7. SYSTEMATIC DESCRIPTIONS

In the present study, a total of 96 planktonic foraminiferal species and subspecies belonging to 17 different genera were identified from all three sections of the Sulaiman Range. One species *Globanomalina rakhiensis* sp. nov. is described as a new. In order to classify the planktonic foraminiferal taxa at generic level, apart from the general morphological characteristics, SEM-photomicrographs of the surface texture (Plate 13-15) were also taken and carefully studied. A vast quantity of literature was consulted during the identification; among them Blow (1979), Stainforth et al. (1975), Toumarkene and Luterbacher (1985), Loeblich and Tappan (1988), Berggren and Norris (1997), and Olsson et al. (1999) were particularly consulted for the classification. The synonymies of the planktonic foraminifers are restricted to original references plus some additional references that effected taxonomic change or provided good quality illustrations. SEM photographs of marker and other important species are presented in Plates 16 to 26.

7.1 Family **Chiloguembelina** Reiss, 1963

7.1.1 Genus ***Chiloguembelina*** Loeblich and Tappan, 1956

(Plate 13, Figures 9–10)

Remarks: Material from the Sulaiman Range has produced abundant small sized specimens. Their surface texture is not clear because the test surface is covered with small-sized recrystallized material (Plate 13, Figures 9-10).

Chiloguembelina goodwini (Cushman and Jarvis)

(Plate 13, Figures 9–10; Plate 26, Figures 23–24)

Gumbelina goodwini Cushman and Jarvis, 1933, p. 69, pl. 7, figs. 15a-16b.

Remarks: This species can easily be distinguished from other *Chiloguembelina* species because of its high but narrow and symmetric aperture.

Stratigraphic Distribution: *Chiloguembelina goodwini* is originally described from the upper Eocene of the Trinidad but the reported age range from middle to upper Eocene.

In the Sulaiman Range, it is recorded from all three sections and occurs in the *Morozovella lehneri, Orbulinoides beckmanni* and *O. beckmanni -Tr. rohri* zones (P12, P13 and P14 Zones).

Chiloguembelina crinita (Glaessner)

(Plate 21, Figures 9–10)

Gumbelina crinita Glaessner, 1937, p. 383, pl. 4, figs. 34a-b.

Chiloguembelina crinita (Glaessner); Olsson, Hemleben, Berggren and Huber, 1999, p. 90, pl.69, figs. 1-8; Loeblich and Tappan, 1957, p. 178, pl. 49, fig.1.

Remarks: This species is very small in size and is very distinctive due to large size of last two chambers covering nearly half of the entire test with a small aperture usually filled with material.

Stratigraphic Distribution: Olsson et al. (1999) has reported its age ranging from lower part of the *Glb. pseudomenardii* (P4) to lower part of *M. velascoensis-M. formosa formosa/ lensiformis* (P6A) zones.

In the Sulaiman Range, it is found only from the Rakhi Nala section and occurs in the *A. sold. soldadoensis-Glb. pseudomenardii* (P4B), *M. velascoensis* and *M. velascoensis-M. formosa formosa/ lensiformis* (P6A) zones.

***Chiloguembelina martini* (Pijpers)**

(Plate 26, Figures 4–5)

Texularia martini Pijpers, 1933, p. 57, text figs. 6–10.

Remarks: In general test morphology, this species shows variation in size and compression of the test. *Chiloguembilina martini* is very much similar to *Ch. woodi* (Samanta, 1973), however, chambers of the later are more globular. Moreover, the aperture of *Ch. martini* also differ from *Ch. woodi* (Samanta, 1973) in being asymmetrical and narrow.

Stratigraphic Distribution: Pijpers (1933) described its age as upper Eocene from Bonaire, Nehterlands West Indies. However, later Raju (1968) and Samanta (1973) have reported its age ranging from middle to upper Eocene.

In the Sulaiman Range, it is found in all three studied sections and occurs in the *Morozovella lehneri, Orbulinoides beckmanni* and *O. beckmanni-Tr. rohri* Zones (P12 to P14 Zones).

Chiloguembelina trinitaensis **(Cushman and Renz)**

(Plate 22, Figures 24–25)

Gumbelina trinitaensis Cushman and Renz, 1942, p. 8, pl. 2, figs. 8a-b.

