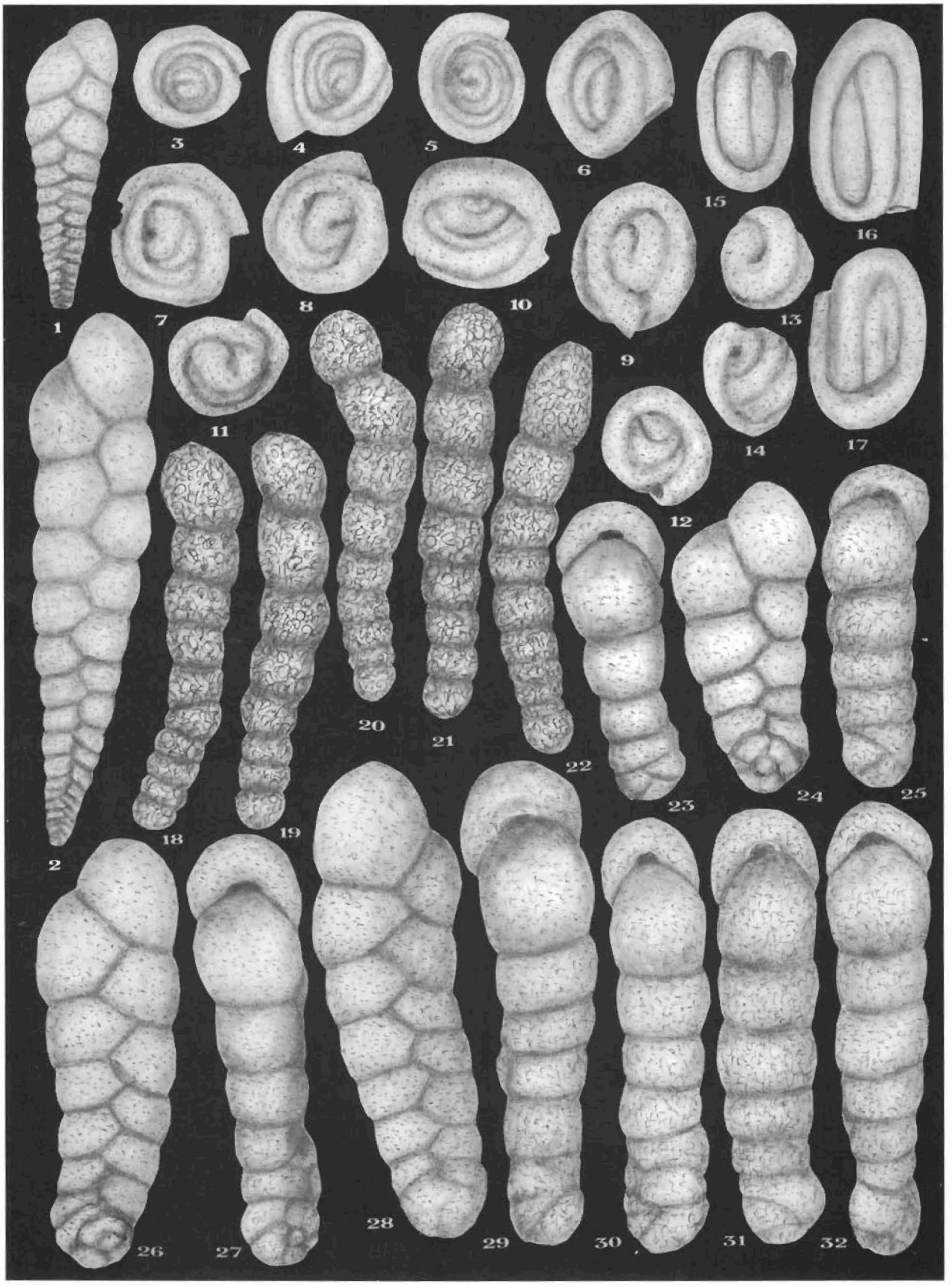

Plate 1. 1-2. *Textularia jurassica* Gümbel, 1862. Lower Kimmeridgian, Haghimas Massif, Lacul Rosu lake, acanthicum Zone, Hypotypes L.P.B. IV 11.132. **3-14.** *Glomospira variabilis* (Kubler & Zwingli, 1870). Lower Kimmeridgian, Haghimas Massif, Lacul Rosu lake, Hypotypes L.P.B. IV 11.091. **15-17.** *Glomospira pussila* (Geinitz, 1848). Upper Kimmeridgian-lower Tithonian, Bucegi Massif (Tataru), Hypotypes L.P.B. IV 11.088. **18-22.** *Reophax multilocularis* Haeusler, 1883. Lower Kimmeridgian, Haghimas Massif, Lacul Rosu lake, Hypotypes L.P.B. IV 11.094. **23-32.** *Pseudomorulaeplecta franconica* (Gümbel, 1862), Lower Kimmeridgian, Haghimas Massif, Lacul Rosu lake, Hypotypes L.P.B. IV 11.134.

