Review article

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Contribution to the European benthic and planktic foraminifera of Anan

Abstract

This study deals with taxonomic consideration of four new genera: *Amphicorynella* Anan[1] and *Marginulinoides* Anan[2] from Romania, *Lenticubella* Anan[3] from Poland, and *Buliminelloides* Anan[4] from Italy. Sixty-one benthic and two planktic foraminiferal species were erected from many European countries in the Northern Tethys: Spain, France, Poland, Germany, Russia, Romania, Hungaria and Italy. The recorded foraminiferal species belong to forty-three genera. Seventeen species are recorded from each of France and Spain (~28%), 12 species from Romania (~19%), 6 species from Hungaria and Italy (~9%), 4 species from Poland (~6%), and only one species from each of Germany and Russia (~1.5%). Twenty-three of the recorded species belong to Suborder Rotaliina, 19 to Lagenina, 18 to Textulariina, 2 to Globigerinina, and one only to Miliolina. Four of the recorded species are believed here to be new: *Marginulinoides romanica, M. hungarica, Hyalinonetrion romanica* and *Bolivina hungarica.* Some of the recorded species present an evolutionary foraminiferal lineage.

Keywords: Benthic and planktic foraminifera, evolutionary lineages, stratigraphy, maastrichtian, paleogene, neogene, Europe, tethys

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Introduction

Sixty-three diagnostic benthic and planktic foraminiferal species were recorded and described from eight European localities in the Northern Tethys: Spain, France, Italy, Germany, Poland, Romania, Hungaria and Russia (Figure 1).

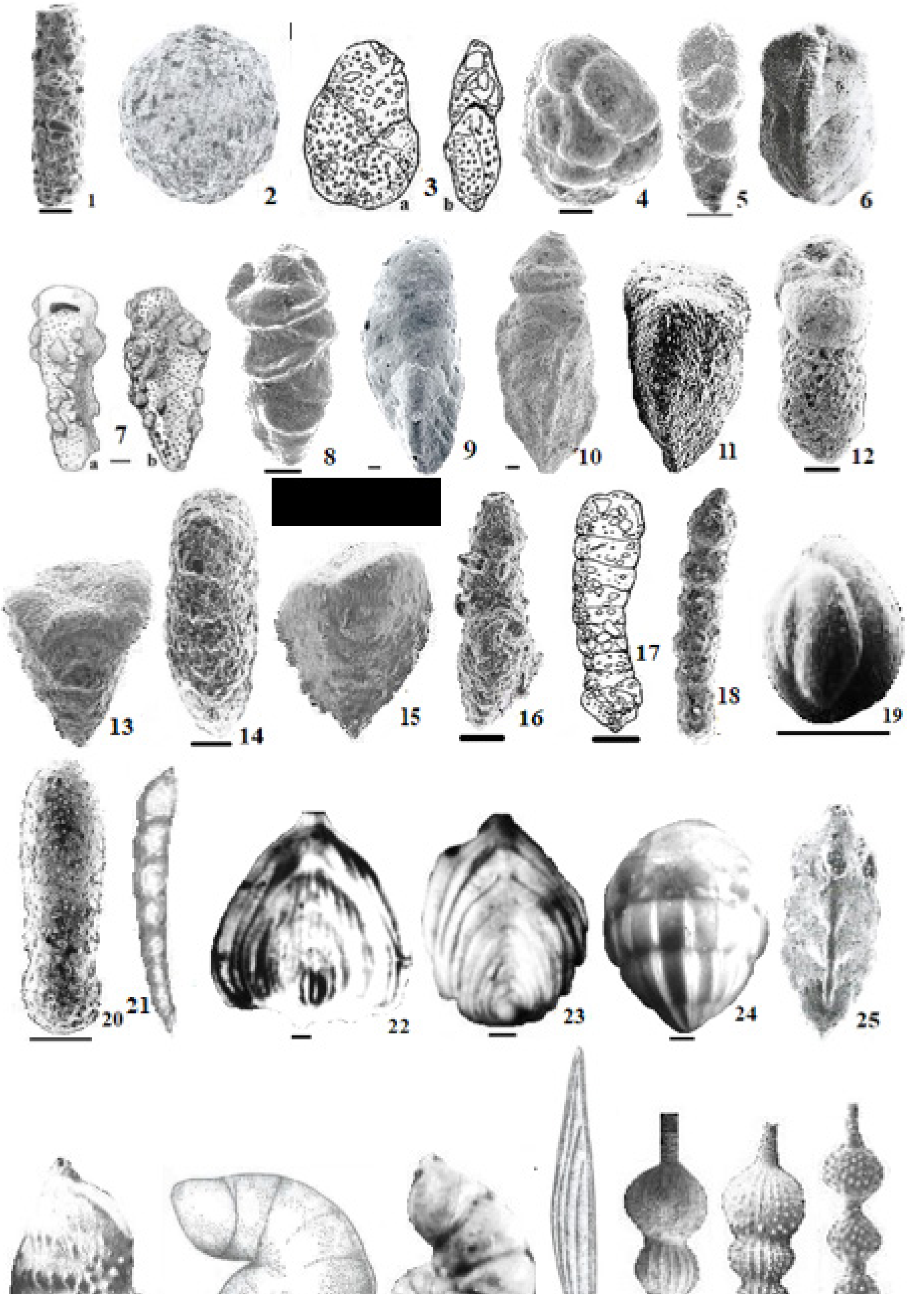
Figure 1 Location map of the study countries in Europe: Spain, France, Italy, Germany, Poland, Hungaria, Romania, and Russia

Systematic paleontology

The taxonomy followed here is that of Loeblich & Tappan,[5] with modern taxonomic consideration, sixty-three benthic and planktic foraminiferal species of the European assemblage are presented and illustrated in Plate 1. Sixty-one of the recorded species are related to benthic agglutinated and calcareous foraminifera, while only 2 species to planktic foraminifera. Nearly half of the were recorded species (34) were erected from Spain and France, followed from Romania with 12 species. One planktic foraminiferal species was erected from each of Italy and Spain.