Chiloguembelina trinitaensis (Cushman and Ponton); Olsson, Hemleben, Berggren and Huber, 1999, p. 92, pl.13, figs. 11, 16; pl. 70, figs. 8-10, 14.

Remarks: This species is very small in size and has slightly compressed test with low aperture often covered with some material. In general, this species resembles with *Ch. crinita.*

Stratigraphic Distribution: Cushman and Renz (1942) originally has reported its age as early Eocene from Soldado Formation, Midway Trinidad. Olsson et al. (1999) has reported this species from the *M. velascoensis* (P5) and lower part of *M. velascoensis-M. formosa formosa/ lensiformis* (P6A) zones.

In the Sulaiman Range, it is only found in the Rakhi Nala section and occurs in the *A. sold. soldadoensis-Glb. pseudomenardii* (P4B) Zone.

Chiloguembelina victoriana **Beckmann**

(Plate 26, Figures 12–13)

Chiloguembelina victoriana Beckmann, 1957, p. 91, pl. 21, figs. 19-20.

Remarks: This species has elongated and slightly compressed test which shows variation both in size as well as in twist in the basal part. The aperture of *Ch. victoriana* is very small usually with a fine lip.

Stratigraphic Distribution: Beckmann (1957) described its age as upper Eocene from San Fernando Formation, Trinidad.

In the Sulaiman Range, it is recognized only from the Zinda Pir eastern section and is present in the *Morozovella lehneri* Zone.

***Chiloguembelina wilcoxensis* (Cushman and Ponton)**

(Plate 21, Figures 27-28)

Gumbelina wilcosensis Cushman and Ponton, 1932, p. 66, pl. 8, figs. 16a-17b.

Chiloguembelina wilcoxensis (Cushman and Ponton); Olsson, Hemleben, Berggren and Huber, 1999, p. 92-93, pl.13, figs. 19-20; pl. 70, figs. 11-13, 15-18.

Remarks: This species is very distinctive and can readily be identified due to the rapid enlargement of its chambers, especially last four chambers giving the test a quadrate shape. It has very small aperture only seen in well-preserved specimens.

Stratigraphic Distribution: Cushman and Ponton (1932) has reported it from the Eocene fauna of Alabama. However, Olsson et al. (1999) has described its age as late Paleocene to early-early Eocene (P4 to P6a).

In the Sulaiman Range, it is recovered only from the Rakhi Nala section and occurs in the *M. velascoensis* (P5) and *M. velascoensis-M. formosa formosa/ lensiformis* (P6A) Zones.

Chiloguembelina woodi **Samanta**

(Plate 26, Figures 25–26)

Chiloguembelina woodi Samanta, 1973, p. 432, pl. 15, fig. 15-16.

Remarks: This species is first described by Samanta (1973) from the (one of the studied sections in this work) Rakhi Nala section. It resembles with *Ch. martini* very much but differs in having more globular chambers, and in possessing broad-subcircular symmetrical aperture.

Stratigraphic Distribution: Samanta (1973) has described this species from his *Truncorotaloides* Zone from Rakhi Nala section.

In this study, *Ch. woodi* is recognized from all three sections of the Sulaiman Range. But in my observations, its age ranges from the *Morozovella lehneri*, to the lower part of the *O. beckmanni-Tr. rohri* Zone that is more wide range than greported by Samanata (1973).

7.2 Family **Globigrinidae** Carpenter, Parker, and Jones, 1862

7.2.1 Genus ***Globigerinoides*** Cushman, 1927a

(Plate 13, Figures 15–16)

Remarks: This genus is distinguished due to its peculiar test morphology that is rapidly enlarging, loosely coiled and highly trochospiral. About the surface texture, Lobelich and Tappan (1988) have stated "surface coarsely perorate and spinose, pores at the base of shallow pits; the smooth spines circular in section and set on slightly raised basis". The material from the Sulaiman Range has yielded well-preserved *Globigerinoides* species (*Globigerinoides higginsi*) showing coarsely perforated and typical pore-pit surface texture (Plate 13, Figure 16).

Globigerinoides higginisi **Bolli**

(Plate 24, Figures 16–18)

Globigerinoides higginisi Bolli, 1957a, p. 164, pl. 36, figs. 11a-b; Blow, 1979, p. 862-864, pl. 183, figs. 7-9; pl. 184, figs. 1-7; Toumarkene and Luuterbacher, 1985, p. 128, Figs 28-14-16; Nishi et al., 1994, p. 542-543, Figs 6:1-3.