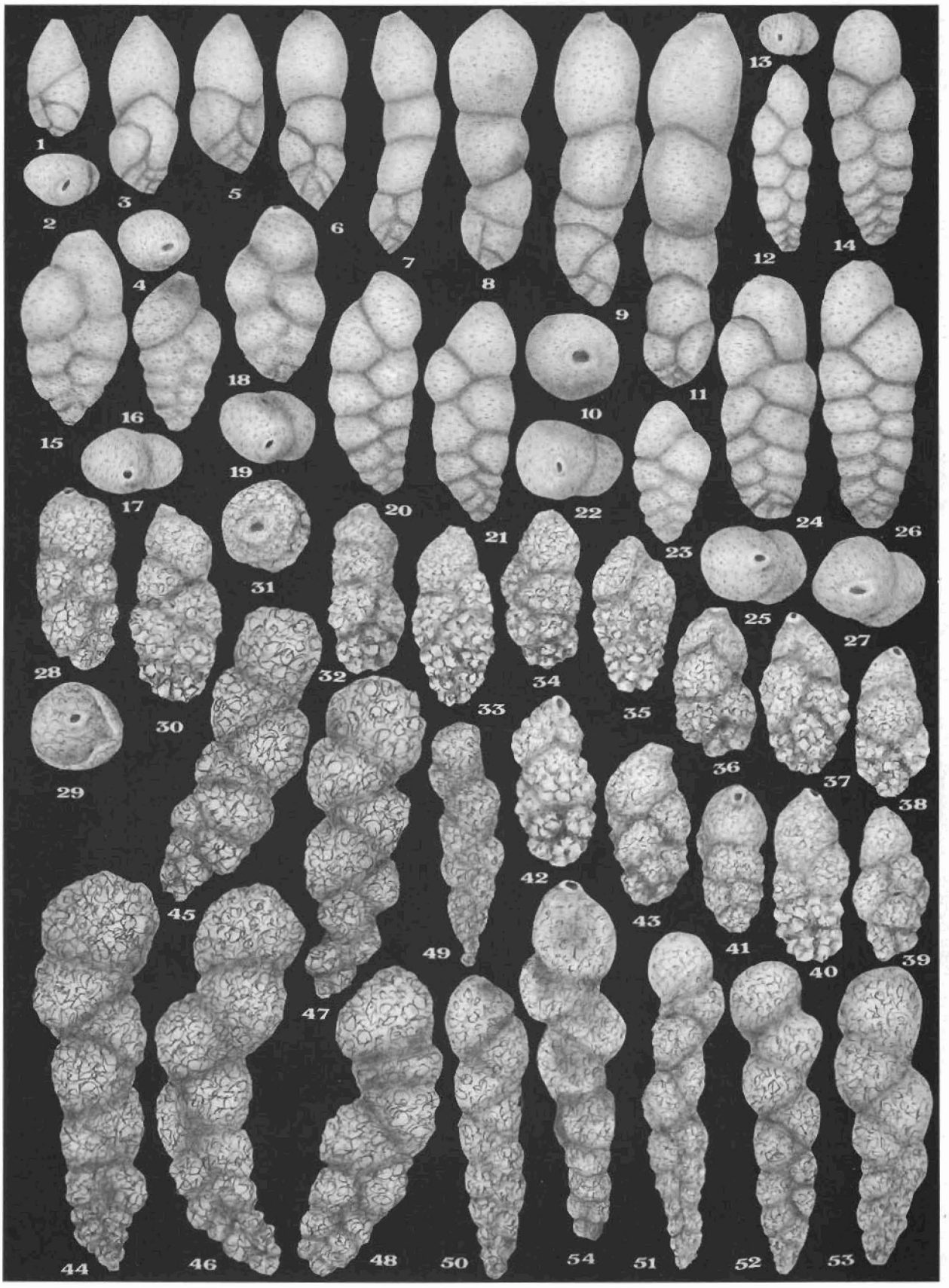

Plate 2. 1-11. *Haghimashella arcuata* (Haeusler, 1890). Lower Kimmeridgian, Haghimas Massif, Lacul Rosu lake, acanthicum Zone, Hypotypes L.P.B. IV 11.107. **12-27.** *Rashnovammina carpathica* Neagu & Neagu, n.sp. Kimmeridgian, Bucegi Massif (Tataru), 26-27. Holotype, L.P.B. IV 11.110; 12-25. Paratypes, L.P.B. IV 11.112. **28-43.** *Uvigerinammina uvigeriniformis* (Seibold & Seibold, 1960). Lower Kimmeridgian, Haghimas Massif, Lacul Rosu lake, Hypotypes L.P.B. IV 11.131. **44-54.