Figure 2.1. *Bathysiphon alegretae* Anan,[6] 2. *Orbulinelloides sztrakosae* Anan,[7] 3. *Asanospira franciana* Anan,[8] 4. *Paratrochamminoides spainica* Anan,[8] 5. *Parvigenerina bidartensis* Anan,[1] 6. *Tritaxia kaminskii* Anan,[7] 7. *Gaudryina pozaryskai* Anan,[9] 8. *Spiroplectinata italiana* Anan,[2] 9. *Pseudogaudryinella baliniaki* Anan,[10] 10. *P. ortizae* Anan,[10] 11. *Verneuilina hungariana* Anan,[8] 12. *Siphogaudryina ortizae* Anan,[9] 13. *Tritaxilina ozsvárti* Anan,[8] 14. *Dorothia sztrákosae* Anan,[9] 15. *Textularia karimae* Anan,[8] 16. *Pseudoclavulina thomasae* Anan,[9] 17. *Clavulina sztrákosae* Anan,[8] 18. *Cylindroclavulina spainica* Anan,[8] 19. *Quinqueloculina alaghai* Anan,[11] 20. *Chrysalogonium ganensis* Anan,[1] 21. *Laevidentalina*

popescui Anan,[12] 22. *Annulofrondicularia crihanae* Anan,[12] 23. *A. sztrakosae* Anan,[13] 24. *Tollmannia romanica* Anan,[12] 25. *Tristix sztrakosae* Anan,[14] 26. *Percultazonaria romanica* Anan,[12] 27. *Lenticubella polonica* Anan,[12] 28. *L. romanica* Anan,[12] 29. *Citharina polonica* Anan,[14] 30. *Amphicorynella popescui* Anan,[15] 31. *A. romanica* Anan,[15] 32. *A. mazeni* Anan,[15] 33. *A. yassini* Anan,[15] 34. *A. franciaca* Anan,[15] 35. *A. sztrákosae* Anan,[15] 36. *Marginulinoides romanica* Anan, n. sp., 37. *M. hungarica* Anan, n. sp., 38. *Hyalinonetrion romanica* Anan, n. sp., 39. *Bolivina ganensis* Anan,[1] 40. *B. hungarica* Anan, n. sp., 41. *B. kamali* Anan,[2] 42. *B. spainica* Anan,[1] 43. *B. sztrakosae* Anan,[1] 44. *Praeglobobulimina franciana* Anan,[1] 45. *Buliminelloides italica* Anan,[4] 46. *B. spainica* Anan,[16] 47. *Uvigerina ashrafi* Anan,[17] 48. *U. awadhi* Anan,[17] 49. *U. sameri* Anan,[17] 50. *Angulogerina abuzeidi* Anan,[18] 51. *Fursenkoina torrecardelaensis* Anan,[1] 52. *Nodosarella ganensis* Anan,[1] 53. *N. spainica* Anan,[1] 54. *Pleurostomella waeli* Anan,[19] 55. *Siphonodosaria franciana* Anan,[1] 56. *S. molinai* Anan,[1] 57. *S. sztrákosae* Anan,[1] 58. *Siphogenerinoides multiribata* Anan,[1] 59. *S. multiribata* Anan,[1] 60. *Gyroidinoides riverocuestai* Anan,[1] 61. *Asterigerina alegretae* Anan,[1] 62. *Plummerita premolisilvae* Anan & Orabi,[20] 63. *P. spainica* Anan.[21]