Globigerina higginsi (Bolli); Stainforth et al., 1975, p. 198, Fig. 52-1-8.

Remarks: *Globigerinoides higginsi* is very distinctive species and can easily be identified because of its high trochospiral test and loose coiling. It also has several secondary apertures but visible only in well-preserved specimen. The test surface is perforate showing typical pore-pit texture (Plate 13, Figures 15-16).

Stratigraphic Distribution: The reported age of this species is middle to late Eocene (Bolli, 1957a, Stainforth et al. 1975, Blow, 1979, Toumarkine and Luterbacher, 1985).

In this study, *Globigerinoides higginsi* is yielded from all three sections of the Sulaiman Range. It was recorded from Zones P9, P12 and P13.

7.3 Family **Catapsydracidae**

Bolli, Loeblich, and Tappan, 1957

7.3.1 Genus ***Catapsydrax*** Bolli, Loeblich, and Tappan, 1957

(Plate 14, Figures 15–16; Plate 15, Figures 1– 2; 3–4)

Remarks: This genus is quite similar to the genus *Subbotina* from which it differs in possessing umbilical bulla and accessory aperture. The genus *Globigerinatheka* differs from this genus in having more than one sutural bulla in addition to umbilical bulla. Moreover, Bolli, Loeblich, and Tappan (1957) have defined the test surface as "surface smooth or pitted". Material from Sulaiman Range also exhibits typical pore-pit surface texture (Plate 14, Figures 15-16). Some species (*C. echinatus*) have spines on the test surface (Plate 15, Figures 3-4).

Catapsydrax howei **(Blow and Banner)**

(Plate 14, Figures 15, 16; Plate 15, Figures 1, 2; Plate 23, Figures 1–3)

Globigerinita howei Blow and Banner, 1962, p. 109, figs. 11, x-xiv, pl. 14, figs. p-r; Samanta, 1973, p. 448, pl. 5, figs. 13-15.

Remarks: This species is easily distinguished from other species of the genus because of its single, large and inflated bulla.

Stratigraphic Distribution: Originally Blow and Banner (1962) have reported from late Eocene (*G. semi-involuta* Zone). However, middle to late Eocene age has been reported by several workers (Stainforth et al., 1975; Samanta, 1973).

In this study, *C. howei* occurs very commonly and is yielded from all three sections of the Sulaiman Range. It ranges in age from middle to late Eocene (Zone P12 to P15).

***Catapsydrax africana* (Blow and Banner)**

(Plate 23, Figures 7–9)

Globigerinita africana Blow and Banner, 1962, p. 105-106, Pl. 15, figs. A-C; text figs. II (I-ii); Samanta, 1973, p. 446, pl. 5, figs. 7-9.

Globigerinita echinata africana (Blow and Banner); Blow, 1979, p. 1336-1337, pl.24, figs. 1, 4; pl. 240, fig. 8.

Remarks: *Catapsydrax africana* possesses small and relatively less inflated umbilical bulla than that of the *C. howei.* Moreover, *C. africana* has three or four accessory apertures in the bulla whereas *C. howei* has only one aperture.

Stratigraphic Distribution: Blow and Banner (1962) has reported as late Eocene (*Globigeropsis semi-involuta* Zone or *Cribrohantkenina danvillensis* Zone). Stainforth et al., 1975 has reported this species from middle Eocene. However, Blow (1979) has described late Eocene age (his Zones P14 to P16) for this species.

In this study, *C. africana* is recognized from all three studied sections. It ranges in age from middle to late Eocene (Zone P12 to P15).

Catapsydrax echinatus Bolli

(Plate 23, Figures 13–15)

Catapsydrax echinatus Bolli, 1957a, p. 165-166, pl. 37, figs. 2-5.

Globigerinita echinatus (Bolli, 1957a); Blow, 1969, p. 268, 328; Samanta, 1973, p. 447, pl. 5, figs. 4-6; Stainforth et al., 1975, p. 182, fig. 46: 1-7.

Globigerinita echinata echinata (Bolli, 1957a); Blow, 1979, p. 1334-1336, pl. 240, fig. 7.

