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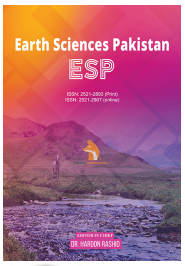

REVIEW ARTICLE

PALEONTOLOGY AND PALEOENVIRONMENT OF THE EARLY PALEOGENE PAKISTANIAN BENTHIC FORAMINIFERAL SPECIES OF HAQUE - SUBORDERS MILIOLINA AND LAGENINA

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ABSTRACT

Thirteen Early Paleogene Pakistanian smaller Miliolid and eight Lagenid benthic foraminiferal species and subspecies from the Ranikot and Laki Formations of the Nammal Gorge, Salt and Sor Ranges, Punjab of Northern Pakistan have been studied. The modern taxonomic consideration and systematic description of the species is based on the diagnostic morphology, and provides a list of synonyms, short remarks about morphological features of the taxa and some annotations about taxa with problematic generic status. Two species of them belong to the genus *Spiroloculina*(*haquei, pakistanica*), four of *Quinqueloculina* (*inflata, pseudosimplex, pseudovata, ranikotensis*), two of *Triloculina* (*psudoenoplostoma, sarahae*), two of *Agglutinella* (*reinemundi, sori*) and three of *Dentostomina (ammobicarinata, ammoirregularis, gapperi*). One species of the Lagenid belongs to the genus *Frondicularia* (*nammalensis*), one of *Lenticulina* (*reussi*), one subspecies of *Palmula* (*woodi nammalensis*), one of *Astacolus* (*vomeriformis*), one of *Vaginulinopsis (nammalensis*), one of *Lagena (reticulatostriata*), one of *Galawayella (nammalensis)* and one of *Parafissurina* (*pakistanica*). The two species of the Miliolids: *Spiroloculina* (*haquei, pakistanica*) and one Lagenid *Parafissurina* (*pakistanica*) are believed to be new. Some of these species are recorded outside of Pakistan in Northern Tethys (France): *Astacolus vomeriformis* and *Vaginulinopsis nammalensis*. The high abundance of pelagic Pakistanian foraminiferal assemblage indicate open connection to the Tethys, which represents middle-outer neritic environment (100-200 m depth) and shows an affinity with 'Midway-Type Fauna'.

KEYWORDS

Benthic foraminifera, Miliolids, Lagenids, Haque, Pakistan.

1. INTRODUCTION

Thirteen smaller Miliolid and eight Lagenid benthic foraminiferal species from Paleocene-Early Eocene of the Ranikot, Laki, Patala and Nammal Formations of the Nammal Gorge, Salt and Sor Ranges of Pakistan have been studied and are systematically listed, for the first time as the author believed (Figure 1). These species belong to five Miliolid genera: *Spiroloculina, Agglutinella, Dentostomina*, *Quinqueloculina* and *Triloculina*, and eight Laginid genera: *Frondicularia, Lenticulina, Palmula, Astacolus Vaginulinopsis, Lagena, Parafissurina* and *Galawayella.* The smaller Miliolid evolved in the Carboniferous, and diversified in the Mesozoic, attaining their maximum diversity during the Late Cretaceous, before suffering some losses in the end-Cretaceous mass extinction, and recovering in the Palaeogene, when they attained their maximum diversity. All the Miliolid and most Lagenid Pakistanian species and subspecies are, so far, an endemic to Pakistan, except two species of them (*Astacolus vomeriformis* and *Vaginulinopsis nammalensis*) were recorded from France (Figure 2). The paleoenvironment of these species are presented.

