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LOWER CRETACEOUS AGGLUTINATED FORAMINIFERA FROM THE SUPERFAMILIES VERNEUILINACEA AND ATAXOPHRAGMIACEA; SOUTHERN DOBROGEA, ROMANIA

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Abstract: The present paper starts the study of the upper Berriasian–lower Aptian agglutinated foraminifera from southern Dobrogea. The following taxa are presented: *Verneuilionoides faraonica*, *V. polonicus*, *V. danubiensis* n.sp., *V. pumilionis* n.sp., *V. fastigatus*, *Gaudryina* cf. *ectypa*, *G. dacica*, *Verneuilina angularis*, *V. dobrogiaca* n.sp., *Arenobulimina venusta* n.sp., *A. melitaeformis* n.sp., *A. melitae*, *A. corniculum*, *A. cochleata*, *A. gibberosa* n.sp., *A. pfenderinae* n.sp., *A. moessiana* n.sp., *A. acervata* n.sp., *A. dissoluta* n.sp., *A. corrugata* n.sp., *A. cuculiformis* n.sp. Two new genera, *Danubina* n.gen. and *Gerochella* n.gen. are also described. Palaeoecological and palaeogeographical considerations, using the morpho-structural characters of the wall are also discussed.

Abstrakt: Prezentowana praca rozpoczyna cykl badań nad otwornicami aglutynującymi z utworów od górnego beriasu do dolnego aptu, występujących w rejonie Dobrudży. Przedstawiono opis systematyczny następujących gatunków: *Verneuilionoides faraonica*, *V. polonicus*, *V. danubiensis* n.sp., *V. pumilionis* n.sp., *V. fastigatus*, *Gaudryina* cf. *ectypa*, *G. dacica*, *Verneuilina angularis*, *V. dobrogiaca* n.sp., *Arenobulimina venusta* n.sp., *A. melitaeformis* n.sp., *A. melitae*, *A. corniculum*, *A. cochleata*, *A. gibberosa* n.sp., *A. pfenderinae* n.sp., *A. moessiana* n.sp., *A. acervata* n.sp., *A. dissoluta* n.sp., *A. corrugata* n.sp., *A. cuculiformis* n.sp. Wyróżniono oraz opisano dwa nowe rodzaje wśród otwornic aglutynujących: *Danubina* i *Gerochella*. Zawarto także uwagi dotyczące paleoekologii i paleogeografii w oparciu o analizę morfostruktury ścian opisanych taksonów.

Key words: Lower Cretaceous foraminifera, Verneuilinacea and Ataxophragmiacea groups, new species and new genera, Dobrogea, Romania.

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INTRODUCTION

The Lower Cretaceous foraminiferal fauna of southern Dobrogea are situated in the first plane regarding the taxa and specimens richness, together with molluscs (Gastropoda and Bivalvia). Among these foraminiferal assemblages, a characteristic feature is the predominance of agglutinated species, with a simple or complex wall structure. The next group in terms of diversity group is comprised of miliolids and involutinids. With a subordinate and reduced frequency occur the calcareous benthic species, represented by rare nodosarinids, polymorphinids, spirillinids, discorbids, epistominids and conorboinids. From these very rich and well preserved assemblages, the pfenderinids, miliolids, and involutinids have already been studied and described (Neagu, 1975).

The present paper begins a detailed study of the agglutinated group with simple wall structure which appear with particular frequency in the upper Berriasian–lower Aptian deposits.

Some taxa from the superfamily Verneuilinacea: *Gerochella cylindrica* n.gen et n.sp., *Danubina obtusa* n.gen. et n.sp., *Verneulinoides faraonica* Said & Barakat, 1961, *V. polonicus* (Cushman & Glazewski), 1949, *V. danubiensis* n.sp., *V. fastigatus* Magnez-Jannine, 1973, *V. pumilionis* n.sp., *Gaudryina* cf. *ectypa* Arnaud-Vanneau, 1980, *G. dacica* Neagu, 1975, *Verneuilina angularis* Gorbatchik, 1971, *V. dobrogiaca* n.sp., and from the superfamily Ataxophragmiacea: *Arenobulimina venusta* n.sp., *A. melitaeformis* n. sp., *A. melitae* Kovatcheva, 1969, *A. corniculum* Arnaud-Vanneau, 1980, *A. cochleata* Arnaud-Vanneau, 1980, *A. moesiana* n.sp., *A. acervata* n.sp., *A. pfenderinae* n.sp., *A dissoluta* n.sp., *A. corrugata* n.sp., *A. cuculiformis* n.sp. will be presented first.

The Verneuilinacea group is well known from Jurassic and Lower Cretaceous deposits, but the Ataxophragmiacea group is completely new in the upper Berriasian-Valanginian deposits, and is sporadically represented by three spe-

cies (*Arenobulimina melitae, A. corniculum* and *A. cochleata*) in the Barremian-Aptian deposits (Kovatcheva, 1969; Arnaud-Vanneau, 1980). The major development of this group is considered to begin in the early Aptian (Anglo-Parisian Basin), and it is later well represented in all Upper Cretaceous deposits from Europe (Barnard & Banner, 1980; Price, 1977; Frieg & Price, 1982; Voloshinova, 1972). The Lower Cretaceous deposits (upper Berriasian–lower Aptian) in southern Dobrogea offer very interesting data which complete the known stratigraphical distribution of this group.

The genus *Arenobulimina* is present even in the upper Berriasian in Cernavoda, and later underwent a large morphostructural evolution during the Barremian–Aptian. This morphostructural evolution and impressive development of populations made it possible to find 9 new species added to the ones already described.

Two new genera, *Danubina* n.gen. and *Gerochella* n.gen. which by their wall structure and aperture can be assigned to the Verneuilinacea group, are also added to the general inventory of the foraminifera.

The richness and good preservation of the available material offered the possibility to mark the limits of the allied genera *Verneuilina* and *Verneuilinoides* according to Loeblich and Tappan (1988). We avoid the confusion caused Arnaud-Vanneau (1980) who considered that there were no noticeable differences between these genera.

SYSTEMATIC PALEONTOLOGY

Suborder TEXTULARIINA Delage and Herouard, 1896
Superfamily VERNEUILINACEA Cushman, 1911
Family PROLIXOPLECTIDAE Loeblich and Tappan, 1985

Genus *Gerochella* n.gen.

Description: Test with a trochospiral early stage, pyramidally square-rounded in transversal section, with 4 chambers per whorl; an intermediate short stage with 2-3 chambers irregularly uniserial. The adult stage is well developed, uniserial, cylindrical, with low chambers, weakly inflated and straight depressed sutures. The aperture in the early stage is represented by a virgulate interiomarginal slit, becoming in the last uniserial stage multiple with many circular or elongated pores. Chambers simple, without inner elements. Wall compact, finely agglutinated, with calcareous cement.
Etymology: This genus is dedicated to the memory of Professor Stanisław Geroch, Jagiellonian University, Kraków in profound homage.
Remarks: The general shape of the test is similar with that of *Pseudolituonella*, but the total absence of inner structure of the chambers, and the nature of the early stage indicate a clear difference. It is noteworthy that the early stage of this genus is similar in its chamber arrangement, to *Riyadhella* Redmond, 1965, described in Middle to Upper Jurassic. The simple inner structure, the trochospiral chamber disposition and the virgulate aperture of the early stage are the features that indicate this genus belongs to the family Prolixoplectidae.
Stratigraphic distribution: Lower Valanginian.

Gerochella cylindrica gen. et sp. nov.
Fig. 1 (1–41)

Etymology: This form is named from the shape of the last stage of the test; latin *cylindricus-i* = cylinder.
Type-locality: Cernavoda Pod, right bank of the Danube River.
Type-level: ISPH drillings C4-Hinog – 47.20 m; lower Valanginian.
Diagnosis: Gracile test, with the early stage trochospiral with a pyramidal shape with 4 chambers per whorl; an intermediate stage with 2–3 chambers irregularly uniserial; the adult stage uniserial; well developed with a cylindrical shape; weakly inflated chambers, and straight sutures. Inner part of the chambers without any kind of secondary elements; wall compact, finely agglutinated with calcareous cement. Aperture in the early stage a virgulate interiomarginal slit, becoming multiple in the adult, represented by many circular or elliptical pores on the apertural face.
Measurements (mm): Holotype length – 1.24; thickness – 0.26. Paratypes length – 0.48-136; thickness – 0.24-0.29 (figured specimens).
Deposition of types: Holotype = L.P.B.IV.11.190. Paratype = L.P.B.IV.11.191.
Stratigraphic distribution: Uppermost Berriasian to lower Valanginian.

Genus *Danubina* n.gen.

Etymology: This form is named from the latin name of the Danube River.
Description: Conical-obtuse trochospiral test, early stage with 2–3 whorls with 5–6 chambers per whorl, last stage with 4 or 4 1/2 chambers per whorl; arcuate weakly depressed sutures, apertural face flat or weakly to moderately concave. Interiomarginal aperture, simple, as low virgulate slit in the early stage, becoming textularoid with a large valvular tooth in the adult stage. Wall finely agglutinated, compact, with calcareous cement.
Remarks: The material from the lower Valanginian of Cernavoda possesses an early trochospiral stage similar to that of *Orientalia* Bykova, 1947 and *Eomarssonella* Levina, 1972. It clearly differs from *Eomarssonella* by its trochospiral last stage, and from *Orientalia* by the absence of a quadriserial chambers arrangement in the adult stage. In addition a clear difference from the above mentioned two genera is the presence of an aperture with a valvular tooth. From *Riyadhella* whose chamber disposition is also trochospiral with 4 chambers per whorl, *Danubina* n.gen. differs by the presence of the valvular tooth.
Stratigrafic distribution: Lower Valanginian.

Danubina obtusa gen. et sp. nov.
Fig. 2 (35–51)

Etymology: This form is named from shape of the test; latin *obtusus-a-um* = obtuse, blunted, not sharpor pointed.
Type-locality: Cernavoda Pod, right bank of the Danube River.
Type-level: Lower Valanginian.
Diagnosis: Free test, conical-obtuse with trochospiral chamber arrangement, 4 to 4 1/2 per whorl. Sutures oblique-arcuate, weakly depressed. Apertural face made by the chambers of the last whorl has a flat to weakly concave shape, and contains an interiomarginal aperture as a simple, arcuate slit in the early stage becoming textularoid in the last stage with a well developed valvular tooth.
Remarks: From *Orientalia norris* Hedinger, 1993, *D. obtusa* differs by the adult chambers arrangement (trochospiral not quadriserial) and structure of the aperture.
Measurements (mm): Holotype length – 0.62; thickness – 0.39. Paratypes length – 0.31-0.55; thickness – 0.31-0.39 (figured specimens).