Remarks: This is the only species of the genus *Catapsydrax* that has spines on the test surface. It can easily be separated from the other *Catapsydrax* species based on this characteristic. Plate 15 (Figure 4) shows clearly the spines on the surface of the bulla, and also it exhibits that the bulla is finely perforated compared to the rest of the test.

Stratigraphic Distribution: Bolli (1957a) has first reported it from his *Globorotalia lehneri* Zone to *Truncorotaloides rohri* Zones (middle Eocene). Similar age has been reported by Stainforth et al., 1975. However, Blow (1979) has reported its age as middle to late Eocene (Zones P12 to P15 of Blow, 1979).

In this study, all three sections have yielded *C. echinatus*. It is recorded from Zone P12 to P13 (middle-middle Eocene).

Catapsydrax dissimilis (Cushman and Bermudez)

(Plate 23, Figures 18–19)

Globigerina dissimilis Cushman and Bermudez, 1937, p. 25, pl. 3, figs. 4-6.

Globigerinita dissimilis (Cushman and Bermudez); Samanta, 1973, p. 448, pl. 5, figs. 13-15.

Globigerinita dissimilis dissimilis (Cushman and Bermudez); Blow, 1979, p. 1328-1329, pl.241, figs. 2-3.

Catapsydrax dissimilis (Cushman and Bermudez); Bolli, Loeblich and Tappan, 1957, p. 36, pl. 7, figs. 6-8; Stainforth et al., 1975, p. 268, fig. 114:1-8; Bolli and Saunders, 1985, p.186-187, fig. 17:1-4.

Remarks: *Catapsydrax dissimilis* possesses small and relatively less inflated bulla restricted to the umbilical area with two to four accessory apertures. Some workers (Stainforth et al., 1975; Bolli and Saunders, 1985) have pointed out that it is difficult to separate this species into subspecies or to separate into different species based on the number of accessory apertures as done by others (Bolli, Loeblich and Tappan, 1957; Blow and Banner, 1962).

Stratigraphic Distribution: The reported range of this species is middle Eocene to early Eocene (Stainforth et al., 1975; Bolli and Saunders, 1985 etc.).

In this study, *C. dissimilis* is produced from all three studied sections. It ranges in age from middle to late Eocene (Zone P12 to P15).

Catapsydrax globiformis (Blow and Banner)

(Plate 23, Figures 16–17)

Globigerinita globiformis Blow and Banner, 1962, p. 108, Pl. 14, fig. s-u; Blow, 1979, p. 1337-1338, p. 197, figs. 7-9.

Remarks: Blow and Banner (1962) has described that the *Catapsydrax globiformis* has very small-test which possess large embracing but less inflated bulla. Material from the Sulaiman Range produces species of *Catapsydrax globiformis* that resemble very well with every respect with the original description.

Stratigraphic Distribution: Blow and Banner (1962) has reported the age of *Catapsydrax globiformis* as late Eocene. Blow (1979), however, has reported this species from older horizons (middle to late Eocene).

In this study, *Catapsydrax globiformis* is yielded from the Rakhi Nala and Zinda Pir eastern sections. It ranges in age from middle to late Eocene (Zone P12 to P15).

Catapsydrax martini (Blow and Banner)

(Plate 23, Figures 4–5, 10)

Globigerinita martini martini Blow and Banner, 1962, p. 110-111, Pl. 14, fig. O; Blow, 1979, p. 1341-1342, pl. 24, fig. 5; pl. 245, figs. 5-6.

Remarks: Originally Blow and Banner (1962) has described two subspecies based on the more stronger coiling, better lobulation and possessing more broader bulla in *Catapsydrax martini scandretti* as compared to *Catapsydrax martini martini.*

In the present material from the Sulaiman Range, *Catapsydrax martini martini* is only present as the other one occurs in much younger horizons. It can be distinguished from other *Catapsydrax* species due to its relatively elongate test with small and moderately inflated bulla restricted to the umbilical portion, and in having only one large accessory aperture.

Stratigraphic Distribution: Blow and Banner (1962) has reported the range of this species as middle to late Eocene and has stated that it do not extend into Oligocene. However, Blow (1979) has described its extended age from late Eocene to Oligocene (his Zone P14 to P18)

In this study, *Catapsydrax martini* is produced from the Zinda Pir western section (Zone P12) and also from the Rakhi Nala section (Zone P.12 to P14). Therefore its age in the Sulaiman Range can be late middle Eocene.