Figure 1: Location map of study area Salt Range, Northern Pakistan (Gibson, 2007)

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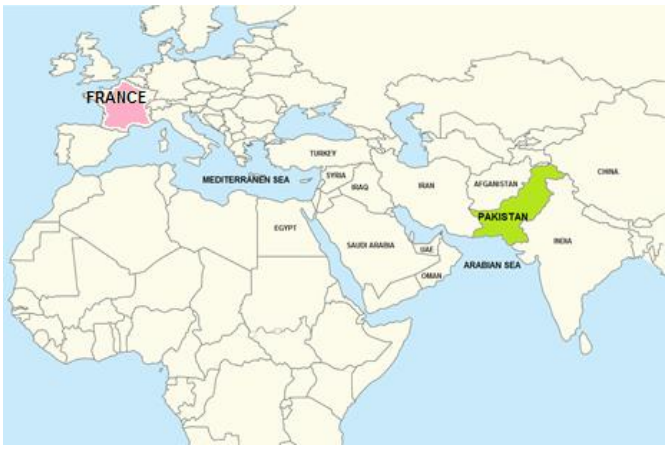


Figure 2: The geographic map showing the location of Pakistan (Southern Tethys) and France (Northern Tethys).

2. STRATIGRAPHY

Based on the stratigraphic distribution of the planktonic, larger foraminifera and calcareous nannoplankton assemblages which recovered by many authors, i. e., the Ranikot Laki, Patala, and Nammal Formations of the Nammal Gorge, Salt and Sor Ranges of Pakistan (Figure 3) indicate that these strata are in the Late Paleocene-Early Eocene age (Haque, 1956; 1960; Dorreen, 1972; Afzal, 1996; Gibson, 2007; Bybell and Self-Trail, 2007; Naz et al., 2011; Özcan et al., 2015; Ahmad et al., 2016; Khawaj et al., 2018). On the other hand, Haque (1956) noted that the Ranikot beds of Pakistan may be correlated to the Esna Shale (Paleocene-Early Eocene) of Egypt. He also noted that many foraminiferal forms which were recorded from Europe, America and Egypt are also recorded in the Laki formation of Pakistan.

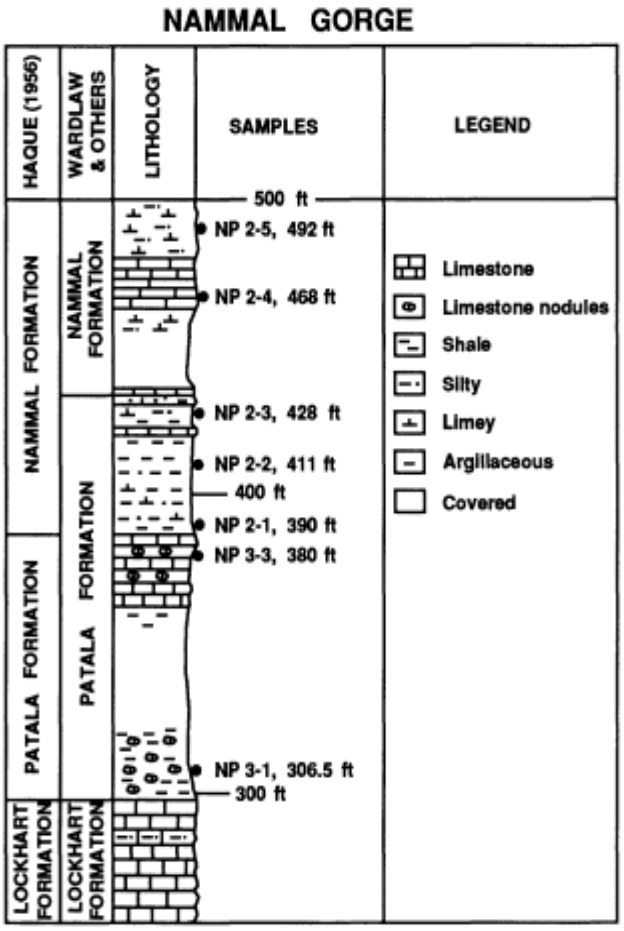


Figure 3: Lithostratigraphic section in Nammal Gorge at Nammal Dam: Patala and Nammal Formations of the Nammal Gorge, Salt and Sor Ranges of Pakistan (Gibson, 2007).