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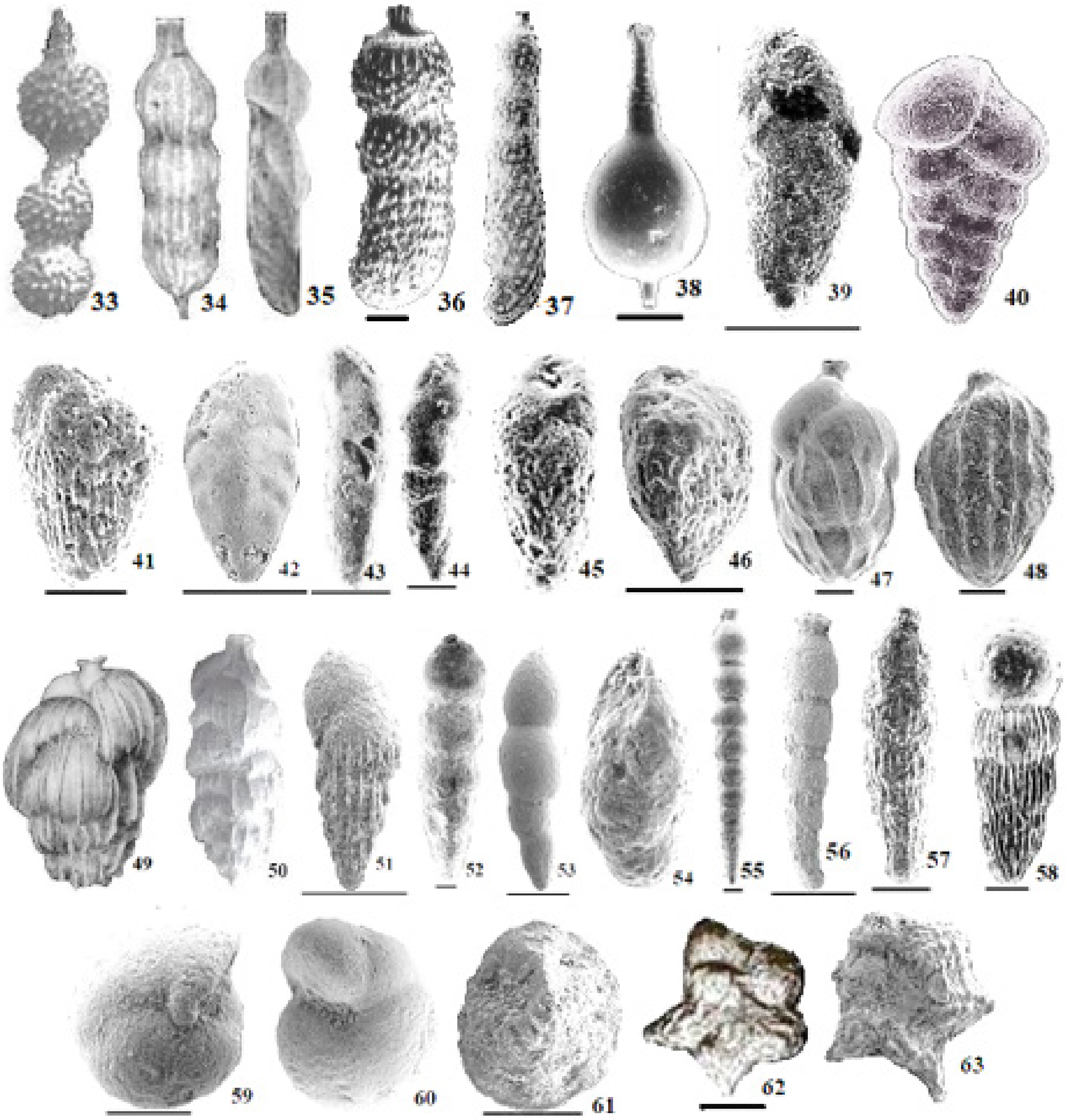

Figure 2 Order Foraminiferida Eichwald, 1830.

Suborder Textulariina Delage & Hérouard, 1896

1) ***Bathysiphon alegretae*** Anan,[6] p. 33, pl. 1, Figure 2.7 (=*Rhabdammina* sp. Ortiz et al,[22] p. 4, pl. 1, Figure 2.19). Lutetian. Spain.

Remarks: The species is regarded here to belong to the genus *Bathysiphon* due to its straight unbranched elongate tube than the restricted Holocene time of the genus *Rhabdammina* Sars, as noted by Loeblich & Tappan.[5] The test has an elongate test, coarsely agglutinated wall, may contain sponge spicules and coarse sand grains with rough exterior. The Early Lutetian *Bathysiphon alegretae* most probably developed to the Bartonian-Priabonian *B. saidi*[23] by its wider test, in the *Bathysiphon alegretae* → *B. saidi* lineage.

2) ***Orbulinelloides sztrakosae*** Anan,[7] p.54, pl. 1, Figure 2.5 (*Psammosphaera* sp. Sztrákos,[24] p. 156, pl. 1, Figure 2.2). Ypresian - Lutetian. France.

Remarks: Loeblich and Tappan[5] treated the genus *Psammosphaera* of as a junior synonym of the Silurian-Permian genus *Thuramminा* of while treated the genus *Psammosphaera* of as a separate genus. The figured form of Sztrákos (from France) treated here to belong to the genus *Orbulinelloides*. It is characterized by its large spherical test, coarsely ill-sorted angular agglutinated wall with organic cement, aperture scattered over the entire surface.

3) ***Asanospira franciana*** Anan,[8] p. 43, pl. 1, Figure 2.21 (=*Ammomarginulina* sp. 1, Sztrákos,[24] p. 76, pl. 1, Figure 2.5). Bartonian. France.

Remarks: It has coarsely agglutinated wall, and slit-like aperture at the base of apertural face.

4) ***Paratrochamminoides spainica,*** Anan,[8] p. 44, pl. 1, Figure 2.24 (=*Paratrochamminoides* sp. Molina et al.,[25] p. 281, pl. 2, Figure 2.23). Priabonian. Spain.

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Remarks: It is distinguished by its enrolled test, streptospirally coiled to a planispiral final whorl.

5) ***Parvigenerina bidartensis*** Anan,[1] p. 2, pl. 1, Figure 2.1 (=*Parvigenerina* sp. 1, Sztrákos,[26] p. 200, pl. 2, Figure 2.2). Danian. France.

Remarks: This species is characterized by its finally agglutinated wall, inflated later loosely biserial chambers, and semiglobular last uniserial chamber.

6) ***Tritaxia kaminskii*** Anan,[7] p. 86, pl. 1, Figure 2.12 (=*Tritaxia* sp. - Kuhnt & Kaminski,[27] p. 78, pl. 7, Figure 2.8). Thanetian-Ypresian. Spain.

Remarks: This species has finely agglutinated smooth test, triangular throughout with distinct angles, aperture rounded, terminal and central in the uniserial stage.

7) ***Gaudryina pozaryskai*** Anan,[9] p. 33, pl. 1, Figure 2.3 (=*Gaudryina* cf. *rugosa rossica* - Pożaryska,[28] p. 53, pl. 1, Figure 2.7). Maastrichtian-Danian. Poland and Russia.

Remarks: This species differs from other species of *Gaudryina* by its coarsely arenaceous wall with big angulate grains protruding irregularly throughout the test. It was recorded from Poland, but the original species was recorded from the Maastrichtian of Russia.