7.4 Family **Hantkeninidae** Cushman, 1927a

7.4.1 Genus ***Hantkenina*** Cushman, 1925a

(Plate 14, Figures 13–14)

Remarks: This short ranging (middle to late Eocene) genus is stratigraphically very important and is readily distinguished from all other genera due to its characteristic planispiral and involute test with very unique type of spines. Material from the Sulaiman Range has produced rare to common but well-preserved specimens. Plate 14 (Figure14) shows typical finely perforate test surface.

Hantkenina alabamensis Cushman

(Plate 26, Figures 6–8)

Hantkenina alabamensis Cushman, 1925a, p. 3, pl. 1, fig. 1; Stainforth et al., 1975, p. 165, 167, Figure: 1-7; Subbotina, 1953, p. 133-134, pl. 1, figs. 6-7; Blow and Banner, 1962, p.126-127, pl. XVI, figs. c, d, j, k; Postuma, 1971, p. 224, figs. on p. 225; Toumarkine and Luterbacher, 1985, p. 123, fig. 25: 1-10.

Hantkenina (Hantkenina) alabamensis alabamensis (Cushman); Blow, 1979, p. 1157-1161, p. 189, figs. 1-9.

Remarks: Toumarkine and Luterbacher (1985) has put the species like *Hantkenina longispina* and *Hantkenina brevispina* within the variation of the *Ht. alabamensis*. *Ht. alabamensis* species can be distinguished because of its long spines present at apical positions of the chambers. It has high-arched, long and narrow slit-like symmetrical aperture and has somewhat tightly coiled test.

Stratigraphic Distribution: The reported age of this species is middle to late Eocene (Stainforth et al., 1975; Toumarkine and Luterbacher, 1985 etc.).

In this study, *Hantkenina alabamensis* is yielded only from the Rakhi Nala section. It is recognized from the upper part of the *Morozovella lehneri* Zone (middle Eocene). Dorreen (1974) has also reported this species from Kirthar Range, Indus Basin.

Hantkenina dumblei Weinzierl and Applin

(Plate 26, Figures 1–3)

Hantkenina dumblei Weinnzerl and Applin, 1929, p. 402, pl. 43, figs. 5a-b; Raju, 1968, p. 290, pl. 1, fig. 5; Postuma, 1971, p. 222, Figures on p. 223 (part); Samanta, 1973, p. 471-472, pl. 7, fig. 18; Toumarkine and Luterbacher, 1985, p. 123, Figure 24: 1-5.

Remarks: *Hantkenina dumblei* has compressed test compared to other *Hantkenina* species. The shape of the chambers of this species which tends to fuse each other and are arranged tangentially are the basis to distinguish it form *H. mexicana* and *H. alabamensis.*

Stratigraphic Distribution: Middle Eocene age is reported by most of the workers (Samanta, 1973; Postuma, 1971; Toumarkine and Luterbacher, 1985 etc).

In this study, *Hantkenina dumblei* is yielded from the Rakhi Nala and Zinda Pir western sections. Its age ranges from Zone P12 to within Zone P13 (middle Eocene).

Hantkenina mexicana Cushman

(Plate 26, Figures 14–16)

Hantkenina mexicana Cushman, 1925a, p. 3, pl. 2, fig.2; Raju, 1968, p. 290, pl. 1, fig.1; Postuma, 1971, p. 222, Figures on p. 223 (part); Samanta, 1973, p.

473, pl. 7, fig. 16-17; Toumarkine and Luterbacher, 1985, p. 123, fig. 23: 8-11.

Hantkenina (Aragonella)mexicana mexicana (Cushman, 1925a); Blow, 1979, p.1166-1168, pl. 167, figs. 1-5; pl. 239, figs. 1-6.

Remarks: *Hantkenina mexicana* differ from other *Hantkenina* species in possessing a stellate-shaped test.

Stratigraphic Distribution: Most of the workers have said that the age of this species is restricted to middle Eocene (e.g. Blow, 1979; Toumarkine and Luterbacher, 1985 etc.).