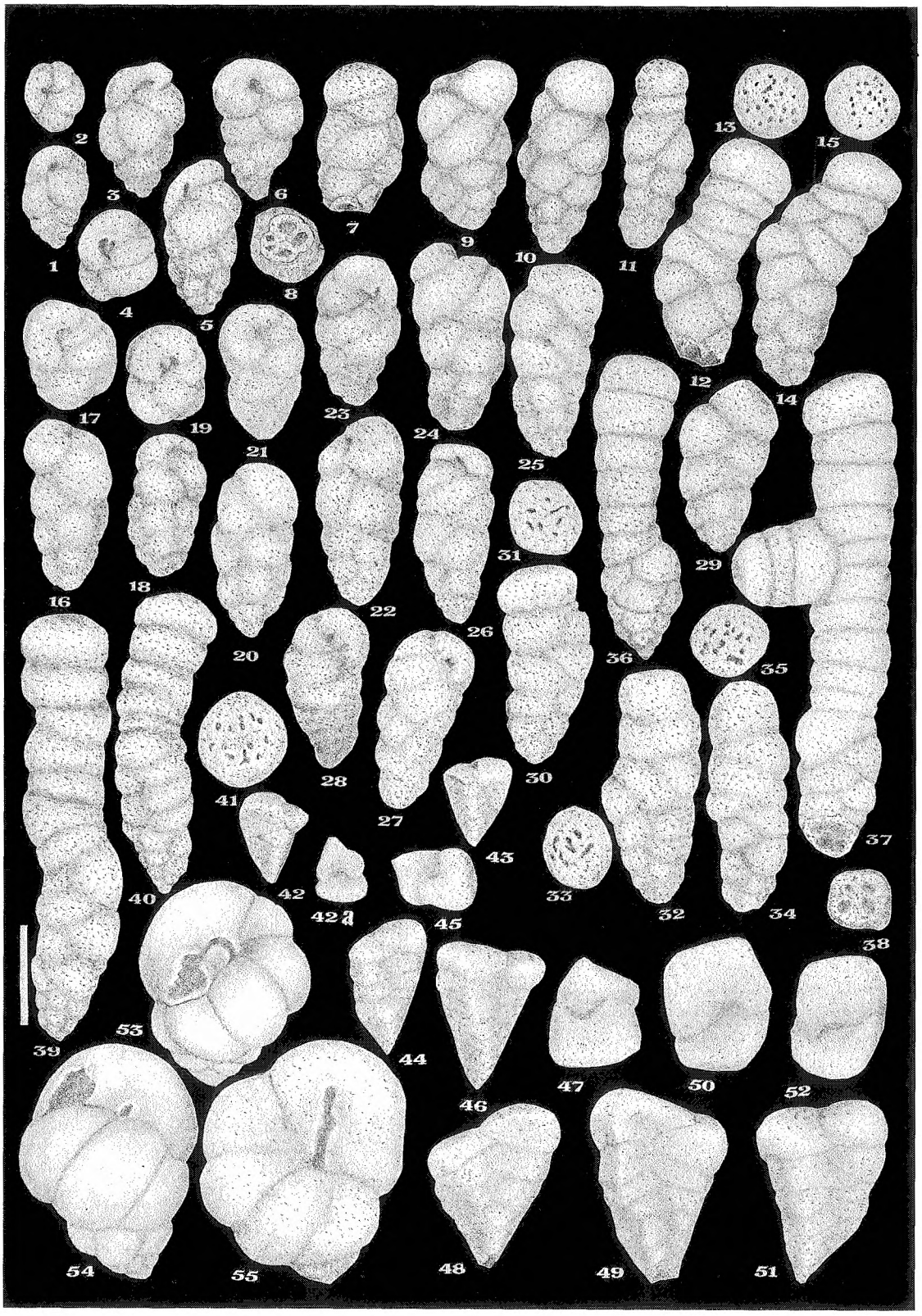

Fig. 1. Lower Cretaceous agglutinated foraminifera from southern Dobrogea. **1-41** – *Gerochella cylindrica* Neagu n.gen. n.sp.: (1-39) paratypes, L.P.B.IV.11.191; (40, 41) holotype, L.P.B.IV.11.190; lower Valanginian, Cernavoda Pod, right bank of the Danube River. **42-53** – *Gaudryina dacica* Neagu, 1975, hipotypes L.P.B.IV.11.192; lower Aptian, Fetesti, ISPH Drilling F.135, 138 m. **54-56** – *Arenobulimina cochleata* Arnaud-Vanneau, 1980, hipotypes, L.P.B.IV.170; lower Aptian, Alimanu-Adâncata. Scale bar = 300 μm

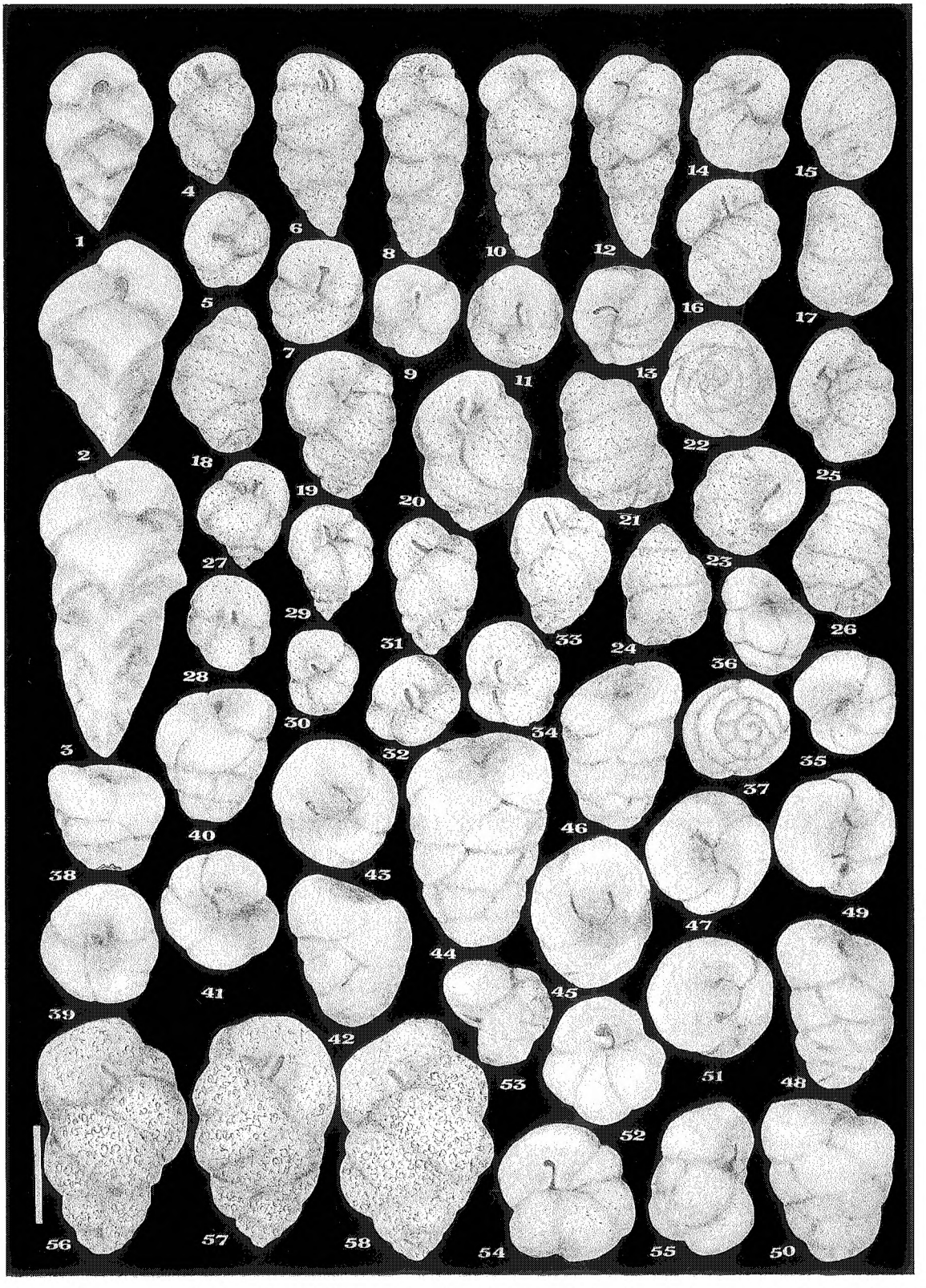

Fig. 2. Lower Cretaceous agglutinated foraminifera from southern Dobrogea. **1-3** – *Verneuilina angularis* Gorbatchik, 1971, hypotypes, L.P.B.IV.11.154; lower Valanginian, Alimanu, left bank of Lake Vederoasa. **4-13** – *Arenobulimina dissoluta* Neagu n.sp., paratypes, L.P.B.IV.11.176; lower Aptian, Oltina ISPH Drilling Bala I, 32 m. **14-26** – *Arenobulimina pfenderinae* Neagu n.sp.: (14-19, 23-26) paratypes, L.P.B.IV.11.166; (20-22) holotype, L.P.B.IV.11.165; lower Aptian, Oltina ISPH Drilling Bala I, 32.1 m. **27-34** – *Arenobulimina acervata* Neagu n.sp.: (27-32) paratypes, L.P.B.IV.11.180; (33-34) holotype, L.P.B.IV.11.179; lower Aptian, Oltina ISPH Drilling Bala I, 32.1 m. **35-51** – *Danubina obtusa* Neagu n.gen. n.sp.: (35-43, 46-51) paratypes, L.P.B.IV.11.153; (44-45) holotype, L.P.B.IV.11.152; lower Valanginian, Cernavoda Pod, right bank of the Danube River. **52-55** – *Arenobulimina melitae* Kovatcheva, 1968, hypotypes, L.P.B.IV.11.188; upper Barremian, Ostrov-Gârlitza, southern bank of the Lake Bugeac. **56-58** – *Arenobulimina corniculum* Arnaud-Vanneau, 1980, hypotypes, L.P.B.IV.11.185; lower Barremian, Alimanu quarry. Scale bar = 300 μm