8) ***Spiroplectinata italiana*** Anan,[2] p. 97, pl. 1, Figure 2.1 (=*Plectina* sp. Galazzo et al,[29]), p. 28, pl. 1, Figure 2.2). Lutetian. Italy.

Remarks: This species belongs here to the genus *Spiroplectinata* with triserial early stage, later biserial and finally uniserial, not *Plectina* with trochospiral early stage and biserial final stage.

9) ***Pseudogaudryinella baliniaki*** Anan,[10] p. 93, pl. 6, Figure 2.2 (=*Pseudogaudryinella* sp. 1, Baliniak,[30] p. 382, pl. 1, Figure 2.13). Thanetian-Ypresian. Poland.

Remarks: The early triserial stage occupies one-third up to half of the test and triangular in section, but rounded section in the later biserial and uniserial stages.

10) ***Pseudogaudryinella ortizae*** Anan,[10] p. 94, pl. 6, Figure 2.5 (*Clavulinoides angularis* (d'Orbigny). Ortiz & Thomas,[31] pl. 1, Figure 2.3). Ypresian. Spain.

Remarks: *P. ortizae* Anan differs from *P. baliniaki* Anan by coarser grain-size wall than finely agglutinates wall, discoidal uniserial chamber than rounded shape, terminal on neck aperture than depressed aperture.

11) ***Verneuilina hungariana*** Anan,[8] p. 44, pl. 1, Figure 2.44 (=*Verneuilina* sp., Ozsvárt,[32] p. 34, pl. 1, Figure 2.17). Bartonian-Priabonian. Hungaria.

Remarks: Test elongate coarsely agglutinated triserial, triangular in outline and triangular in cross-section, sutures barely visible. The Maastrichtian-Paleocene *Verneuilina aegyptiaca* Said & Kenawy is considered here as the precursor of the Ypresian *V. luxorensis* (Nakkady) followed by the Bartonian-Priabonian *V. hungariana* Anan, in the *Verneuilina aegyptiaca* >*V. luxorensis* > *V. hungariana* lineage.

12) ***Siphogaudryina ortizae*** Anan,[9] p. 34, pl. 1, Figure 2.8 (=*Gaudryina arenata* (Cushman) - Ortiz & Thomas,[31] p. 107, pl. 1, Figure 2.10a, b). Ypresian. Spain.

Remarks: This species is characterized by elongate coarsely agglutinated test, and aperture a high domed arch at the top of the apertural face.

13) ***Tritaxilina ozsvárti*** Anan,[8] p. 46, pl. 1, Figure 2.73 (=*Tritaxilina* sp. - Ozsvárt,[32] p.40, pl. 3, Figure 2.1). Bartonian-Priabonian. Hungaria.

Remarks: this species has coarsely agglutinated test, and strongly depressed sutures.

14) ***Dorothia sztrákosae* Anan,**[9] p. 34, pl. 1, Figure 2.6 (=? *Arenobulimina* sp. Sztrákos,[26] p. 184, pl. 2, Figure 2.7, pl. 11, Figure 2.30). Selandian. France.

Remarks: The genus *Arenobulimina* has gradually tapering at the base of the test, not nearly parallel sides in the genus *Dorothia.* This species is characterized by elongate coarsely agglutinated test with nearly parallel sides with a circular in section, early stage trochospirally enrolled, then reduced to biserial increasing very slowly in size, aperture an interiomarginal slit of the final chamber face.

15) ***Textularia karimae*** Anan,[8] p. 46, pl. 1, Figure 2.63 (=*Textularia* sp. 3, Ozsvárt,[32] p. 37, pl. 2 Figure 2.13). Bartonian-Priabonian Hungaria.

Remarks: This species is characterized by rapidly flaring biserial chambers towards apertural end, and corrugated periphery.

16) ***Pseudoclavulina thomasae*** Anan,[9] p. 35, pl. 1, Figure 2.9 (=*Pseudoclavulina* sp. A - Ortiz & Thomas,[31] p. 108, pl. 2, Figure 2.1). Ypresian. Spain.

Remarks: It is characterized by rough and coarsely agglutinated test, and long triserial part with indistinct chambers.

17) ***Clavulina sztrákosae*** Anan,[9] p. 35, pl. 1, Figure 2.11 (=*Clavulina parisiensis* d'Orbigny - Sztrákos,[24] p. 78, pl. 2, Figure 2.6). Lutetian. France.

Remarks: This species differs the figured holotype of the species *Clavulina parisiensis* d'Orbigny by its coarsely agglutinated wall and lacks an apertural tooth.

18) ***Cylindroclavulina spainica*** Anan,[9] p. 47, pl. 1, Figure 2.71(=*Pseudoclavulina* sp. B, Molina et al.,[25] p. 281, pl. 2, Figure 2.20). Priabonian. Spain.

Remarks: This species has coarsely agglutinated test, cylindrical short early triserial stage, not triangular cross section than *Pseudoclavulina*.

I. Suborder Miliolina Delage & Hérouard,

19) ***Quinqueloculina alaghai*** Anan,[11] p.169, pl. 1, Figure 2.26 (=*Quinqueloculina* sp. 2, Ozsvárt,[32] p. 42, pl. 3 Figure 2.14). Bartonian-Priabonian. Hungaria.

Remarks: This species is characterized by each chamber is overlapped by subsequent chambers.

II. Suborder Lagenina Delage & Hérouard, 1896

20) ***Chrysalogonium ganensis*** Anan,[1] p. 2, pl. 1, Figure 2.2 (=*Chrysalogonium* sp. 1, Sztrákos,[26] p. 185, pl. 3, Figure 2.8). Selandian-Thanetian. France.

Remarks: It is characterized by its globular early chamber, papillose surface and flush sutures.