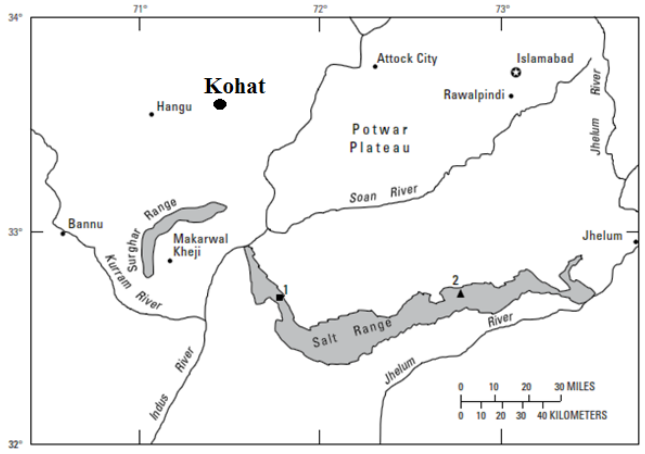


Figure 4: The Salt Range study area in Northern Pakistan showing locations at the section study 1 Nammal Dam section, and Kohat sub-basin, Northern Pakistan (Gibson, 2007)

3. TAXONOMY

Some modern references have been added to complete description, and taxonomic considerations. The generic concept of the thirteen Miliolid and eight Lagenid identified species in this study are adapted according to the taxonomic classification of and presented in Plate 1 (Loeblich and Tappan, 1988).

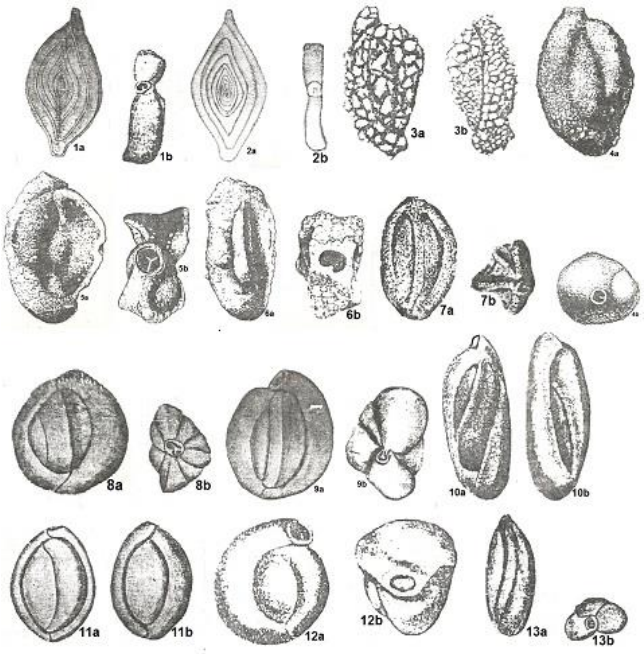


Plate 1: Micrographs of Pakistanian Miliolids foraminiferal genera and species that used in this study: 1. Spiroloculina haquei Anan, n. sp. x 45, a. side view, b. apertural view; 2. S. pakistanica Anan, n. sp. x 80, side view, b. apertural view; 3. Agglutinella reinemundi (Haque, 1960) x 90, a, b. opposite sides; 4. A. sori (Haque, 1960) x 60, a. side view, b. apertural view; 5. Dentostomina ammobicarinata Haque, 1960 x 30, a. side view, b. apertural view; 6. D. ammoirregularis (Haque, 1960) x 35, a. side view, b. apertural view; 7. D. gapperi (Haque, 1956) x 55, a. side view, b. apertural view; 8. Quinqueloculina inflata Haque, 1956 x 130, a. side view, b. apertural view; 9. Q. pseudosimplex (Haque, 1960) x 100, a. side view, b. apertural view; 10. Q. pseudovata Haque, 1956 x 55, a, b. opposite sides; 11. Q. ranikotensis Haque, 1956 x 45, a, b. opposite sides; 12. Triloculina psudoenoplostoma Haque, 1960 x 135, a. side view, b. apertural view; 13. T. sarahae Haque, 1956 x 50 a. side view, b. apertural view.