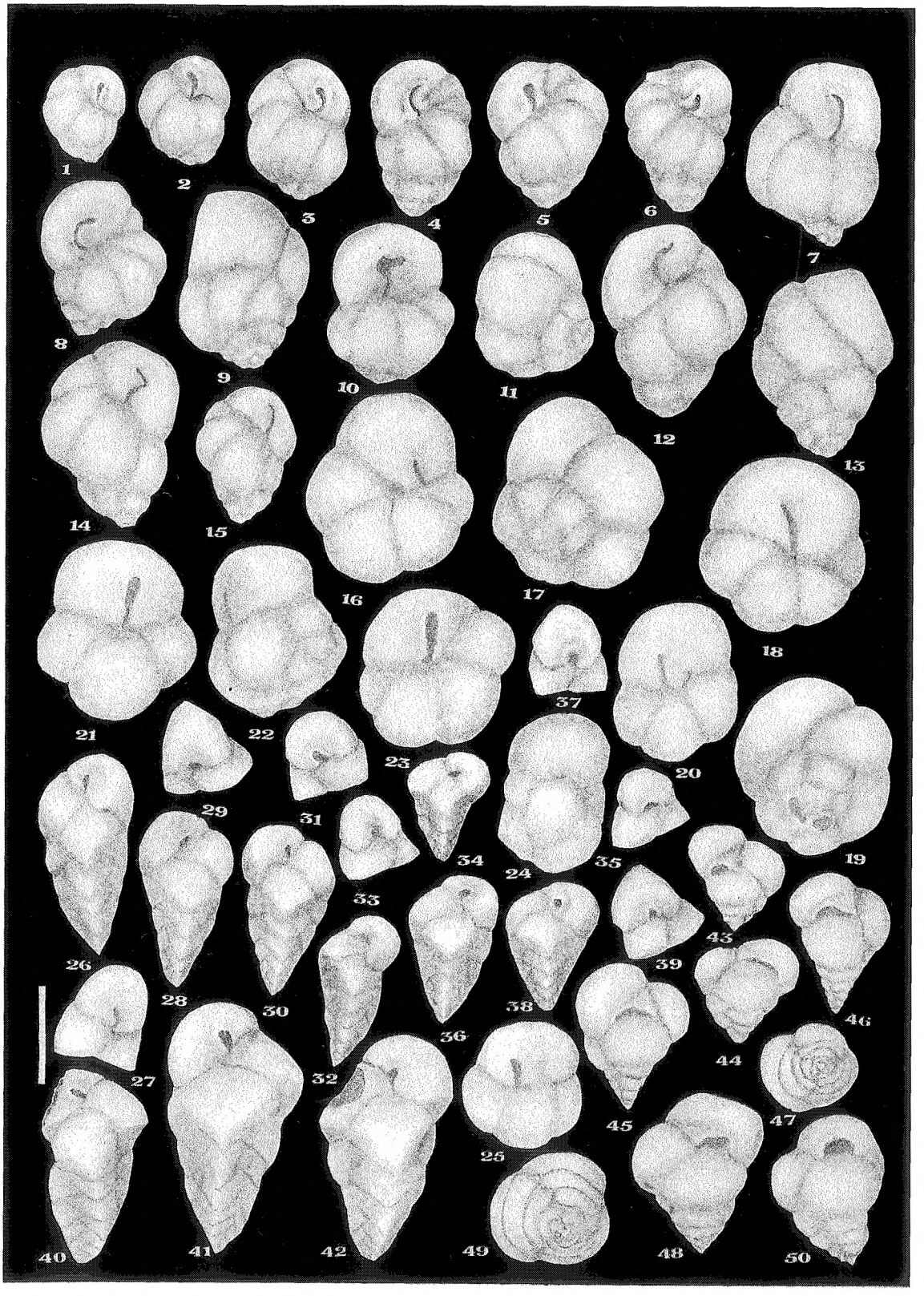

Fig. 3. Lower Cretaceous agglutinated foraminifera from southern Dobrogea. **1-15** – *Arenobulimina venusta* Neagu n.sp.: (1-3, 5-15) paratypes, L.P.B.IV.11.162; (4) holotype, L.P.B.IV.11.161; lower Valanginian, Cernavoda Pod, right bank of the Danube River. **16-25** – *Arenobulimina melitaeformis* Neagu n.sp.: (16-17) holotype, L.P.B.IV.11.163.; (18-25) paratypes, L.P.B.IV.11.164; lower Valanginian, Cernavoda Pod, right bank of the Danube River. **26-42** – *Verneuilina dobrogiacea* Neagu n.sp.: (26-39) paratypes, L.P.B.IV.155, lower Valanginian, Cernavoda Pod, right bank of the Danube River; (40-42) paratypes, L.P.B.IV.11.159, lower Aptian Oltina, ISPH Drilling Bala I, 36 m. **43-50** – *Verneuilinoides faraonica* Said & Barakat, 1961, holotypes, L.P.B.IV.11.140; lower Valanginian, Alimanu. Scale bar = 300 μm

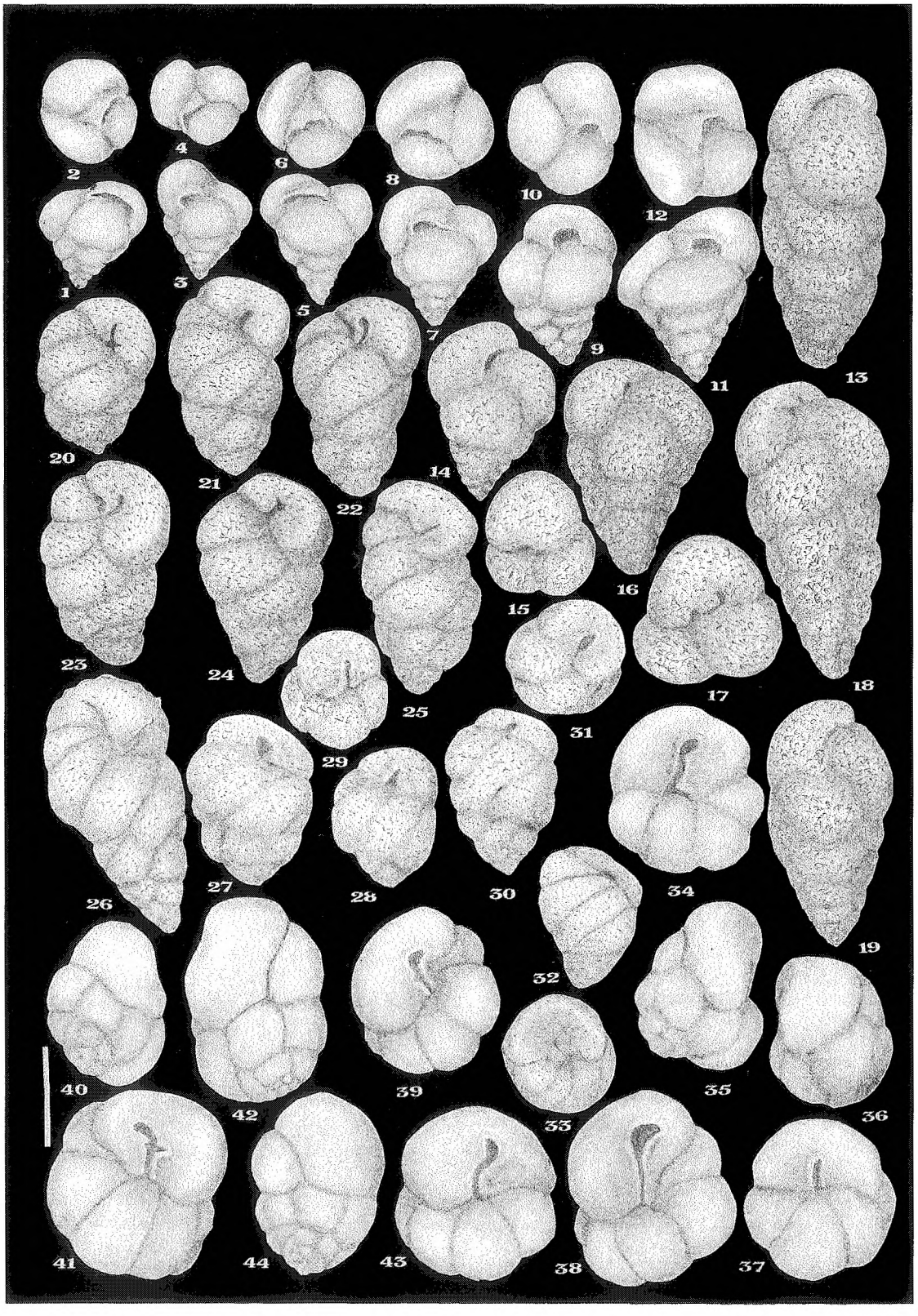

Fig. 4. Lower Cretaceous agglutinated foraminifera from southern Dobrogea. **1-12** – *Verneuilinoides faraonica* (Said & Barakat, 1961), hipotypes, L.P.B.IV.11.140; lower Valanginian, Alimanu, left bank of Lake Vederoasa. **13-19** – *Verneuilinoides polonicus* (Cushman & Glazewski, 1949), hipotypes, L.P.B.IV.11.141; lower Valanginian, Cernavoda Pod, right bank of the Danube River. **20-26** – *Arenobulimina corniculum* Arnaud-Vanneau, 1980, hipotypes, L.P.B.IV.11.185; lower Aptian, Alimanu-Adâncata. **27-31** – *Arenobulimina gibberosa* Neagu n.sp.: (27-29) paratypes, L.P.B.IV.11.183; (30,31) holotype, L.P.B.IV.11.182; lower Aptian, Oltina, ISPH Drilling Bala I, 36 m. **32, 33** – *Arenobulimina pfenderinae* Neagu n.sp., paratypes, L.P.B.IV.11.166; lower Aptian, Oltina, ISPH Drilling Bala I, 36 m. **34-44** – *Arenobulimina cochleata* Arnaud-Vanneau, 1980, hipotypes, L.P.B.IV.11.170; lower Barremian, Alimanu quarry. Scale bar = 300 μm

Stratigraphic distribution: Lower Valanginian.
Deposition of types: Holotype = L.P.B.IV.11.152. Paratype = L.P.B.IV.11.153.