21) ***Laevidentalina popescui*** Anan,[12] p. 114, pl. 1, Figure 2.4(=*Laevidentalina* sp. 2 - Popescu & Crihan,[33] p. 398, pl. 4, Figure 2.23). Luisan. Romania.

Remarks: This species has elongated and arcuate smooth test, apiculate globular proloculus, uniserial chambers nearly cylindrical

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smaller than proloculus, chambers gradually increased as added, sutures slightly depressed, aperture terminal radiate. *L. popescui* may be evolved from the M-L Eocene *L. salimi* Anan in *Laevidentalina salimi> L. popescui* lineage.

22) *Annulofrondicularia crihanae* Anan,[12] p. 114, pl. 1, Figure 2.8 (=*Annulofrondicularia annularis* – Popescu & Crihan,[33] p. 388, pl. 1, Figure 2.13). Luisan. Romania.

Remarks: This new species has fewer chambers than the other species, and ornamented by longitudinal costae. *A. crihanae* may be evolved from the Late Eocene *A. sztrakosae* Anan.[13]

23) *Annulofrondicularia sztrakosae* Anan,[13] p. 4, pl. 1, Figure 2.8 (=*Annulofrondicularia* sp. Sztràkos,[24]; *A. annularis* of Popescu & Crihan,[33]). Priabonian-Luisan. France, Romania.

Remarks: This French species has large proloculus followed by 7 uniserial chevron-shaped chambers, not completely surrounding the base but strongly overlapping at the margin, with terminal protruding aperture on a slight neck. It differs from A. nakkadyi (Futyan) by its larger length/width (1/¾) in the former than (1/1) in the latter, larger inflated smooth proloculus than two or three longitudinal ribs on it.

24) *Tollmannia romanica* Anan,[12] p. 115, l. 1, Figure 2.15 (=*Lingulina costata* - Popescu & Crihan,[33] p. 389, pl. 1, Figure 2.11). Luisan. Romania.

Remarks: This species is characterized by large globular-semi globular test, longitudinal ribs on the surface except the smooth final chamber.

25) *Tristix sztrakosae* Anan,[14] p. 54, pl. 1, Figure 2.6 (=*Tristix* cf. *carinatus* (Sidebottom) - Sztrákos,[24] p. 160, pl. 9, Figure 2.12). Lutetian. France.

Remarks: It resembles the Liasic *T. liasina* (Berthelin), but differs by more depressed sutures, more produced aperture.

26) *Percultazonaria romanica* Anan,[12] p. 115, pl. 1, Figure 2.23 (= *Percultazonaria* sp. - Popescu & Crihan,[33] p. 398, pl. 4, Figure 2.9). Luisan. Romania.

Remarks: This species differs from other species by its rectilinear uncoiling part of the test.

Genus *Lenticubella* Anan,[3]

27) *Lenticubella polonica* Anan,[12] p. 19, pl. 1, Figure 2.2 (=*Darbyella irregularis* Pożaryska,[28] p. 66, pl. 8, Figure 2.6). Paleocene. Poland.

Remarks: It has larger size than *L. irregularis* (Pożaryska), not depressed sutures, without keel.

28) *Lenticubella romanica* Anan,[12] p. 115, pl. 1, Figure 2.27 (=*Lenticulina kittlii*-Popescu & Crihan,[33] p. 392, pl. 2, Figure 2.9). Luisan. Romania.

Remarks: It differs from the other species by its depressed thickened sutures.

29) *Citharina polonica* Anan,[14] p. 54, pl. 1, Figure 2.8 (=*Citharina* sp. Pożaryska,[28] p. 81, pl. 11, Figures 2.8&2.9). Danian. Poland.

Remarks. This species is characterized by its very elongate proloculus and test, never previously described any species of *Citharina*.

Genus *Amphicorynella* Anan,[1]

30) *Amphicorynella popescui* Anan,[15] p. 127, pl. 1, Figure 2.3 (=*Amphicoryna spinicosta* - Popescu & Crihan,[33] p. 393, pl. 3, Figure 2.11). Luisan. Romania.

Remarks: This species has rectilinear globular uniserial chambers, surface commonly longitudinally striate, aperture terminal radiate.

31) *Amphicorynella romanica* Anan,[15] p. 127, pl. 1, Figure 2.4 (=*Amphicoryna spinicosta* - Popescu & Crihan,[33] p. 393, pl. 3, Figure 2.12). Middle Miocene. Romania.

Remarks: This species differs from *Amphicorynella popescui* Anan by ornamented by fine costae broken up into rows of small pustules than longitudinally striate.

32) *Amphicorynella mazeni* Anan,[15] p. 127, pl. 1, Figure 2.5 (=*Amphicoryna hispida* - Popescu & Crihan,[33] p. 393, pl. 3, Figure 2.7). Luisan Middle Miocene. Romania.

Remarks: It is distinguished by its hispid spinose surface.

33) *Amphicorynella yassini* Anan,[15] p. 127, pl. 1, Figure 2.6 (=*Amphicoryna hispida* - Popescu & Crihan,[33] p. 393, pl. 3, Figure 2.8). Luisan. Romania.

Remarks: It differs from *A. mazeni* by a smaller number of chambers, more globular size which rapidly increasing as added.

34) *Amphicorynella franciaca* Anan,[15] p. 127, pl. 1, Figure 2.7 (=*Amphicoryna* cf. *badenensis* – Sztrákos,[26] p. 98, pl. 9, Figure 2.14). Priabonian. France.

Remarks: It is distinguished by its longitudinally striate and crossing sutures, aperture terminal radiate with an elongate neck with ring.