Order Foraminiferida Eichwald, 1830
Suborder Miliolina Delage & Hérouard, 1896
Superfamily Miliolacea Ehrenberg, 1839

Family Spiroloculinidae Wiesner, 1920
Genus *Spiroloculina* d'Orbigny, 1826
Type species *Spiroloculina depressa* d'Orbigny, 1826

***Spiroloculina haquei* Anan, n. sp. - (Pl. 1, figure 1)**

1956 *Spiroloculina* sp. A Haque, p. 153, pl. 34, figure 3● [illustrated species]
Holotype: Illustrated specimen in Pl. 1, figure 1 x 45.
Dimension: Length 28 mm, width 14 mm.
Etymology: In the honor of the Pakistanian micropaleontologist A.F.M. Mohsenul Haque.
Type locality: Patala Shales, horizon B 26.
Age: *Punjabia ovoidea* Zone (Late Paleocene).
Depositary: Geological Survey of Pakistan.

Diagnosis: This species has fusiform test in outline with flattened sides, microspheric small proloculus followed by planispirally wound tubular second chambers in one-half coil in length added in a single plane, few added pair-chambers of the test, wall calcareous imperforated porcelaneous, sutures are limbate, aperture rounded at the open end of the final chamber with projecting neck and simple teeth.

Remarks: This species is characterized by its limbate sutures between the successive pair-chambers and thick final-chamber periphery.

***Spiroloculina pakistanica* Anan, n. sp. - (Pl. 1, figure 2)**

1956 *Spiroloculina* sp. B Haque, p. 60, pl. 28, figure 10. ●

Holotype: Illustrated specimen in Pl. 1, figure 2 x 80.
Dimension: Length 24 mm, width 11 mm.
Etymology: After the Islamic Republic of Pakistan.
Type locality: Nammal Limestone and Shales, horizon B 79.
Age: *Loxostoma applinae* Zone *(=Orthokarstenia applinae,* sensu Anan*,* 1998) (Late Paleocene).
Depositary: Geological Survey of Pakistan.
Diagnosis: This species has fusiform test, being longer than broad, sutures simple.
Remarks: This species is characterized by its simple not limbate sutures, less thick final-chambers periphery than *S. haquei* and more added pair-chambers in the test.

Family Hauerinidae Schwager, 1976
Subfamily Siphonapertinae
Genus *Agglutinella* El-Nakhal, 1983
Type species *Agglutinella soriformis* El-Nakhal, 1983

***Agglutinella reinemundi* (Haque, 1960) - (Pl. 1, figure 3)**

1960 *Triloculina reinemundi* Haque, p. 19, pl. 2, figure 5●

Remarks: This Eocene species belongs here to the genus *Agglutinella* due to its triloculine arrangement of chambers, agglutinated external wall and porcelaneous imperforate inner wall, and a simple aperture with simple tooth. It is characterized by its elongated test with coarsely agglutinated external wall. It is, so far, an endemic to Pakistan.

***Agglutinella sori* (Haque, 1960) - (Pl. 1, figure 4)**

1960 *Triloculina sori* Haque, p. 20, pl. 5, figure 9●

Remarks: This Eocene species has inflated elongated chambers, subcircular cross-section, curved depressed sutures, simple tooth in circular opening aperture. It differs from *A. reinemundi* by its more inflated chambers, subcircular cross-section, and less coarsely agglutinated external wall. With its simple tooth, this species differs from the Recent foraminiferal species *Agglutinella soriformis* by its bifid tooth, which recorded from Jeddah sea shore of Saudi Arabia, Gulf of Suez of Egypt and Mukha sea shore of Yemen (El-Nakhal, 1983).

Genus *Dentostomina* Cushman, 1933

Type species *Dentostomina bermudiana* Carman, 1933

***Dentostomina ammobicarinata* (Haque, 1960) - (Pl. 1, figure 5)**

1960 *Triloculina ammobicarinata* Haque, pl. 6, figure 6●

Remarks: This Eocene species belongs here to the genus *Dentostomina* due to its quinqueloculine arrangement test with crenulated margin, agglutinated quartz grains outer layer, terminal circular aperture with long narrow bifid tooth. It is, so far, an endemic to Pakistan.