Family VERNEUILINIDE Cushman, 1911
Subfamily VERNEUILINOIDINAE Suleymanov, 1973

Genus *Verneuilinoides* Loeblich & Tappan, 1949

Remarks: In the reference literature (Arnaud-Vanneau, 1980; Gorbatchik, 1971) there are different opinions regarding the definition and individuality of the genus *Verneuilinoides*. I took into consideration Loeblich and Tappan (1988) to differentiate *Verneuilinoides* from the morphologically similar genus *Verneuilina*.

Verneuilinoides faraonica (Said & Barakat, 1961)
Fig. 3 (43–50), Fig. 4 (1–12)

1958. *Verneuilinoides minuta* Said & Barakat: Said & Barakat, p. 242, pl. 4, fig. 5.
1961. Verneuilina *faraonica* Said & Barakat: Said, p. 148.
non 1980. *Verneuilina* aff. *faraonica* Said & Barakat: Arnaud-Vanneau, p. 399, text-fig. 148, pl. 6, figs. 15-16.

Measurements (mm): Length – 0.34-0.46; breadth 0.29-0.40 mm (figured specimens).
Occurrence: Alimanu, left bank of Lake Vederoasa.
Stratigraphic distribution: Lower Valanginian.
Deposition of types: Hipotype = L.P.B.IV.11.140.

Verneuilinoides polonicus (Cushman & Glazewski, 1949)
Fig. 4 (13–19), Fig. 5 (39–49)

1949. *Verneuilina polonica* Cushman & Glazewski: Cushman & Glazewski, p. 7, pl. 1, figs. 14-15.

Remarks: As already mentioned by Cushman and Glazewski (1949), this species presents a large to very large size (> 1 mm). In our material, a very rich assemblage made it possible to follow the progressive development of the test from small specimens (0.40 mm length) to the largest ones (over 1.10 mm length). The small specimens are similar to *Verneuilina subminuta* Gorbatchik, 1971. It is possible that Gorbatchik's species from the Berriasian of the Crimea represents a junior synonym of *V. polonicus*.
Measurements (mm): Length – 0.60-1.08; breadth 0.40-0.48.
Occurrence: Cernavoda Pod, right bank of the Danube River.
Stratigraphic distribution: Lower Valanginian.
Deposition of types: Hipotype = L.P.B.IV.11.141.

Verneuilinoides danubiensis n.sp.
Fig. 5 (21–26)

Etymology: This form is named from the latin name of the Danube River = *Danubius-i.*
Type-locality: Cernavoda Pod, right bank of the Danube River, Ilie Barza's quarry.
Type-level: ISPH drillings FD VIII – 68.10 m; uppermost Berriasian to lower Valanginian.
Diagnosis: Test free, finely agglutinated, smooth, triserial with globular chambers increasing rapidly in dimensions. The last three chambers are strongly inflated. Sutures weakly oblique and deeply depressed. Apertural face low, with a crescentic shape, with an interiomarginal aperture present as a low slit with a thick lip.
Remarks: This species differs from *V. polonicus* (small specimens) and *V. faraonica* by its smooth agglutinated test and the globular shape of the chambers.
Measurements (mm): Holotype length – 0.68, breadth – 0.49. Paratypes length – 0.42-0.68; breadth – 0.34-0.49 (figured specimens).
Stratigraphic distribution: Uppermost Berriasian to lower Valanginian.
Deposition of types: Holotype = L.P.B.IV.11.142. Paratypes = L.P.B.IV.11.143-11.145.

Verneuilinoides fastigatus Magniez-Jannin, 1973
Fig. 5 (27–35)

1973. *Verneuilinoides fastigatus* Magniez-Jannin: Magniez-Jannin, p. 23, pl. 3, figs.1-8.

Remarks: This species differs from *V. danubiensis* by its gracile-elongate test and its interiomarginal-arcuate aperture. It differs from *V. schizea* (Cushman & Alexander) by the shape and position of the apertural face, and by the form of the aperture.
Measurements (mm): Length – 0.48-0.96; breadth – 0.24-0.39 (figured specimens).
Occurrence: Ostrov-Gârlitza, southern bank of Lake Bugeac, Oltina ISPH drillings Bala I – 36 m.
Stratigraphic distribution: Upper Barremian to lower Aptian.
Deposition of types: Hipotypes = L.P.B.IV.11.146-11.148.

Verneuilinoides pumilionis n.sp.
Fig. 5 (9–20)

Etymology: This form is named from the reduced dimensions of the test; latin *pumilio-oni* = dwarf (regarding plants and animals).
Type-locality: Ostrov-Gârlitza, southern bank of Lake Bugeac.
Type-level: Fetesti ISPH Drilling F. 135, 138 m; upper Barremian to lower Aptian.
Diagnosis: Small sized triserial test (rarely more than 0.5 mm length); globulose chambers with straight and depressed sutures. Wall medium agglutinated with a large quantity of calcareous cement. Test with a rough aspect. Aperture interiomarginal, virgulate with a fine lip. In robust specimens the test can take a twisted shape.
Remarks: By the small size and the globulose shape of the chambers and the virgulate aperture, this species differs from *V. fastigatus* to which it is frequently associated.
Measurements (mm): Holotype length – 0.51; breadth – 0.25. Paratypes length – 0.34-0.51; breadth 0.22-0.29 (figured specimens).
Stratigraphic distribution: Upper Barremian to lower Aptian.
Deposition of types: Holotype = L.P.B.IV.11.149. Paratypes = L.P.B.IV.11.150-11.151.

Subfamily VERNEUILININAE Cushman, 1911

Genus *Gaudryina* d'Orbigny, 1839

Gaudryina cf. *ectypa* Arnaud-Vanneau, 1980
Fig. 6 (45–48)

Diagnosis: Test very large (up to 1,68 mm length). Early triserial stage not tricarinate, with globulose chambers representing up to half of the total length; terminal stage biserial also with globulose chambers. Sutures straight, depressed. Wall coarsely agglutinated with calcareous cement. Aperture interiomarginal, textularoid with a large valvular tooth.
Remarks: Our material differs from *G. ectypa* Arnaud-Vanneau, 1980 by its early triserial rounded stage (*Verneuilinoides* shape) and by the presence of a valvular apertural tooth.
Measurements (mm): Length 1.65-1.68; thickness 0.72 (figured specimens).
Occurrence: Ostrov-Gârlitza, southern bank of Lake Bugeac.
Stratigraphic distribution: Upper Barremian

Deposition of types: Hipotype = L.P.B.IV.11.160.

Gaudryina dacica Neagu, 1975
Fig. 1 (42–53)

1975. *Gaudryina dacica* Neagu: Neagu, p. 33, pl. 26, figs. 21-28; pl. 27, figs. 1-9; pl. 28, figs. 1-15; pl.29, figs. 1-2.

Measurements (mm): Length – 0.26-0.60; breadth – 0.25-0.43.
Occurrence: Fetesti, ISPH drillings F 135-138 m.
Stratigraphic distribution: Lower Aptian.
Deposition of types: Hipotype = L.P.B.IV.11.

Genus *Verneuilina* d'Orbigny, 1839

Verneuilina angularis Gorbatchik, 1971
Fig. 2 (1–3)

1971. *Verneuilina angularis* Gorbatchik: Gorbatchik, p. 131, pl. 2, fig. 6.
1975. *Verneuilina angularis* Gorbatchik: Neagu, p. 31, pl. 25, figs. 14-15.

Remarks: This species differs from *V. dobrogiaca* by the truncate, carinate shape of the chambers in the last stage.
Measurements (mm): Length – 0.55-0.86; breadth – 0.34-0.43 (figured specimens).
Occurrence: Alimanu, left bank of Lake Vederoasa, Cernavoda Pod, right bank of the Danube River, Ilie Barza's quarry.
Stratigraphic distribution: Lower Valanginian.
Deposition of types: Hipotypes = L.P.B.IV.11.154-11.156.

Verneuilina dobrogiaca n.sp.
Fig. 3 (26–42), Fig. 5 (1–8)

Etymology: from Dobrogea, the historical name of the territory between the Black Sea and the Danube River.
Type-locality: Ostrov-Gârlitza, southern bank of Lake Bugeac; Cernavoda Pod, right bank of the Danube River.
Type-level: Oltina ISPH Drilling Bala I – 36 m; Fetesti ISPH Drilling F. 135, 138 m; upper Barremian.
Diagnosis: Test ordinarily small sized, rarely exceeding 0.8 mm in length, triserial, tricarinate in the early stage with acute keels, becomes later weakly rounded, with the last 2–3 chambers weakly inflated with straight depressed sutures. Wall medium agglutinated with calcareous cement. Interiomarginal aperture, as a virgulate slit.
Remarks: This species differ from *V. angularis* Gorbatchik, 1971 by its small size and the absence of the truncate carinated last chambers.
Measurements (mm): Holotype length – 0.54; breadth – 0.34. Paratypes length – 0.34-0.84; breadth – 0.27-0.46 (figured specimens).
Stratigraphic distribution: Lower Valanginian, Barremian to lower Aptian.
Deposition of types: Holotype = L.P.B.IV.11.157. Paratypes = L.P.B.IV.11.156-11.158, 11.159.

Superfamily ATAXOPHRAGMIACEA Schwager, 1877
Family ATAXOPHRAGMIIDAE Schwager, 1877
Subfamily ATAXOPHRAGMIINAE Schwager, 1877
Genus *Arenobulimina* Cushman, 1927

Arenobulimina venusta n.sp.
Fig. 3 (1–15)

Etymology: This form is named from the general shape of the test; latin *venustus-a-um* = elegant.
Type-locality: Cernavoda Pod, right bank of the Danube River.
Type-level: Lower Valanginian.
Diagnosis: Small sized test, typical trochospiral with 4–6 chambers per whorl. Chambers of the last part globulous with falcate-depressed sutures. Wall compact, finely agglutinated, smooth with calcareous cement; the virgulate aperture may or may not have a small valvular tooth and a peripheral lip.
Measurements (mm): Holotype length – 0.46; thickness – 0.29. Paratypes length – 0.29-0.46; thickness – 0.31-0.58 (figured specimens).
Stratigraphic distribution: Uppermost Berriasian to lower Valanginian.
Deposition of types: Holotype = L.P.B.IV.11.161. Paratype = L.P.B.IV.11.162.