** *Bicazammina jurassica* (Haeusler, 1890). 44-53. Lower Kimmeridgian, Haghimas Massif, Lacul Rosu lake, Hypotypes L.P.B. IV 11.109; 54. Upper Kimmeridgian, Ialomitza Valley (Galma Ialomitza olistolith), Hypotypes L.P.B. IV 11.135.

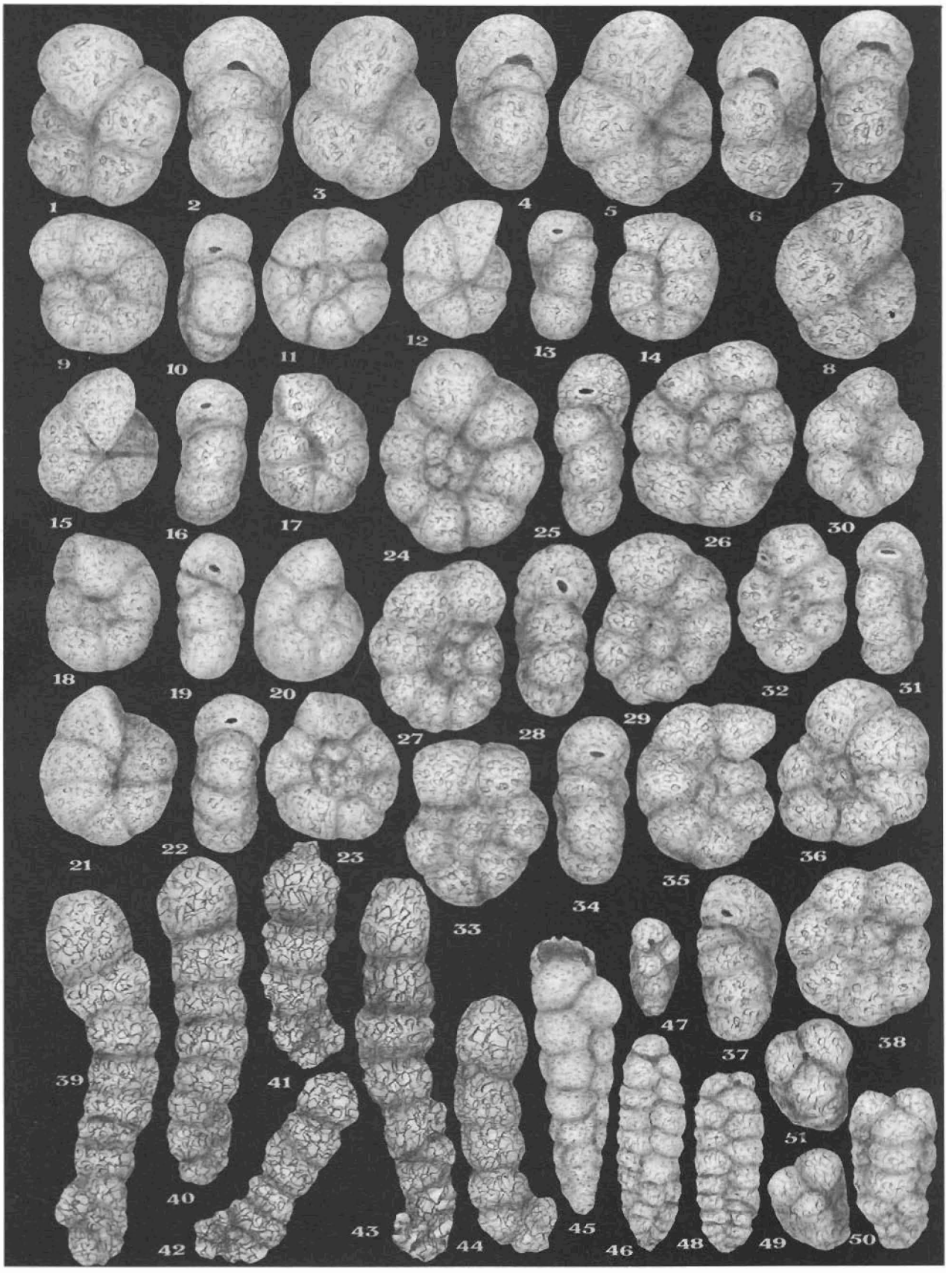

Plate 3. **1-8.** *Haplophragmoides globigerinoides* (Haeusler, 1881). Lower Kimmeridgian, Haghimas Massif, Lacul Rosu lake, acanthicum Zone, Hypotypes L.P.B. IV 11.095. **9-23.** *"Recurvoides" universus* (Haeusler, 1881). 