***Dentostomina ammoirregularis* (Haque, 1960) - (Pl. 1, figure 6)**

1960 *Triloculina ammo-irregularis* Haque, pl. 6, figure 4. ●

Remarks: This Eocene species belongs also to the genus *Dentostomina*. It is characterized by its mainly elongated test with simple tooth in semi-circular open aperture, than the other species *E. ammobicarinata* which has semi-circular crenulated test and long bifid tooth in circular aperture. It is, so far, an endemic to Pakistan.

***Dentostomina gapperi* (Haque, 1956) - (Pl. 1, figure 7)**

1956 *Quinqueloculina gapperi* Haque, p. 54, pl. 32, figure 11. ●
2007 *Quinqueloculina gapperi* Haque - Gibson, p. E12.

Remarks: This Paleocene species has quinqueloculine arrangement test with median ridge, surface layer of agglutinated small quartz particles, with simple tooth in oval-shaped aperture. It is, so far, an endemic to Pakistan.

Subfamily Hauerininae Schwager, 1876
Genus *Quinqueloculina* d'Orbigny, 1826
Type species *Serpula seminulum* Linné, 1759

***Quinqueloculina inflata* Haque, 1956 - (Pl. 1, figure 8)**

1956 *Quinqueloculina lamarckiana* (d'Orbigny) var. *inflata* Haque, p. 55, pl. 32, figure 3. ●

Remarks: This Early Eocene species *Quinqueloculina inflata* has equal long and broad test, composed of chambers a half coil in length and added successively in planes 144° apart, each chamber 72° from its next adjacent one. Five chambers visible at the exterior, of which four are visible in one side and three from that opposite. Wall calcareous porcelaneous, ovate aperture provided with a small bifid tooth. It is, so far, an endemic to Pakistan.

***Quinqueloculina pseudosimplex* (Haque, 1960) - (Pl. 1, figure 9)**

Triloculina pseudo-simplex Haque, pl. 5, figures 3, 4. ●

Remarks: This Eocene species has elongated test, sutures curved and limbate, aperture subcircular and terminal, wall calcareous porcelaneous. It is, so far, an endemic to Pakistan.

***Quinqueloculina pseudovata* Haque, 1956 - (Pl. 1, figure 10)**

1956 *Quinqueloculina pseudovata* Haque, p. 66, pl. 25, figure 1. ●

Remarks: This Paleocene species has ovate robust smooth test, nearly equal long and broad, inflated chambers in quinqueloculine arrangement, wall calcareous porcelaneous, pear-shaped aperture with bifid tooth and imperforated lip. It is, so far, an endemic to Pakistan.

***Quinqueloculina ranikotensis* Haque, 1956 - (Pl. 1, figure 11)**

1956 *Quinqueloculina ranikotensis* Haque, p. 53, pl. 21, figure 5; p. 58, pl. 32, figure 12. ●

Remarks: This Paleocene species has ovate smooth test, large initial chambers than the final fourth and fifth chambers, which have one-half coil in length, wall calcareous porcelaneous, aperture terminal and rounded. It is, so far, an endemic to Pakistan.

Genus *Triloculina* d'Orbigny, 1826
Type species *Miliolites trigonula* Lamarck, 1804

***Triloculina psudoenoplostoma* Haque, 1960 - (Pl. 1, figure 12)**

1960 *Triloculina psudo-enoplostoma* Haque, p. 19, pl. 6, figure 3. ●

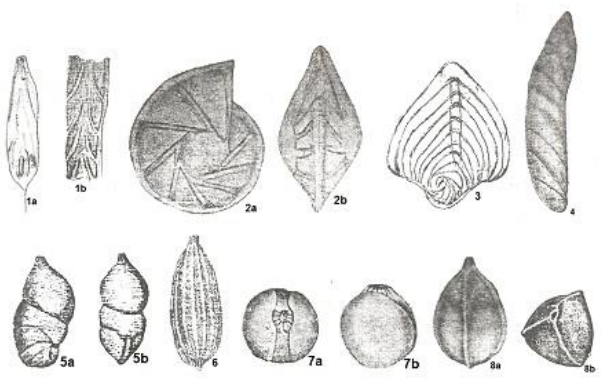
Remarks: This Eocene species has rounded equatorial smooth test, triloculine arrangement in later generation instead of quinqueloculine in early stage, the three visible chambers in one side have successive arrangement added in planes 120° apart, and two from that opposite, wall calcareous porcelaneous, aperture terminal and rounded with simple tooth. It is, so far, an endemic to Pakistan.