Arenobulimina melitaeformis n.sp.
Fig. 3 (16–25)

Etymology: This form is named from the resemblance of the test with that of *Arenobulimina melitae* Kovatcheva, 1969.
Type-locality: Cernavoda Pod, right bank of the Danube River.
Type-level: Lower Valanginian.
Diagnosis: Medium-sized trochospiral test with a low whorl; 4–5 globulose chambers in the last whorl increasing rapidly in size, sutures arcuate, deeply depresed. Wall finely agglutinated with calcareous cement. Aperture interiomarginal, a large virgulate slit in the middle of the apertural face of the last chamber.
Remarks: This species differs from *A. melitae* Kovatcheva, 1969 from the Barremian–Aptian by the shape of test and the aperture position.
Measurements (mm): Holotype length – 0.46; thickness – 0.50. Paratypes length – 0.36-0.53; thickness 0.36-0.53 (figured specimens).
Stratigraphic distribution: Lower Valanginian.
Deposition of types: Holotype = L.P.B.IV.11.163. Paratypes = L.P.B.IV.11.164.

Arenobulimina melitae Kovatcheva 1969
Fig. 2 (52–55)

1969. *Arenobulimina melitae* Kovatcheva: Kovatcheva, p. 37, pl. 1, figs. 1-3.
1971. *Arenobulimina melitae* Kovatcheva: Bartenstein, Bettenstaedt & Kovatcheva, p. 133, pl. 1, figs. 9-11.
1975. *Eggerellina melitae* (Kovatcheva): Neagu, p. 41, pl. 23, figs. 1-24; pl. 24, figs. 1-37.

Measurements (mm): Diameter – 0.36-0.43; height – 0.24-0.36.
Occurrence: Ostrov-Gârlitza, southern bank of Lake Bugeac, Fetesti, ISPH drillings F. 135, 138 m.
Stratigraphic distribution: Upper Barremian to lower Aptian.
Deposition of types: Hipotype = L.P.B.IV.11.188.

Arenobulimina cochleata Arnaud-Vanneau, 1980
Fig. 1 (54–56), Fig. 4 (34–44), Fig. 7 (43–52)

1980. *Arenobulimina cochleata* Arnaud-Vanneau: Arnaud-Vanneau, p. 446, pl. 53, figs. 4-10; pl. 81, figs. 9-21, text-figs. 166-167.

Measurements (mm): Length – 0.46-0.67; thickness – 0.48-0.58 (figured specimens).
Occurrence: Alimanu quarry, Alimanu-Adanceata.
Stratigraphic distribution: Lower Barremian to Aptian.
Deposition of types: Hipotype = L.P.B.IV.11.170.

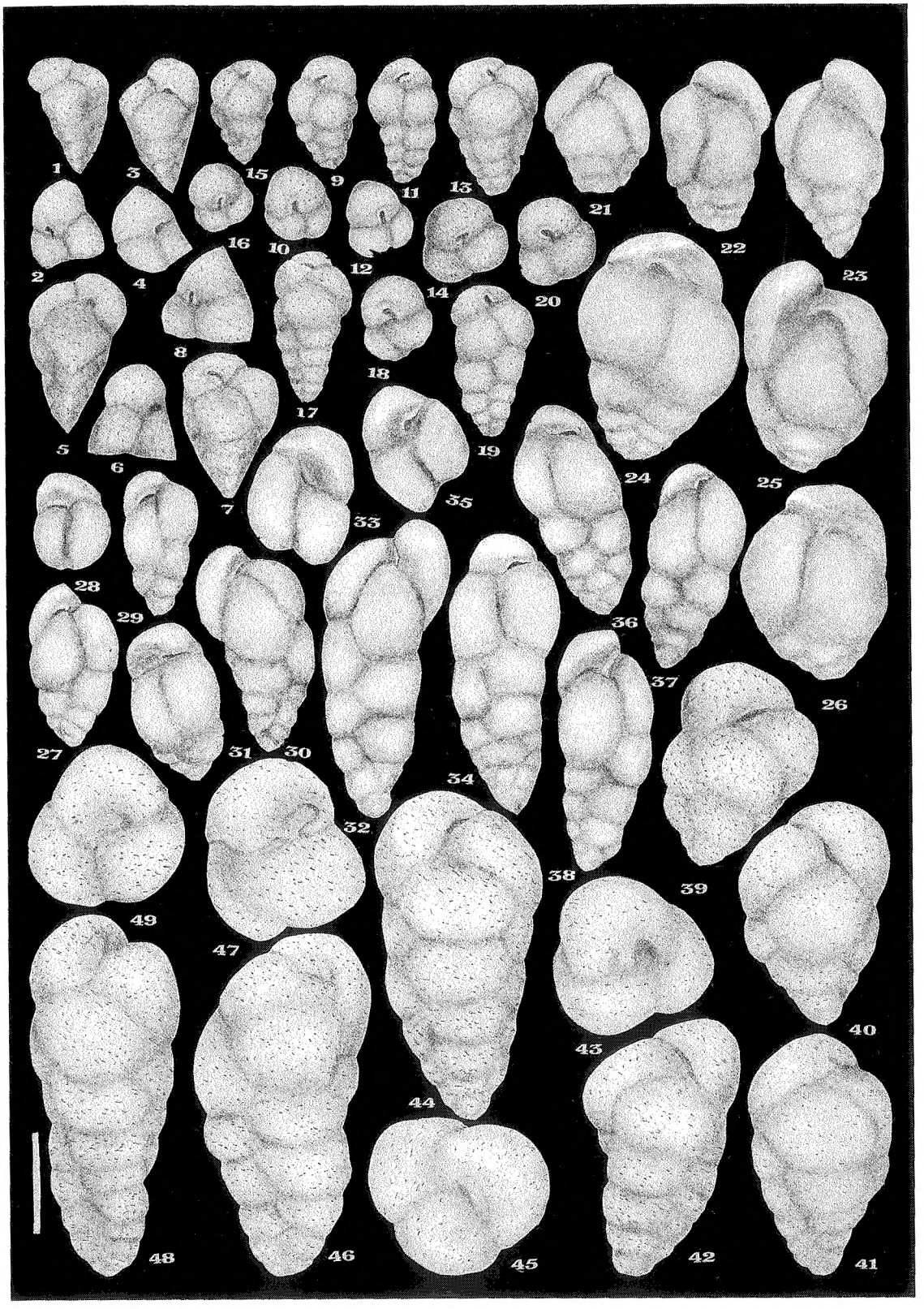

Fig. 5. Lower Cretaceous agglutinated foraminifera from southern Dobrogea. **1-8** – *Verneuilina dobrogiaca* Neagu n.sp.: (1-6) paratypes, L.P.B.IV.11.158; (7-8) holotype, L.P.B.IV.11.157; upper Barremian, Ostrov-Gârlitza, southern bank of the Lake Bugeac. **9-20** – *Verneuilinoides pumilionis* Neagu n.sp: (9-18) paratypes, L.P.B.IV.11.150; (19-20) holotype, L.P.B..IV.11.149; upper Barremian, Ostrov-Gârlitza, southern bank of the Lake Bugeac. **21-26** – *Verneuilinoides danubiensis* Neagu n.sp.: (21-23, 25-26) paratypes, L.P.B.IV.11.143; (24) holotype, L.P.B.IV.11.142; upper Barremian, Ostrov-Gârlitza, southern bank of the Lake Bugeac. **27-38** – *Verneuilinoides fastigatus* Magniez-Jannin, 1973, hipotypes, L.P.B.IV.11.146-11.147; upper Barremian, Ostrov-Gârlitza, southern bank of the Lake Bugeac. **39-49** – *Verneuilinoides polonicus* (Cushman & Glazewski, 1949), hipotypes L.P.B.IV.11.141; lower Valanginian, Cernavoda Pod, right bank of the Danube River. Scale bar = 300 μm