9-17. Lower Kimmeridgian, Haghimas Massif, Lacul Rosu lake, Hypotypes L.P.B. IV 11.103; 18-23. Upper Kimmeridgian, Ialomitza Valley (Galma Ialomitza olistolith), Hypotypes L.P.B. IV 11.139. **24-38.** *"Recurvoides" pygmaeus* (Haeusler, 1881). Upper Kimmeridgian, Ialomitza Valley (Galma Ialomitza olistolith), Hypotypes L.P.B. IV 11.102. **39-44.** *Ammobaculites irregularis* (Gümbel, 1862). Lower Kimmeridgian, Haghimas Massif, Lacul Rosu lake, Hypotypes L.P.B. IV 11.097. **45-51.** *Verneuilinoides favus* (Bartenstein, 1937). 45. Upper Kimmeridgian, Ialomitza Valley (Galma Ialomitza olistolith), Hypotypes L.P.B. IV 11.126; 46-51. Upper Kimmeridgian, Bucegi Massif (Tataru), Hypotypes L.P.B. IV 11.125.

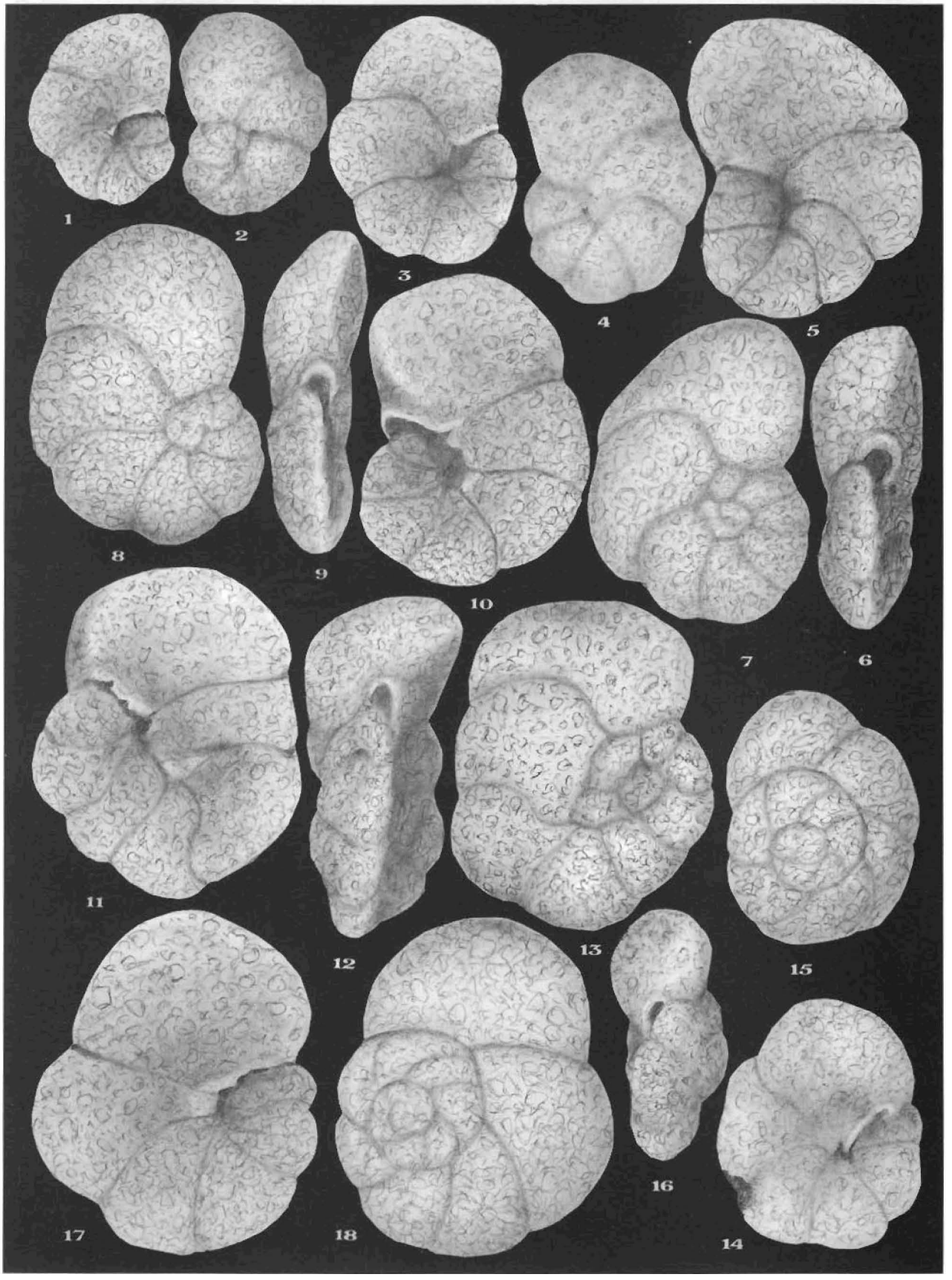

Plate 4. 1-13. *Trochammina pulchra* Ziegler, 1959. Lower Kimmeridgian, Haghimas Massif, Lacul Rosu lake, acanthicum Zone, Hypotypes L.P.B. IV 11.118. **14-18.** *Trochammina concava* Seibold & Seibold, 1960. Lower Kimmeridgian, Haghimas Massif, Lacul Rosu lake, acanthicum Zone, Hypotypes L.P.B. IV 11.120.

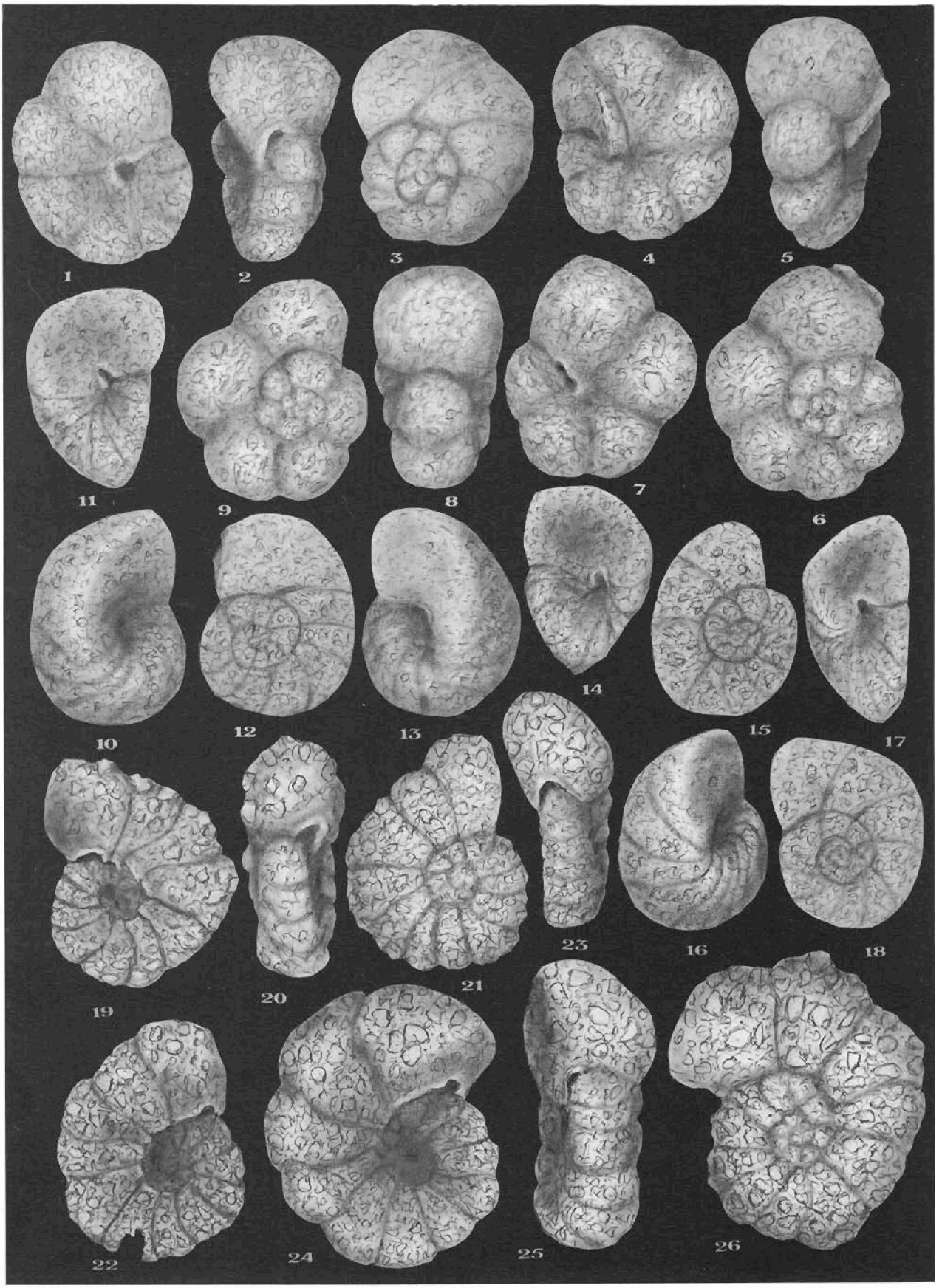

Plate 5. 1-3. *Trochammina concava* Seibold & Seibold, 1960. Lower Kimmeridgian, Haghimas Massif, Lacul Rosu lake, acanthicum Zone, Hypotypes L.P.B. IV 11.120. **4-9.** *Trochammina rotundata* Seibold & Seibold, 1960. Lower Kimmeridgian, Haghimas Massif, Lacul Rosu lake, Hypotypes L.P.B. IV 11.114. **10-18.** *Trochammina rumana* Neagu & Neagu, n.sp. Lower Kimmeridgian, Haghimas Massif, Lacul Rosu lake, 10-12. Holotype L.P.B. IV 11.112; 13-18. Paratypes, L.P.B. IV 11.113. **19-30.** *Trochammina neoparva* Oesterle, 1968. Lower Kimmeridgian, Haghimas Massif, Lacul Rosu lake, Hypotypes L.P.B. IV 11.116.