***Triloculina sarahae* Haque, 1956 - (Pl. 1, figure 13)**

Triloculina sarahae Haque, p. 59, pl. 32, figures 5-8 (*non* figure 9). ●
1996 *Triloculina sarahae* Haque - Afzal, p. 20.

Remarks: This Paleocene species has elongate smooth test, aperture terminal and rounded with simple tooth. It is, so far, an endemic to Pakistan.

Suborder Lagenina Delage & Hérouard, 1896
Superfamily Nodosariacea Ehrenberg, 1838
Family Nodosariidae Ehrenberg, 1838
Subfamily Nodosariinae Ehrenberg, 1838
Genus *Frondicularia* Defrance, 1826
Type species *Renulina complanata* Defrance, in de Blainville, 1824



***Frondicularia nammalensis* Haque, 1956 - (Pl. 2, figure 1a, b)**

1956 *Frondicularia linearis* Franke var. *nammalensis* Haque, p. 90, pl. 21, figures 3, 4. ●

Remarks: This Early Eocene species has nearly parallel and flat compressed test with few chambers, truncated periphery and tapering aperture, sutures limbate, ornamented with a few longitudinal costae. It is characterized by its base with long acicular spine. The *F. linearis* Franke was originally described from the Cretaceous of Germany. *Frondicularia nammalensis* Haque most probably was evolved from the descendent *F. linearis* Franke (Franke, 1928). It is, so far, an endemic to Pakistan.

Genus *Lenticulina* Lamarck, 1804

Type species *Lenticulina rotulatus* Lamarck, 1804

***Lenticulina reussi* (Haque, 1956) - (Pl. 2, figure 2a, b)**

1956 *Robulus reussi* Haque, p. 66, pl. 28, figure 4. ●

Remarks: This Early Eocene species has strongly convex smooth test with large prominent umbo, 8-10 distinct chambers gradually added, sutures straight and slightly raised and extending in the umbo area, periphery acute and keeled, aperture at the peripheral angle. It is, so far, an endemic to Pakistan.

Family Vaginulinidae Reuss, 1860
Subfamily Palmulinae Saidova, 1981
Genus *Palmula* Lea, 1833
Type species *Palmula sagittaria* Lea, 1833

***Palmula woodi nammalensis* Haque, 1956 - (Pl. 2, figure 3)**

1956 *Palmula woodi nammalensis* Haque p. 91, pl. 3, figure 3.

2020a *Palmula woodi nammalensis* Haque - Anan, p. 70, pl. 2, figure 7d. ●

Remarks: The early coiled portion of the Early Eocene *P. w. nammalensis* has astrocoline-shape and below the general level of the test. It is considered here as the ancestor of the descendent Late Paleocene *P. w. woodi* (Nakkady, 1950). This lineage most probably was produced by Phyletic Gradualism trend of speciation (model A of Lemon, 1990) as proposed by (Anan, 2020a). It is, so far, an endemic to Pakistan.

Subfamily Marginulininae Wedekind, 1937
Genus *Astacolus* de Montfort, 1808
Type species *Astacolus crepidulatus* de Montfort, 1808

***Astacolus vomeriformis* (Haque, 1956) - (Pl. 2, figure 4)**

1956 *Dentalina* (?) *vomeriformis* Haque, p. 78, pl. 23, figure 9.
2005 *Astacolus vomeriformis* (Haque) - Sztràkos, p. 186, pl. 14, figure 16. ●
2020b *Astacolus vomeriformis* (Haque) - Anan, p. 72, pl. 1, figure 7.

Remarks**:** This Early Eocene species has elongate test with nearly parallel sides, early stage constitutes minor coiled portion, about 10 chambers uniserial stage, sutures curved, acute outer periphery, wall smooth, aperture terminal. It was recorded from Pakistan (S. Tethys), and later from France (N. Tethys).