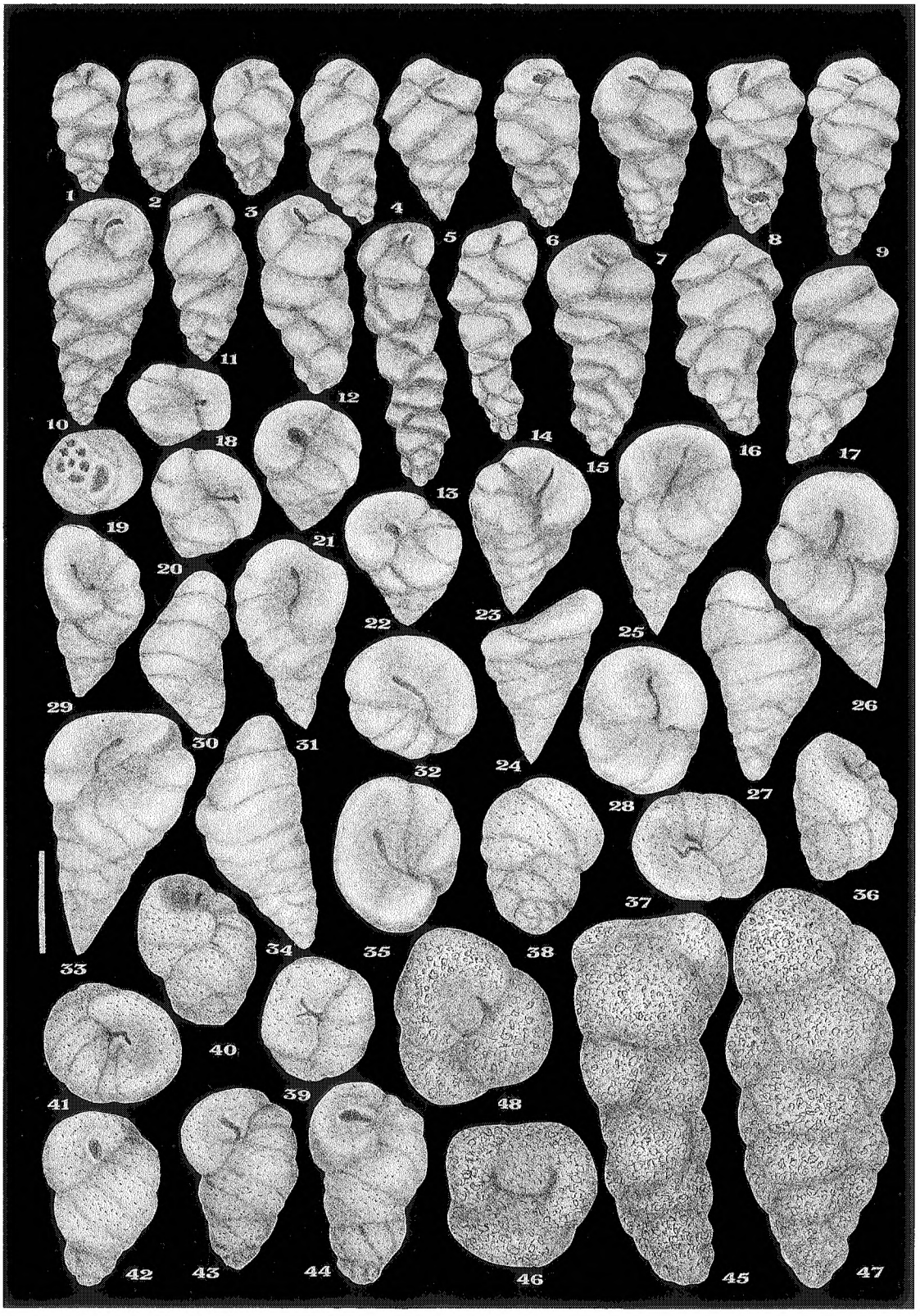

Fig. 6. Lower Cretaceous agglutinated foraminifera from southern Dobrogea. **1-17** – *Arenobulimina corrugata* Neagu n.sp.: (1-9, 11-15) paratypes, L.P.B.IV.11.173, upper Barremian, Ostrov-Gârlitza, southern bank of the Lake Bugeac; (10) holotype, L.P.B.IV.11.174, upper Barremian, Ostrov-Gârlitza, southern bank of the Lake Bugeac; (1-17) paratypes, L.P.B.IV.11.173, lower Aptian, Oltina, ISPH Drilling Bala I, 32-32.1 m. **18-35** – *Arenobulimina cucullaeformis* Neagu n.sp.: (18-32) paratypes, L.P.B.IV.11.168; (33-35) holotype, L.P.B.IV.11.168; upper Barremian, Ostrov-Gârlitza, southern bank of the Lake Bugeac. **36-44** – *Arenobulimina pfenderinae* Neagu n.sp., paratypes, L.P.B.IV.11. 166; lower Aptian, Oltina, ISPH Drilling Bala I, 36 m. **45-48** – *Gaudryina* cf. *ectypa* Arnaud-Vanneau, 1980, hipotypes L.P.B.IV.11.160; upper Barremian, Ostrov-Gârlitza, southern bank of the Lake Bugeac. Scale bar = 300 μm

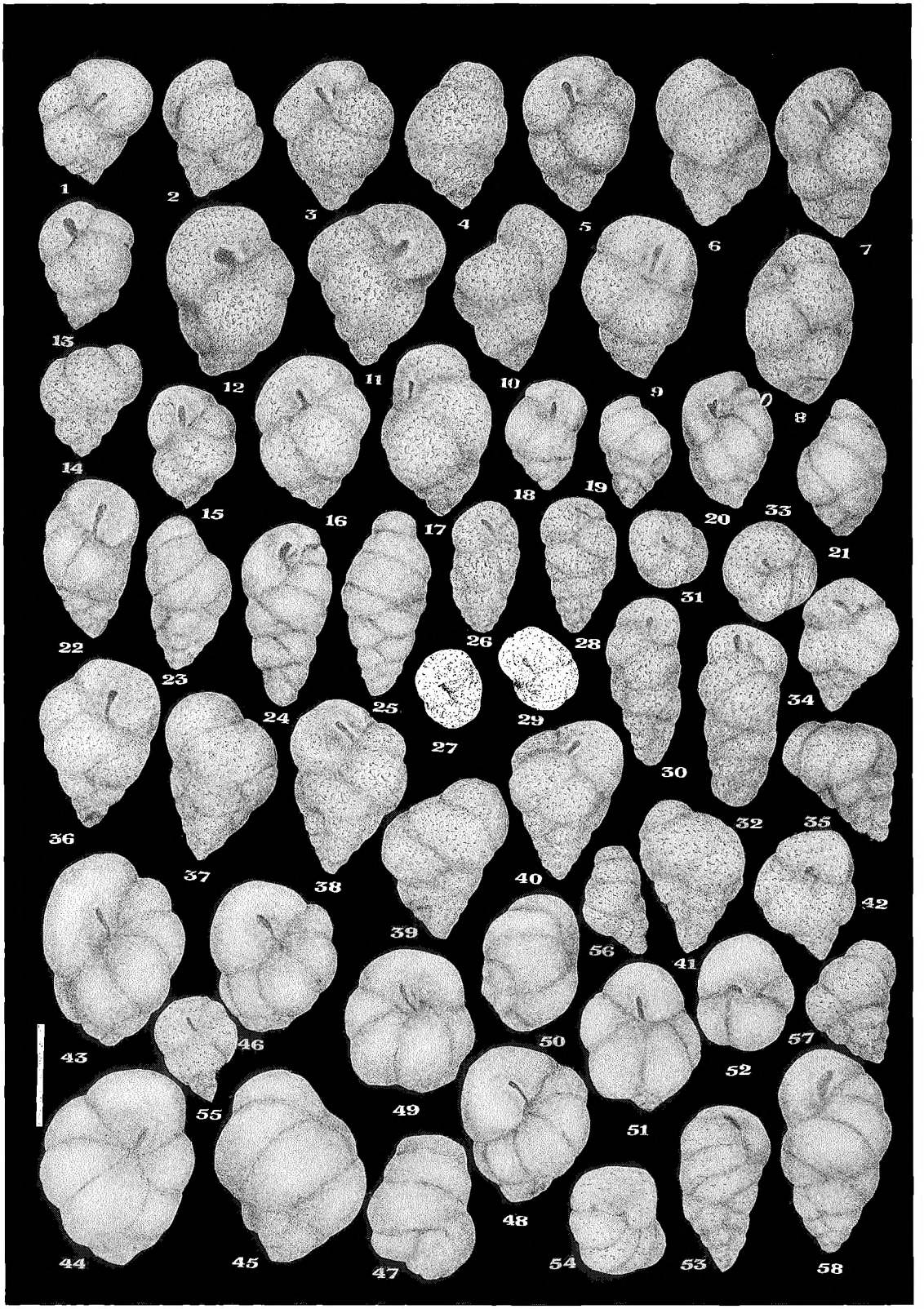

Fig. 7. Lower Cretaceous agglutinated foraminifera from southern Dobrogea. **1-17** – *Arenobulimina acervata* Neagu n.sp., paratypes, L.P.B.IV.11.180; lower Aptian, Oltina, ISPH Drilling Bala I, 36 m. **18-25** – *Arenobulimina* sp. cf. *A. acervata* Neagu n.sp., L.P.B.IV.11.180; lower Aptian, Oltina ISPH Drilling Bala I, 36 m. **26-33** *Arenobulimina dissoluta* Neagu n.sp., paratypes, L.P.B.IV.11.176; lower Aptian, Oltina, ISPH Drilling Bala I, 36 m. **34-42, 55-57** – *Arenobulimina moesiana* Neagu n.sp.; (34-37, 40-42, 55-57) paratypes, L.P.B.IV.11.187; (38, 39) holotype, L.P.B.IV.11.186; lower Aptian, Oltina, ISPH Drilling Bala I, 36 m. **43-52** – *Arenobulimina cochleata* Arnaud-Vanneau, 1980, hipotypes L.P.B.IV.11.170; lower Aptian, Alimanu-Adâncata. **53, 54** – *Arenobulimina gibberosa* Neagu n.sp., paratypes, L.P.B.IV.11.183; lower Aptian, Oltina ISPH Drilling Bala I, 36 m. **58** – *Arenobulimina* sp.; lower Aptian, Oltina, ISPH Drilling Bala I, 32.1 m. Scale bar = 300 μm

Fig. 8. Lower Cretaceous agglutinated foraminifera from southern Dobrogea. **1-14** – *Arenobulimina gibberosa* Neagu n.sp., paratypes, L.P.B.IV.11.184; upper Barremian, Ostrov-Gârlitza, southern bank of the Lake Bugeac. **15-51** – *Arenobulimina dissoluta* Neagu n.sp.: (15-45, 49-51) paratypes, L.P.B.IV.11.175; (46-48) holotype, L.P.B.IV.11.175; lower Aptian, Oltina, ISPH Drilling Bala I, 36 m. **52-57** – *Arenobulimina gibberosa* Neagu n.sp., paratypes, L.P.B.IV.11.183; lower Aptian, Oltina, ISPH Drilling Bala I, 36 m. Scale bar = 300 μm

Arenobulimina corniculum Arnaud-Vanneau, 1980
Fig. 2 (56–58), Fig. 4 (20–26)

1980. *Arenobulimina corniculum* Arnaud-Vanneau: Arnaud-Vanneau, p. 441, pl. 53, figs. 1-3; pl. 81, figs. 1-8, text-figs. 164-165.

Measurements (mm): Length – 0.48-0.77; thickness – 0.34-0.46 (figured specimens).
Occurrence: Alimanu – quarry, Alimanu-Adancata.
Stratigraphic distribution: Lower Barremian to lower Aptian.
Deposition of types: Hipotype = L.P.B.IV.11.185.