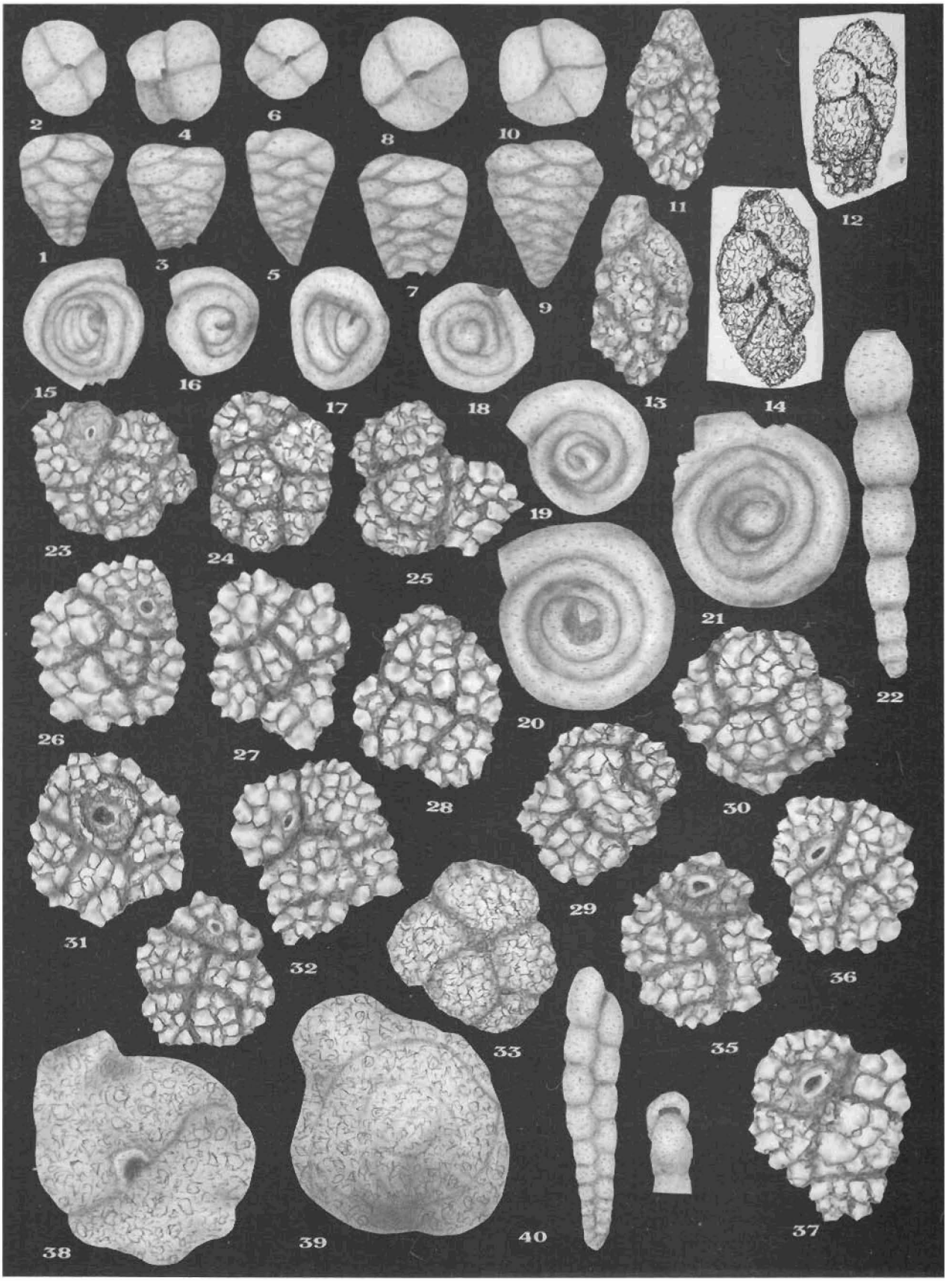

Plate 6. 1-10. *Verneuilinella carpathica* Neagu & Neagu, n.sp. Kimmeridgian, Ialomitza Valley (Galma Ialomitza olistolith), 9-10. Holotype, L.P.B. IV 11.128; 1-8. Paratypes, L.P.B. IV 11.129. **11-14.** *Uvigerinammina uvigeriniformis* (Seibold & Seibold, 1960). Lower Kimmeridgian, Haghimas Massif, Lacul Rosu lake, Hypotypes L.P.B. IV 11.131 (12,14. in glycerine). **15-21.** *Glomospira variabilis* (Kubler & Zwingli, 1870). **22.** *Reophax chrysalis* (Haeusler, 1881). Kimmeridgian, Ialomitza Valley (Galma Ialomitza olistolith), Hypotype L.P.B. IV 11.093. **23-37.** *Thalmannammina atanasiui* Neagu & Neagu, n.sp. Lower Kimmeridgian, Haghimas Massif, Lacul Rosu lake, 26-28. Holotype, L.P.B. IV 11.104; 23-25, 29-37. Paratypes, L.P.B. IV 11.105. **38-39.** *Tritaxis lobata* (Seibold & Seibold, 1960). Lower Kimmeridgian, Haghimas Massif, Lacul Rosu lake, Hypotype L.P.B. IV 11.123. **40.** *"Textularia"* sp. Upper Kimmeridgian - lower Tithonian, Bucegi Massif (Tataru).