In this study, *Hantkenina mexicana* is recorded from the Rakhi Nala section with rare occurrence from the upper part of the *Morozovella lehneri* Zone (middle Eocene). Previous workers (Latif, 1961; Samanta, 1973; Dorreen, 1974) have not reported this species from any part of the Indus Basin.

***Hantkenina longispina* Cushman**

(Plate 26, Figures 9–11)

Hantkenina longispina Cushman, 1925a, p. 2, pl. 2, fig. 4; Stainforth et al., 1975, p. 202, Figure 64: 1-6; Subbotina, 1953, p. 134-135, pl. 1, figs. 8-10.

Remarks: *Hantkenina longispina* differ from other *Hantkenina* species being less lobate and having longer spines.

Stratigraphic Distribution: Middle to late Eocene age has been reported (e.g. Stainforth et al., 1975).

In this study, *Hantkenina longispina* is recorded from the Rakhi Nala section only with rare occurrence from the upper part of the *Morozovella lehneri* Zone (middle Eocene). Previous workers (Latif, 1961; Samanta, 1973; Dorreen, 1974) have not reported this species from any part of the Indus Basin.

7.5 Family **Hastigerinidae** Bolli, Loeblich, and Tappan, 1957

7.5.1 Genus ***Hastigerina*** Thomson, 1876

Hasigerina cf. ***bolivariana*** Toumarkine and Luterbacher

(Plate 24, Figures 28–30)

Remarks: Toumarkine and Luterbacher (1985) has described and figured a number of species which are less planispiral and possess less globular last chamber compared to original *Hastigerina bolivariana* (Petters, 1954).

Stratigraphic Distribution: Toumarkene and Luterbacher (1985) has reported its age as whole middle Eocene.

In this work, *Hastigerina* cf. *bolivariana* occured quite commonly in all three sections. It is recorded from Zone P10 to the lower part of Zone P15. Therefore it is found in entire middle Eocene as described (Toumarkene and Luterbacher, 1985) but range a little higher that is up to the early Eocene.

Hasigerina bolivariana Petters

Hasigerina bolivariana Petters, 1954, p. 39, pl. 8, figs. 9a-c; Toumarkine and Luterbacher, 1985, p. 126, fig. 27.24-29.

Remarks: This species looks nearly planispiral from side view with low arch-shaped aperture slightly extending towards ventral side than the dorsal one.

Stratigraphic Distribution: The reported age of this species is middle Eocene.

In this study, *H. bolivariana* is yielded only from the Zinda Pir west section. It occurs in the Zone P12.

7.6 Family **Truncorotaloididae** Loeblich and Tappan 1961

7.6.1 Genus ***Acarinina*** Subbotina, 1953

(Plate 14, Figures 1–8)

Acarinina bullbrooki (Bolli)

(Plate 25, Figures 4–5, 10)

Globorotalia bullbrooki Bolli, 1957, p. 167, pl. 38, figs. 5a-b; Stainforth et al., 1975, p. 174-175, fig. 40: 1-5.

Acarinina bullbrooki (Bolli); Toumarkine and Luterbacher, 1985, p. 130, fig. 29: 4-10; Snyder and Waters, 1985, p. 459, pl. 6, figs. 7-9; Nishi, Ashraf, and Ishizaki, et al., 1994, p. 538, fig. 6: 16-18.

Globorotalia (*Acarinina*) *bullbrooki* (Bolli); Blow, 1979, p. 915-917, pl. 149, figs. 8-9; pl. 155, figs. 1-8; pl. 171, figs. 1-3, 7-9.

Stratigraphic Distribution: The reported age of this species is middle Eocene.

In this study, *A. bullbrooki* is yielded from all three studied sections and occurs in P8 to P14 Zones.

Acarinina coalingensis (Cushman and Hana)

(Plate 17, Figures 17-19)

Globigerina coalingensis Cushman and Hana, 1927, p. 219, pl.14, fig. 4.

Globorotalia (*Acarinina*) *primitiva* (Finlay); Blow, 1979, p. 949-951, pl. 143, figs. 6-9; pl. 249, figs. 1-4.

Globorotalia primitiva (Finlay); Stainforth et al., 1975, p. 215, fig. 75: 1-5.

Globigerina primitiva (Finlay); Postuma, 1971, p. 154, figs. on p. 155.