Arenobulimina pfenderinae n.sp.
Fig. 2 (14–26), Fig. 6 (36–44)

Etymology: This form is named from the resemblance of the test to that of *Pfenderina globosa* Foury, 1964.
Type-locality: Ostrov-Gârlitza, southern bank of Lake Bugeac.
Type-level: Oltina, ISPH Drilling Bala I – 32.10-36 m; upper Barremian to lower Aptian.
Diagnosis: Test trochospiral, globulose with 4–5 crescentic chambers in the last whorl (with breadth smaller than length). Sutures arcuate weakly depressed. Apertural face truncate and weakly concave, in the middle position. Aperture is a simple virgulate slit, rarely with an "Y"- shape tooth. The globulose spheroidal test can rarely become elongate. Wall finely agglutinated with calcareous cement.
Remarks: This species is characterised by the pfenderiniform shape of its test.
Measurements (mm): Holotype length – 0.46; thicknes – 0.34. Paratypes length – 0.36-0.67; thickness 0.29-0.39 (figured specimens).
Stratigraphic distribution: Upper Barremian to lower Aptian.
Deposition of types: Holotype = L.P.B.IN.11.165. Paratypes = L.P.B.IV.11.166-11.167.

Arenobulimina cucullaeformis n.sp.
Fig. 6 (18–35)

Etymology: This form is named from its hood shaped test; latin *cuculus-i* = hood, and *forma-ae* = form, shape.
Type-level: Upper Barremian.
Type-locality: Ostrov-Gârlitza, southern bank of Lake Bugeac.
Diagnosis: Conical tapering test (as a hood shape), trochospiral with 4–5 chambers in the last whorl; chambers are narrow with a falcate-arculate, weakly depressed sutures. The patelliform (form of a flattened cone) apertural face and concave, supports in a median position, the large virgulate slit-aperture with a thin lip. Test surface is smooth; wall finely agglutinated with calcareous cement.
Measurements (mm): Holotype length – 0.74; thickness – 0.46. Paratypes length – 0.21-0.67; thickness 0.29-0.36 (figured specimens).
Stratigraphic distribution: Upper Barremian.
Deposition of types: Holotype = L.P.B.IV.11,168. Paratype = L.P.B.IV.11.169.

Arenobulimina corrugata n.sp.
Fig. 6 (1–17)

Etymology: This form is named from the shape of the chambers; latin *corrugo-are* = to wrinkle.
Type-locality: Ostrov-Gârlitza, southern bank of Lake Bugeac.
Type-level: Oltina ISPH Drilling Bala I – 32,10-36 m; Fetesti ISPH Drilling F. 135,138 m; upper Barremian.
Diagnosis: Test elongate, gracile, and trochospirally coiled comprised of 4–7 whorls with globulose-truncate chambers, three per whorl. Sutures arcuate-depressed, marked by the keel formed by the truncated chambers. Apertural face concave, supports, in median position, a virgulate slit aperture with a thin lip. Test smooth, finely agglutinated, with calcareous cement.
Remarks: This species is distinguished by the truncate-carinate aspect of its chambers.
Measurements (mm): Holotype length – 0.72; thickness – 0.34. Paratypes length – 0.40-0.72, thickness – 0.21-0.36 (figured specimens).
Stratigraphic distribution: Upper Barremian to lower Aptian.
Deposition of types: Holotype = L.P.B.IV.11.171. Paratypes = L.P.B.IV.11.172-11.174.

Arenobulimina dissoluta n.sp.
Fig. 2 (4–13), Fig. 8 (15–51)

Etymology: This form is named from the uncoiled shape of the last part of the test; latin *dissolutus-a-um* = unwound.
Type-locality: Ostrov-Gârlitza southern bank of Lake Bugeac.
Type-level: Oltina ISPH Drilling Bala I – 32,10-36 m; Fetesti ISPH Drilling F. 135, 138 m, Alimanu-Adâncata; upper Barremian to lower Aptian.
Diagnosis: Test elongate with a gracile aspect, trochospiral (narrower than broad) with 3–6 chambers per whorl. Chambers in the early stage weakly globular with arcuate depressed sutures, with a tendency to become uncoiled in the terminal stage, 2 or 2½ chambers in the last whorls. Apertural face truncate and concave, supports in median position, the aperture, a simple virgulate slit sometime with an "Y" shape; wall medium agglutinated with calcareous cement.
Remarks: This species is well defined by the tendency of the last two whorls to uncoil.
Measurements (mm): Holotype length – 0.84; thickness – 0.40. Paratypes length – 0.26-0.67; thickness – 0.24-0.36 (figured specimens).
Stratigraphic distribution: Upper Barremian to lower Aptian.
Deposition of types: Holotype = L.P.B.IV.11.175. Paratypes = L.P.B.IV.11.176-11.178.

Arenobulimina acervata n.sp.
Fig. 2 (27–34), Fig. 7 (1–17)

Etymology: This form is named from the shape of the chambers disposition; latin *acervatus-a-um* participle of the verb *acervo-are* = to pile up, to assemble, to gather.
Type-locality: Ostrov-Gârlitza, southern bank of Lake Bugeac.
Type-level: Oltina ISPH Drilling Bala I – 32.10-36 m; lower Aptian.
Diagnosis: Small conical-trochospiral test with a tapering shape of the early stage; 3–4 globulose chambers in the last whorl. Sutures arcuate, depressed. Wall finely to moderately agglutinated, with calcareous cement. Aperture a virgulate slit with a weak lip.
Remarks: This species differs from *A. moesiana* n.sp. by its globular chambers of the last whorl.
Measurements (mm): Holotype length – 0.40; thickness – 0.29. Paratypes length – 0.29-0.53; thickness 0.24-0.40.
Stratigraphic distribution: Upper Barremian to lower Aptian.
Deposition of types: Holotype = L.P.B.IV.11.179. Paratypes = L.P.B.IV.11.180-11.181.

Arenobulimina gibberosa n.sp.
Fig. 4 (27–31), Fig. 7 (53–54), Fig. 8 (1–14)

Etymology: This form is named from the general shape of the test; latin *gibberosus-a-um* = humped.

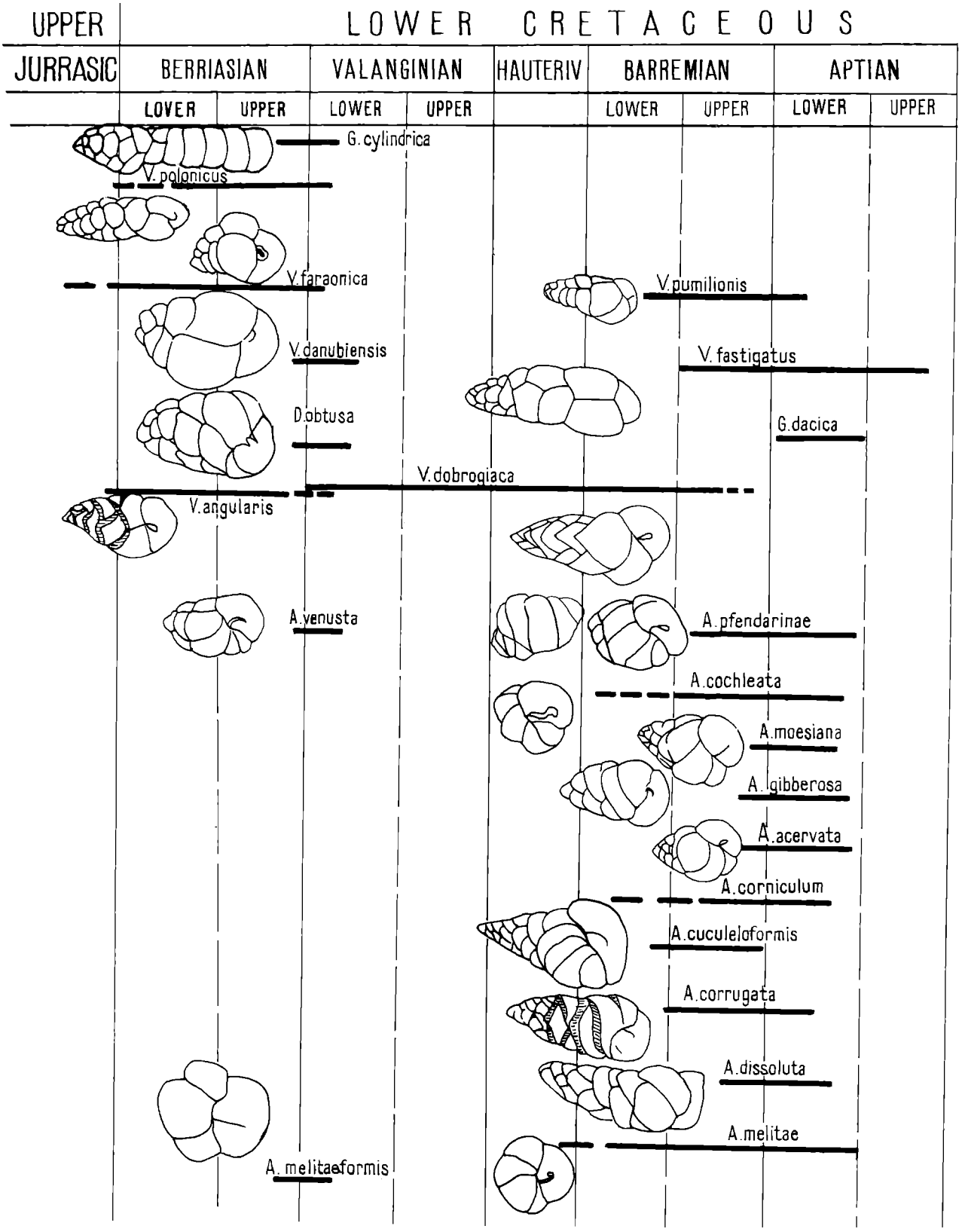

Fig. 9. Stratigraphic distribution of agglutinated foraminifera from the Superfamilies Verneuilinacea and Ataxophragmiacea; southern Dobrogea, Romania

Type-locality: Ostrov-Gârlitza, southern bank of Lake Bugeac.
Type-level: Oltina ISPH Drillings Bala I – 10-36 m; lower Aptian.
Diagnosis: Test small to moderate size (0.30–0.60 mm in length) humped shaped in the last stage, trochospiral with blunt shape of the early stage; 3–4 chambers in the last whorl. Chambers weakly to moderately inflated. Sutures arcuate-falcate weakly depressed. Wall moderately agglutinated, compact, with calcareous cement. Aperture a large interiomarginal slit with a thin lip on the concave

apertural face.