Genus *Vaginulinopsis* Silvestri, 1904
Type species *Vaginulina soluta* Silvestri var. *carinata* Silvestri 1898

***Vaginulinopsis nammalensis* (Haque, 1956) - (Pl. 2, figure 5a, b)**

1956 *Marginulina glabra* d'Orbigny *nammalensis* var. Haque, p.74, pl.11, figures 1-4.
2005 *Vaginulinopsis nammalensis* (Haque) - Sztràkos, p. 186, pl. 14, figures 28. ●
2020b *Vaginulinopsis nammalensis* (Haque) - Anan, p. 72, pl. 1, figures 8.

Remarks: This Early Eocene species has planispirally enrolled involute early stage, later uncoiled laterally compressed and ovate in section, sutures curved, smooth surface. It was recorded from Pakistan (S. Tethys), and France (N. Tethys).

Family Elliposolagenidae A. Silvestri, 1923
Subfamily Oolininae Loeblich & Tappan, 1961
Genus *Lagena* Walker & Jacob, 1798
Type species *Serpula (Lagena) sulcata* Walker & Jacob, 1798, in Kanmacher, 1798

***Lagena reticulatostriata* Haque, 1956 - (Pl. 2, figure 6)**

1956 *Lagena reticulato-striata* Haque, pl. 8, figure 8, pl. 23, figure 4, 5. ●

Remarks: This Early Eocene species is characterized by its unilocular ovate test, surface with about 15 longitudinal costae, aperture rounded terminal on short neck. It differs from *L. sulcata* by its ovate test and less number of longitudinal costae, and shorter neck aperture. It also differs from *Reussoolina apiculata* (Reuss) by its costate surface than smooth one and less apiculate base. It is, so far, an endemic to Pakistan.

Subfamily Parafissurininae Jones, 1984
Genus *Parafissurina* Parr, 1947
Type species *Lagena ventricosa* Silvestri, 1904

***Parafissurina pakistanica* Anan, n. sp. - (Pl. 2, figure 7a, b)**

1956 *Lagena* sp. Haque, p. 103, pl. 32, figure 15. ●

Holotype: Illustrated specimen in Pl. 2, fig. 7 x 50.
Dimension: Length about 32 mm, width about 29 mm.
Etymology: After the Islamic Republic of Pakistan.
Type locality: Basal Laki Formation, horizon B-56, Pakistan.
Age: Early Eocene, Nammal Limestone and Shale.
Depositary: The holotype of this species is deposited in Geological Survey of Pakistan.
Diagnosis: It is characterized by its unilocular globular smooth test, periphery have double keels, oval hooded subterminal crescentic aperture at a test apex which consisting of radially arranged slits that lead through channels to the interior.

Remarks: This Early Eocene Pakistanian species differs from the Egyptian Middle Eocene *Entosolenia* sp. of Fahmy (1975, p. 322, pl. 3, figure 2) by its more depressed test and lack channels around aperture. On the other hand, the genus *Entosolenia* was treated by as a junior synonym of the genus *Oolina* due to its smooth surface or fine longitudinal striae without keel and rounded aperture (Loeblich and Tappan, 1988).

Genus *Galawayella* Patterson & Pettis, 1986
Type species *Lagena trigonoelliptica* Balkwill & Millett, 1884

***Galawayella nammalensis* (Haque, 1956) - (Pl. 2, figure 8a, b)**

1956 *Dentalinopsis globulifera* (Reuss) var. *nammalensis* Haque, p. 138, pl. 23, figure 1. ●

Remarks: This Early Eocene species is related here to the genus *Galawayella* due to its unilocular ovate test, triangular in section and smooth surface. It is characterized by its convex sides, semi-rounded terminal aperture with a short tube. It is, so far, an endemic to Pakistan.