35) *Amphicoryna sztrákosae* Anan,[15] p. 127, pl. 1, Figure 2.9 (=*Amphicoryna* cf. *badenensis* - Sztrákos,[26] p. 98, pl. 9, Figure 2.13). Priabonian. France.

Remarks: It differs from *A. scalaris* (Batsch) by inclined elongate chambers in the former than globular of the latter.

Genus *Marginulinoides* Anan,[1]

The new genus *Marginulinoides* Anan differs from the Lagenid fauna by its closed coiled early stage, followed by uniserial chambers, and spinose and knobs ornamented surface.

36) *Marginulinoides romanica* Anan, sp. nov. (=*Marginulina hirsuta* d'Orbigny - Popescu & Crihan,[33] p. 394, pl. 3, Figure 2.24). Langhian. Romania.

Etymology: after the State of Romania.

Diagnosis: Close coiled planispiral early stage of the test, later elongate uncoiled uniserial and rectilinear, 4 globular uniserial parallel chambers, surface ornamented by heavily knobs, aperture central terminal on neck.

Remarks: This species differs from the holotype *Marginulinoides arabica* Anan by a smaller number of parallel uniserial chambers very gradually increased as added, ornamented by knobs. The Priabonian *Marginulinoides arabica* most probably evolved to the Langhian *M. romanica* in *Marginulinoides arabica>M. romanica* lineage.

37) *Marginulinoides hungarica* Anan, sp. nov. (=*Vaginulinopsis fragaria* (Gümbel) - Ozsvárt,[32] p. 56, pl. 6, Figure 2.1). Bartonian-Priabonian. Hungaria.

Etymology: after the State of Hungaria.

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Stratigraphic level: Bartonian-Priabonian. Hungaria.

Diagnosis: Test close coiled planispiral early stage, later elongate uncoiled 7 uniserial and rectilinear chambers decreased gradually as added, sutures slightly depressed, ornamented with numerous fine longitudinal beads, aperture terminal, circular on short neck.

Remarks: This species differs from *M. romanica* by more numbers of uniserial chambers, non-equal globular chambers which decreased gradually as added with fine longitudinal beads ornamentation.

38) *Hyalinonetrion romanica* Anan, sp. nov. (=*Amphicoryna inconstans* (Neugeboren) - Popescu & Crihan,[33] p. 393, pl. 3, Figure 2.4). Langhian. Romania.

Etymology: after the State of Romania.

Diagnosis: Unilocular globular smooth unornamented test, tapering slowly at the base, aperture rounded at the end of the long tapering neck.

Remarks: The genus *Hyalinonetrion* differs from *Lagena* in having a globular test with smooth unornamented surface, elongate neck, and phialine lip. It also differs from *Amphicoryna* by smooth unilocular test.

III. Suborder Rotaliina Delage & Hérouard,

39) *Bolivina ganensis* Anan,[1] p. 2, pl. 1, Figure 2.3 (=*Bolivina* sp. 3, Sztrákos,[26] p. 185, pl. 5, Figure 2.13). Selandian-Thanetian. France.

Remarks: It differs from other species of the genus by conspicuous ornamentation ribbed on chambers along the test.

40) *Bolivina hungarica* Anan, sp. nov. (*Bolivina* sp. - Ozsvárt,[32] p. 63, pl. 7, Figure 2.6).

Etymology: after the State of Hungaria.

Stratigraphic level: Bartonian-Priabonian. Hungaria.

Diagnosis: Elongate biserial smooth test, triangular in outline, length approximately two times of maximum width, 6 sets of biserial inflated chambers, depressed sutures, basal terminal aperture.

Remarks: This species is characterized by smooth biserial inflated chambers.

41) *Bolivina kamali* Anan,[2] p. 97, pl. 1, Figure 2.10 (=*Bolivina* sp. - Galazzo et al.,[29] p. 28, pl. 1, Figure 2.10). Lutetian. Italy.

Remarks: This species differs from other species of the genus by its conspicuous ornamentation striations to ribs on the chambers along the test.

42) *Bolivina spainica* Anan,[1] p. 3, pl. 1, Figure 2.4 (=*Brizalina* sp. - Rivero-Cuesta et al,[34] p. 106, Figure 2.3.18). Bartonian. Spain.

Remarks: The genus *Bolivina* with its compressed, triangular and broad test at the last part differs from the genus *Brizalina* by its lanceolate test and inflated chambers. This species triangular in outline and somewhat compressed biserial test, chambers broad at the last part of the test, sutures slightly depressed, surface smooth, aperture a narrow loop at the base of the apertural face.

43) *Bolivina sztrakosae* Anan,[1] p. 3, pl. 1, Figure 2.5 (=*Bolivina* sp. 1, Sztrákos,[26] p. 185, pl. 5, Figure 2.9). Ypresian. France.

Remarks: It characterized by its an elongate narrow biserial smooth test, about 5 times as long as broad, sutures oblique and very slightly depressed.

44) *Praeglobobulimina franciana* Anan,[1] p. 3, pl. 1, Figure 2.6 (=*Bulimina thanetensis* - Sztrákos,[26] p. 185, pl. 6, Figure 2.10). Danian-Thanetian. France.

Remarks: This species belongs here to the genus *Praeglobobulimina* due to its more elongated test, and its chambers do not overlap earlier ones than in *Bulimina*. It is distinguished by an elongate triserial smooth test, rapidly enlarging globular chambers that do not overlap earlier ones, sutures depressed, aperture loop shaped.

Genus *Buliminelloides* Anan,[1]

The *Buliminelloides italica* Anan has an elongate subcylindrical triserial perforate calcareous test, with surface finely ornamented with wrinkles.