Globorotalia (*Acarinina*) *primitiva* (Subbotina); Blow, 1979, p. 963-964, pl. 97, figs. 8-9.

Acarinina triplex Subbotina, 1953, p. 230, pl. 23, figs. 1-5; Toumarkine and Luterbacher, 1985, p. 116, fig. 17: 6-7.

Acarinina primitiva (Finlay); Pearson et al., 1993, p. 125, pl. 1, fig. 19.

Acarinina coalingensis (Cushman and Hana); Berggren and Norris, 1997, p. 68, pl. 11, figs. 16-20, 22-23; Olsson et al., 1999, p. 47, pl. 39, figs. 1-16.

Remarks: Berggren and Norris (1997) and Olsson et al. (1999) have discussed in detail the morphological variations of this species. They have stated "there are two basic types that characterize this robust and strongly muricate species: a form with triangular-subquadrate appearance characterized by globular

chambers (typified by *Globigerina coalingensis* Cushman and Hana, (1927) and its junior synonym *Acarinina triplex* Subbotina, 1953), and forms with a subquadrate to quadrate appearance characterized by straight and circumumbilical pointed, smooth (nonmuricate) globoquadrinid-like chambers (typified by *Globoquadrina primitiva* Finlay, 1947)". They have grouped these two forms together under *Acarinina coalingensis* (Cushman and Hana), and in this study, same concept is adopted and applied.

Stratigraphic Distribution: The reported age of this species is late Paleocene to middle Eocene (*M. velascoensis* to *O. beckmanni* Zones). However, Berggren and Norris (1997) and Olsson et al. (1999) have reported the age range of this species from the *A. soldadoensis –Glb. pseudomenardii* Zone (Zone P4c) to *Tr. rohri-M. spinulosa* Zone (Zone P14).

In this study, *A. coalingensis* is produced from all three studied sections and occurs common to abundantly in P3B to P12 Zones.

***Acarinina esnaensis* (LeRoy)**

(Plate 21, Figure 21–22, 26)

Globigerina esnaensis LeRoy, 1953, p. 31, pl. 6, figs. 8-10.

Acarinina esnaensis (LeRoy); Nishi, Ashraf and Ishizaki, 1994, p. 538.

Globorotalia esnaensis (LeRoy); Samanta, 1973, p. 457, pl. 15, figs. 7-9.

Stratigraphic Distribution: The reported age of this species is late Paleocene to early Eocene.

In this study, all three sections have produced *A. esnaensis*. It occurs in P6A to P8 Zones.

Acarinina mckannai (White)

(Plate 14, Figures 5–6; Plate 17, Figures 1–3)

Globigerina mckannai White, 1928, p. 194, pl. 27, figs. 16a-c; Loeblich and Tappan, 1957, p. 181, pl. 47, figs. 7a-c; pl. 53, figs. 1a-2c; pl. 57, figs. 8a-c, pl. 62, figs. 7a-c; Stainforth et al., 1975, p. 205, fig. 66: 1-4; Samanta, 1973, p. 439, pl. 4, figs. 13-15.

Globorotalia mckannai (White); Bolli, 1957b, pl. 79, figs. 16-18.

Acarinina mckannai (White); Toumarkine and Luterbacher, 1985, p.116, fig. 18: 3-6.

Muricoglobigerina mckannai (White); Blow, 1979, p. 93, fig. 5.

Acarinina mckannai (White); Berggren and Norris, 1997, p.65, pl. 11, figs. 1-3, 5, 7; Olsson et al., 1999, p. 48, pl. 40, figs. 1-16.

Remarks: *Acarinina mckannai* differs from *A. nitida* in being larger in size. *Acarinina mckannai* possesses five to seven chambers in the last whorl instead *Acarinina nitida* has only four. Moreover, *Acarinina mckannai* usually possess an aborted last chamber.

Stratigraphic Distribution: The reported age of this species is middle to late Paleocene (*Globorotalia pusilla pusilla* to *M. velascoensis* Zones). However,

Berggren and Norris (1997), and Olsson et al. (1999) have reported slightly more restricted age of this species (P4a to P4c).

In this study, *A. mckannai* recognized from all three studied sections and it occurs quite commonly. It is recognized from P3B to P4B Zones.