4. Paleoenvironment

Haque correlated the Nammal Formation with the Midway-Type Fauna (MTF) (Haque, 1956). Murray and Anan noted that Miliolid foraminifera are known to favor warm sheltered environments, while the larger foraminifera occur in shallow warm tropical waters within the photic zone (Snavely et al., 1979; Murray, 1973; Anan, 1984). Nomura and Brohi noted that the Southern Pakistan with its variety of Mesozoic and Cenozoic sedimentary rocks, is an ideal place to test the Indian-Asian convergence model from the view point of paleoenvironmental changes (Nomura and Brohi, 1995). The Cretaceous to Paleocene benthic foraminiferal assemblages along the Gai River in southern Pakistan, and this river cuts across the Kirthar Range and exposes a good lithostratigraphic succession of Cretaceous-Oligocene marine sediments. Such a collision event should have led to distinct environmental changes in the Tethys Sea and the Indian Ocean, and by the time of magnetic anomaly 29, the Tethys Sea has been reduced to a long channel. Despite northward movement of the Indian continent at the rate of 18-19.5 cm/yr, the Tethys Sea remained without restricted deep-water circulation. Shafique noted that the basal part of the Patala Formation is interpreted as shallow marine; while the top is deep marine (Shafique, 2001). There was an abrupt change in basin setting of the region during the Late Paleocene to Early Eocene time as deep marine bathyal deposits of Patala Formation overlay the shallow marine strata of the Lockhart Limestone. Gibson noted that the Lockhart (mainly limestone), Patala (mainly shale) and Nammal Formation (mainly nodular limestone) have been deposited predominantly in shallow marine environments (about 100 ft ~ 30 m deep), and the change of lithology from carbonate to shale must be largely related to the supply of the fine clastic material rather than to water depth (Gibson, 2007). Jones noted that the benthic foraminifera are the most important group of fossils in palaeobathymetric interpretation in the Indian subcontinent, and those from the Paleogene formations of Pakistan represent a range of predominantly shallow marine carbonate environments and palaeobathymetries (Jones, 2014). He also noted that the smaller Miliolids range from marginal to deep, and some are tolerant of hyposalininity or hypersalinity as well as normal marine salinity. A group researchers noted that the Panoba Formation in Kohat sub-basin of the Indus Basin, Northern Pakistan (north of Salt and Sor Ranges, Figure 4) exposes excellent early Eocene Tethyan section (equivalent of E1 and E2 planktic foraminiferal biozones), and this formation was deposited in a variety of setting ranging from middle-upper bathyal zone environments (Ahmad et al., 2016). A group researchers noted that the Eocene is an important Epoch for carbonate depositions in Pakistan, and it was the time of marine transgression (Khawaj et al., 2018).

5. Conclusion

The analysis of large number of tests of thirteen smaller Miliolid and eight Lagenid foraminiferal benthic species in the Late Paleocene-Early Eocene of Ranikot and Laki Formations of the Nammal Gorge, Salt and Sor Ranges of Pakistan led to the following neritic conclusions: (1) Haque recorded thirteen smaller Miliolid foraminiferal species from different stratigraphic horizons of Pakistan, and two of them are treated her to be new: *Spiroloculina haquei* and *S. pakistanica* (Haque, 1956; 1960). (2) Eight Laginid foraminiferal species and subspecies are recorded, and one of them is treated as new: *Parafissurina pakistanica*, and all of these species are, so far, an endemic to Pakistan, except two species (*Astacolus vomeriformis* and *Vaginulinopsis nammalensis*) which recorded also in France in Northern Tethys. (3) Haque (1956) noted that the Ranikot beds of Pakistan may be correlated to the Esna Shale (Paleocene-Early Eocene) of Egypt, and many foraminiferal forms which were recorded from Europe, America and Egypt are also recorded in the Laki formation of Pakistan, which emphasizes the interpretations that have been presented by different authors about the extended realms of Indo-Pacific via ancestral Tethys, which was connected with the ancestral Atlantic Ocean (Haque, 1956). (4) Due to the high abundance of pelagic Pakistanian foraminiferal assemblage represents middle-outer neritic environment (100-200 m depth) and shows an affinity with " Midway-Type Fauna" of Berggren & Aubert while the smaller Miliolid in some horizons has only shallow marine environment (about 30 m) which range from marginal to deep, and some are tolerant of hyposalininity or hypersalinity as well as normal marine salinity (Berggren and Aubert, 1975).

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