45) *Buliminelloides italica* Anan,[4] p. 42, pl. 1, Figure 2.7 (*Bulimina* cf. *semicostata* (Galazzo et al.[29]), p. 28, pl. 1, Figure 2.14). Lutetian. Italy.

Remarks: The new genus and its holotype species *B. italica* differ from other genera of the Buliminids by wrinkled rugosa ornamented surface than smooth test.

46) *Buliminelloides spainica* Anan,[16] p., pl. 1, Figure 2.10 (=*Bulimina semicostata* – Ortiz & Thomas,[31] p. 114, pl. 4, Figure 2.14). Lutetian. Spain.

Remarks: This species is characterized by nearly cylindrical test with rounded initial end, and rounded aperture.

47) *Uvigerina ashrafi* Anan,[17] p. 109, pl. 1, Figure 2.12 (=*Uvigerina* sp. C - Galazzo et al,[29] p. 28, pl. 1, Figure 2.27). Eocene, Italy.

Remarks: This species has semi-globular test with rounded in section, longitudinal platy costae ornamented surface, with long terminal aperture.

48) *Uvigerina awadhi* Anan,[17] p. 110, pl. 1, Figure 2.13 (=*Uvigerina* sp.- Galazzo et al,[29] p. 28, pl. 1, Figure 2.28). Eocene, Italy.

Remarks: This species is characterized by elongated heavy costae along the elongate test with nearly flush sutures.

49) *Uvigerina sameri* Anan,[17] p. 110, pl. 1, Figure 2.26 (=*Uvigerina* sp. - (Cushman & Edwards), p. 84, pl.14, Figure 2.10). Middle Oligocene Germany.

Remarks: This species has nearly fusiform shape, about 1½ times as long as broad, ornamented by10-12 high plate-like longitudinal costae and mostly independent of the chamber limits.

50) *Angulogerina abuzeidi* Anan,[18] pl.1, Figure 2.1 (=*Angulogerina* cf. *angulosa* Williamson - Pirkenseer et al., p. 72, pl. 8, Figure 2.10). Rupelian, France.

Remarks: It has shorter test than *A. angulosa*, longitudinal costae continuous over the sutures.

51) *Fursenkoina torrecardelaensis* Anan,[1] p. 52, pl. 1, Figure 2.8 (=*Fursenkoina* sp. A - Rivero-Cuesta et al,[34] p. 106, Figure 2.3.22). Bartonian. Spain.

Remarks: It has an ornamented ribbed surface along the test, except the terminal chamber.

52) *Nodosarella ganensis* Anan,[1] p. 52, pl. 1, Figure 2.9 (=*Nodosarella* sp. 2. Gan, C11-Sztrákos,[26] p. 185, pl. 7, Figure 2.13). Thanetian. France.

Remarks: It is characterized by its uniserial rectilinear and gradually larger chambers as added.

53) *Nodosarella spainica* Anan,[1] p. 52, pl. 1, Figure 2.10 (=*Nodosarella* sp. - Rivero-Cuesta et al,[34] p.106, Figure 2.3. 25). Bartonian. Spain.

Remarks: It is characterized by its semi-rectilinear uniserial test, aperture terminal, an arcuate slit with bordering lip and produced on a short neck.

54) *Pleurostomella waeli* Anan, 2023f, p. 76, pl. 1, Figure 2.26 (=*Pleurostomella* sp. - Alegret et al.,[35] p. 197, pl. 1, Figure 2.25). Ypresian. Spain.

Remarks: This Early Eocene species differs from the other species of the genus, particularly *P. acuta* Hantken by its rounded initial test. The former may develop to the latter.

55) *Siphonodosaria franciana* Anan,[1] p. 2, pl. 1, Figure 2.10 (=*Siphonodosaria* sp. 1 - Sztrákos,[26] p. 185, pl. 7, Figure 2.16). Thanetian. France.

Remarks: It is characterized by its smooth uniserial rectilinear, and chambers subglobular and larger as added, aperture terminal phialine produced on a short neck.

56) *Siphonodosaria molinai* Anan,[1] p. 2, pl. 1, Figure 2.13 (=*Siphonodosaria* sp. - Rivero-Cuesta et al,[34] p. 106, Figure 2.3. 26). Bartonian. Spain.

Remarks: It is characterized by its uniserial rectilinear 5-6 smooth subglobular chambers, aperture terminal phialine and produced on neck.

57) *Siphonodosaria sztrákosae* Anan,[1] p. 3, pl. 1, Figure 2.12 (=*Siphonodosaria* 2 - Sztrákos,[26] p. 185, pl. 7, Figure 2.17). Thanetian-Ypresian. France.

Remarks: It is distinguished by its 5-7 chambers subglobular and larger rapidly as added, ornamented by ribs, aperture terminal phialine produced on neck.

58) *Siphogenerinoides multiribata* Anan,[1] p. 3, pl. 1, Figure 2.7 (=*Siphogenerinoides* sp. - Sztrákos,[26] p. 185, pl. 7, Figure 2.12). Selandian-Thanetian. France.

Remarks**:** It is characterized by its elongate and slender test, biserial early stage and uniserial rectilinear later stage, more than twenty ribs, except the terminal one.

59) *Valvulineria spainica* Anan,[1] p. 52, pl. 1, Figure 2.15 (=*Pullenia* sp. - Rivero-Cuesta et al,[34] p. 106, Figure 2.3.15). Bartonian. Spain.

Remarks: Test has closed coiled smooth biconvex test, 6 chambers in the last whorl increasing gradually as added, sutures narrow curved slightly depressed, last chamber extending slightly into ventral umbilical region, periphery rounded, aperture a narrow slit at the base of the last-formed chamber.