Remarks: This species differs from *A. moesiana* by the blunt shape of its early stage; from *A. corniculum* Arnaud-Vanneau, 1980 by the generally smaller size and the arrangement of chambers in the last two whorls.

Measurements (mm): Holotype length – 0.48, thickness – 0.34. Paratypes length – 0.36-0.53, thickness – 0.29-0.40 (figured specimens).

Stratigraphic distribution: Upper Barremian to lower Aptian.

Deposition of types: Holotype = L.P.B.IV.11.182. Paratypes = L.P.B.IV.11.183-11.184.

Arenobulimina moesiana n.sp.
Fig. 7 (34–42, 55–57)

Etymology: This form is named from the latin name of present-day Dobrogea = *Moesia-ae*.

Type-locality: Ostrov-Gârlitza, southern bank of Lake Bugeac.

Type-level: Oltina, ISPH Drilling Bala I – 32.10-36 m; lower Aptian.

Diagnosis: Test small, trochospiral (smaller than 0.5 mm length) with a conical shape (with a tapered early stage); 3–4 globulose chambers on the last two whorls. Sutures arcuate depressed. Planoconcave apertural face support the aperture, which is a slit with a thin lip. Wall moderately to finely agglutinated with calcareous cement.

Remarks: This species differs from *A. gibberosa* by the tapered-conical shape of its early stage.

Measurements (mm): Holotype length – 0.50; thickness – 0.39. Paratypes length – 0.31-0.46; thickness – 0.24-0.36.

Stratigraphic distribution: Upper Barremian to lower Aptian.

Deposition of types: Holotype = L.P.B.IV.11.186. Paratypes = L.P.B.IV.11.187.

PALAEOECOLOGICAL AND PALAEOGEOGRAPHICAL CONSIDERATIONS

By considering the areal distribution of the studied taxa and their structure, it is possible to carry out some palaeoecological and geographical interpretations. The genus *Verneuilinoides* includes species described from the Upper Jurassic that extend, with a constant frequency, into the Lower Cretaceous, both in the Tethyan and Boreal realms. *Verneuilinoides neocomiensis* Mjatliuk, 1939 with a coarsely agglutinated test and moderate size is frequent in the Boreal facies (of northern Germany, Poland and Russia). With the same morphological features of the test, this taxon is also present in the Lower Cretaceous flysch deposits of the Carpathians (Poland, the Ukraine and Romania). Other species of *Verneuilinoides* (*V. polonicus*) that posseses a finely and smooth agglutinated test and large dimensions develop together with the previous *V. neocomiensis* group during the Late Berrasian–Valanginian in the Tethyan realm and their morphostuctural character was preserved until the early Aptian. It is possible to draw the conclusion that environmental conditions had a decisive influence on the morphostructural characteristics of the test. Species from the Boreal realm, living in cold water basins with coarse sediments made an adequate test structure, while those from the inner carbonate platform sedimentary facies of the Tethyan area (with a reduced amount of clastics) made a fine, smooth agglutinated test. This explains the absence of the contemporaneous species *V. neocomiensis* in the assemblages in southern Dobrogea.

The genus *Arenobulimina*, with its large specific and subgeneric variability, was also described from the Albian and Upper Cretaceous deposits of the Anglo-Parisian Basin. Up to now, this genus is known to have only three species in deposits older than Albian (i.e. Barremian and Aptian) in the carbonatic platforms of France and Bulgaria. In southern Dobrogea *Arenobulimina*, is present in sediments as old as late Berriasian (Fig. 9), with scarce populations, and is represented by two species. In the Barremian to Aptian one can notice a spectacular development of this genus, represented by ten species with large populations. The Lower Cretaceous assemblage from the southern Dobrogea demonstrates that the provenance of this genus may have been located in the south Tethyan area from where it probably migrated northwards during the Albian. In the case of this genus also, the correlation between the morphostructural characteristics and the environmental conditions clearly appear. Different populations of this genus have, as constant feature, a smooth and finely agglutinated test structure since the beginning of the late Berriasian. The upper Barremian to lower Aptian populations with smooth and finely agglutinated tests appear, together with ones having a medium to roughly agglutinated wall structure. These features later characterise the Albian–Upper Cretaceous species as well.

In both cases it is possible to reach a general conclusion. The intimate correlation between the test morphology, the nature of the bottom sediment, and the water temperature are decisive factors. The Boreal facies are characterised by coarsely agglutinated tests, while synchronous tests from the Tethyan realm have finely, smooth to moderately agglutinated ones. The strong influence of limiting environmental factors on the agglutinated foraminifera is once more demonstrated.

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Streszczenie

DOLNOKREDOWE OTWORNICE AGLUTYNUJĄCE Z NADRODZINY VERNEUILINACEA I ATAXOPHRAGMIACEA; POŁUDNIOWA DOBROGEA, RUMUNIA

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Bogaty zespól makrofauny (Bivalvia, Gastropoda) oraz mikrofauny (Foraminiferida) zawierają osady dolnej kredy w rejonie południowej Dobrogei (Rumunia). Wśród mikrofauny dominują otwornice aglutynujące, których przedstawiciele z nadrodziny Verneuilinacea oraz Ataxophragmiacea są przedmiotem niniejszych badań autora.

Otwornice z nadrodziny Verneuilinacea są znane z osadów jury oraz dolnej kredy, natomiast ataxophragmidy były opisywane z osadów znacznie młodszych (barem–apt: *Arenobulimina melitae, A. corniculum, A. cochleata*; Kovatcheva, 1969, Arnaud-Vanneau, 1980). W osadach południowej Dobrogei występuje zespół starszy od znanych dotychczas otwornic z tej grupy, reprezentujący górny berias–dolny apt.

Autor opisał dziewięć nowych gatunków z rodzaju *Arenobulimina* (Figs. 2–4, 6–8): *Arenobulimina venusta* n.sp., *A. melitaeformis* n.sp., *A. gibberosa* n.sp., *A. pfenderinae* n.sp., *A. moessiana* n.sp., *A. acervata* n.sp., *A. dissoluta* n.sp., *A. corrugata* n.sp., *A. cuculiformis* n.sp. Rodzaj ten pojawia się po raz pierwszy w badanych osadach (Cernavoda Pod) od górnego beriasu (Fig. 9).

Opisano ponadto dwa nowe rodzaje *Danubina* n.gen. i *Gerochella* n.gen., a wśród nich 2 gatunki: *Danubina obtusa* n.sp. (Fig. 2) i *Gerochella cylindrica* (Fig. 1). Rodzaje te włączono do nadrodziny Verneuilinacea.

Dobry stopień zachowania otwornic z tej nadrodziny pozwolił na szczegółową analizę mikropaleontologiczną w obrębie dwóch rodzajów: *Verneuilina* i *Verneuilinoides* (Figs. 2–5). Szczegółowy opis systematyczny kilku gatunków (*Verneuilinoides faraonica, V. polonicus, V. danubiensis* n.sp., *V. pumilionis* n.sp., *V. fastigatus, Verneuilina angularis, V. dobrogiaca* n.sp.) dał podstawę do postawienia wyraźnych granic taksonomicznych po-między tymi rodzajami.

Biorąc pod uwagę rozprzestrzenienie geograficzne opisanych taksonów oraz różnice w ich strukturze wewnętrznej można przeprowadzić pewne interpetacje paleoekologiczne i paleogeograficzne. Rodzaj *Verneuilinoides* został opisany z osadów od górnej jury i był znajdowany licznie w osadach dolnej kredy prowincji tetydzkiej i borealnej. *Verneuilinoides neocomiensis* Mjatliuk, 1939, który posiada skorupkę średnich rozmiarów, aglutynowaną z grubych ziarn jest liczny w osadach prowincji borealnej (północne Niemcy, Polska i Rosja). Takie same cechy morfologiczne skorupki tego taksonu charakteryzują osobniki występujące w osadach Karpat fliszowych (Polska, Ukraina i Rumunia). Inny z gatunków tego rodzaju – *V. polonicus* – który ma skorupkę dużych rozmiarów, aglutynowaną z bardzo drobnych ziaren, współwystę-

pował z opisanym wyżej taksonem w czasie od późnego beriasu do walanżynu w prowincji tetydzkiej, zachowując charakter morfostruktury ścian skorupki do wczesnego aptu. Według autora, warunki środowiska sedymentacji byly główną przyczyną różnic morfostrukturalnych u obu gatunków. Osobniki z prowincji borealnej, żyjące w wodzie chłodnej, w warunkach dostawy gruboklastycznego materiału miały adekwatną do tego strukturę i rozmiary skorupki. Otwornice żyjące w obrębie wewnętrznej części platformy węglanowej prowincji tetydzkiej, w warunkach zredukowanej dostawy materiału klastycznego charakteryzuje bardzo drobnoziarnista struktura ścian skorupki. Te przyczyny mogą tłumaczyć fakt nieobecności gatunku *Verneuilinoides neocomiensis* w osadach w południowej Dobrogei.

W obrębie rodzaju *Arenobulimina* opisano tylko trzy gatunki z osadów starszych od albu (platforma węglanowa z rejonu Francji i Bułgarii). W południowej Dobrogei pojedyncze otwornice tego taksonu występują w osadach już od górnego beriasu, reprezentowane tam przez dwa gatunki. W czasie od baremu do aptu nastąpił rozkwit tej grupy, która występuje tam reprezentowana przez 10 gatunków w bardzo licznych zespołach. Fakt ten wskazuje na to, że migracja otwornic z rodzaju *Arenobulimina* miała miejsce z tego właśnie obszaru w kierunku północnym, od albu.

W obrębie tej grupy otwornic widoczne są również zmiany morfostruktury związane ze zmianami warunków paleośrodowiska. Zmieniała się mianowicie wielkość aglutynowanego ziarna w skorupkach. Najstarsze zespoły (górny berias–hoteryw) charakteryzuje skorupka aglutynowana z bardzo drobnych ziarn. W osadach od górnego baremu do dolnego aptu populacje z rodzaju *Arenobulimina* charakteryzuje podobny typ morfostruktury ścian skorupki. Jednak współwystępują one z osobnikami o skorupkach zbudowanych ze średnich i grubych ziarn. Ten ostatni typ przeważa u gatunków znanych od albu i żyjących w późnej kredzie.