60) *Gyroidinoides riverocuestai* Anan,[1] p. 52, pl. 1, Figure 2.16 (=*Gyroidinoides* sp. - Rivero-Cuesta et al,[34] p. 106, Figure 2-12). Bartonian. Spain.

Remarks: It is characterized by its mainly flush sutures and small umbilicus than wide deep umbilicus in the most members of the genus.

61) *Asterigerina alegretae* Anan,[1] p. 52, pl. 1, Figure 2.14 (=*Asterigerina* sp. B - Rivero-Cuesta et al,[34] p. 106, Figure 2-7). Bartonian. Spain.

Remarks: It has nearly planoconvex test, and lack granules and pustules cover the final portion of the preceding whorl just below the aperture on the umbilical side, which exists in the holotype *A. carinata* d'Orbigny.

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62) *Plummerita premolisilvae* Anan & Orabi,[20] p. 183, Figure 2.4 C (=*Plummerita hantkeninoides* (Brönnimann) - Coccioni & Premoli Silva,[36] p. 59, pl. 3, Figure 2.15 (Non Figures 2.12-2.16). Maastrichtian. Italy.

Remarks: It is distinguished by its first two radially elongated chambers with axially spine-like prolongation in linear pattern rugose surface in the last whorl with low trochoid volution, while the third, fourth, and fifth-last chambers are strongly inflated without spine-like prolongation. The second chamber with axially spine-like prolongation of *P. premolisilvae* has perpendicular to the last fifth chamber at the vertical line of the test.

63) *Plummerita spainica* Anan,[21] p. 25, pl. 1, Figure 2.7 (=*Plummerita hantkeninoides* (Brönnimann) - Gilabert et al.,[37] p. 6, Figure 2.3L). Maastrichtian. Spain.

Remarks: This new species showing a kind of tubulospine on the four early chambers of the Six-chamber volution of the last whorl, while *P. costata* has four early chambers of the five-chamber volution of the last whorl, this species most probably developed from *P. costata* (Brönnimann) of *P. hantkeninoides* group (*P. hantkeninoides, P. costata, P. inflata*).[38-40]

Paleogeography

The Paleogene paleogeographic map show that the distribution of the Northern and Southern Tethyan (Figure 3).

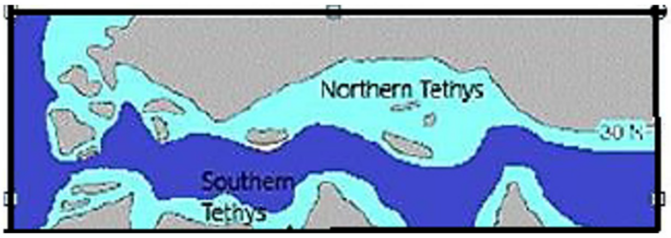

Figure 3 The Paleogene paleogeographic distribution of the Northern and Southern Tethys.

Paleoenvironment

Most of the European benthic and planktic foraminiferal assemblage of the study area are endemic to their original description, which mainly controlled by different water depths (the paleorelief highs and lows), lack of available literatures, different stratigraphical levels of species, and/or misidentification of some species by different authors. Due to their small size and abundance, they are the most widely used for environmental interpretation (Figure 4). Moreover, composition of the wall tests may present an indicator of water temperatures, as an essential than other environmental factors.

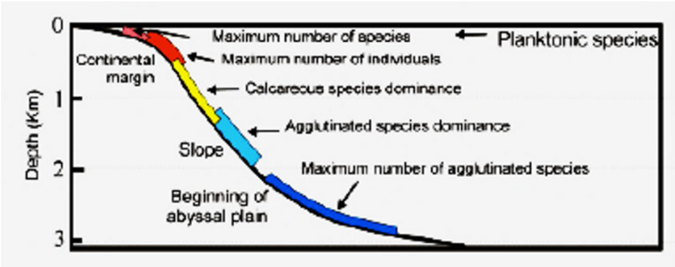

Figure 4 Depth distribution of planktic and benthic foraminiferal fauna.

Summary and conclusions

The study of the spatial distributions of the European foraminiferal assemblage enables to reach the following conclusions:

i. The study area represents a classical example of a mixed agglutinated-carbonate ramp system.

ii. The most abundant wall type in the study area based on the number of the identified benthic foraminiferal species is hyaline, followed by agglutinated arenaceous wall.

iii. The erection of four benthic foraminiferal genera: *Amphicorynella* Anan[1] and *Marginulinoides* Anan[1] from Romania, *Lenticubella* Anan[3] from Poland, and *Buliminelloides* Anan[1] from Italy.

iv. The erection of new three Lagenid benthic foraminiferal species (*Marginulinoides romanica, M. hungarica* and *Hyalinonetrion romanica*) and one Rotaliid species (*Bolivina hungarica*).

v. Two Globigerinid planktic foraminifera are also recorded as a part of the assemblage (*Plummerita premolisilvae* and *Plummerita spainica*).

vi. Rotaliid foraminiferal species are the most diversified order of benthic foraminifera (23of 63 species), followed by Lagenid (19 species), Textulariid (18 of 63 species), Globigerinid (2 of 63), and only one Miliolid species, which shows the lowest diversity.

vii. Presented four benthic foraminiferal evolutionary lineages: *Bathysiphon alegretae*→*B. saidi* lineage, *Verneuilina aegyptiaca* >*V. luxorensis* > *V. hungariana* lineage, *Laevidentalina salimi*> *L. popescui* lineage and *Marginulinoides arabica*>*M. romanica* lineage.

viii. The study area is generally characterized by an endemic fauna that may interpret to lack of literatures, misidentification of the fauna by different authors, and/or different stratigraphic levels of the recorded foraminifera.

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None.

Conflicts of interest

We declare that there is no conflict of interest of any kind.

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