Acarinina nitida (Martin)

(Plate 17, Figures 4–5, 10)

Globigerina nitida Martin, 1943, p. 115, pl. 7, figs. 1a-c; Stainforth et al., 1975, p. 208, fig. 69: 1-6; Samanta, 1970, p. 611, pl. 95, figs. 9-10.

Acarinina acarinata Subbotina, 1953, p. 229-230, pl. 22, figs. 4-10

Acarinina mckannai (Martin); Toumarkine and Luterbacher, 1985, p.116, fig. 18: 1a-2c.

Acarinina mckannai (Martin); Berggren and Norris, 1997, p.65, pl. 10, figs. 10-14, 17-17; Olsson et al., 1999, p. 48, pl. 41, figs. 1-16.

Stratigraphic Distribution: The reported age of this species is middle to late Paleocene (*Globorotalia pseudomenardii* to *M. formosa formosa* Zones). Berggren and Norris (1997) has reported its age from late Paleocene to early Eocene (Zones P4 to P6/P6a c). Olsson et al. (1999) has reported more restricted age as late Palepcene (P4a to P4c).

In this study, *A. nitida* is yielded from all three studied sections and it occurs commonly. Its age ranges from P3B to P8 Zones (late Paleocene to middle-early Eocene).

Acarinina quetra (Bolli)

(Plate 22, Figures 13–15)

Globorotalia quetra Bolli, 1957b, p. 79-80, pl. 19, figs. 1-6; Samanta, 1973, p. 463, pl. 10, figs. 5-7; Stainforth et al., 1975, p. 221, fig. 80: 1-5c.

Morozovella quetra (Bolli); Toumarkine and Luterbacher, 1985, p. 114, fig. 15: 4a-5c.

Remarks: *Acarinina quetra* is quite similar with *A. wilcoxensis* in general test-morphology. It differs from *Acarinina wilcoxensis* in having more angular aspect of periphery like middle Eocene *Truncorotaloides topilensis* species, and on the spiral side chambers are nearly at right angles to each other.

Stratigraphic Distribution: The reported age of this species is early Eocene (*Globorotalia subbotinae* to *G. pentacamerata* Zones).

In this study, *A. quetra* is recognized from all three studied sections and occurs commonly. It is found in P7 to P8 Zones (middle-early Eocene).

Acarinina pentacamerata (Subbotina)

(Plate 22, Figures 16–18)

Globorotalia pentacamerata, Subbotina, 1947, p. 128-129, pl. 12-17, figs. 24-26; Stainforth, et al., 1975, p. 212-213, fig. 73: 1-6.

Acarinina pentacamerata (Subbotina); Subbotina, 1953, p. 233-234, pl. 23, fig. 8, pl. 24, figs. 1-9; Toumarkine and Luterbacher, 1985, p. 116, fig. 17: 5a-c.

Globorotalia aspensis Colom, 1954, p. 151-154, pl. 3, figs. 1-5, pl. 4, figs. 1-3; Bolli, 1957a, p. 166-167, pl. 37, figs. 18a-c; Postuma, 1971, p. 174, figs. on p. 175; Samanta, 1973, p. 452-453, pl. 15, figs. 10-12.

Acarinina aspensis (Colom, 1954); Nishi, Ashraf and Ishizaki, 1994, p. 538, fig. 7: 4-6; Blow, 1979, p. 908-911, pl. 148, figs. 7-9; pl. 153, figs. 5-6; pl. 157, figs. 1-6; pl. 165, figs. 5-6; pl. 203, fig. 6.

Acarinina pentacamerata pentacamerata (Subbotina); Nishi, Ashraf and Ishizaki, 1994, p. 539, fig. 7: 10-11.

Remarks: *Acarinina pentacamerata* has large test and contains five to eight chambers (Globigerina-like) in the last whorl. Its umbilicus is usually very open and deep. Some workers (Stainforth, et al., 1975) have put the *A. aspensis* in synonymy with it whereas others (e.g. Nishi et al., 1994) have separated. In this study all these forms are included within the variation of the *A. pentacamerata*

Stratigraphic Distribution: Early to middle Eocene (*Globorotalia aragonensis* Zone to *M. lehneri* Zone) age has been reported by most of the workers (Stainforth et al., 1975; Toumarkine and Luterbacher, 1985 etc.).

In this study, *A. pentacamerata* is recognized from all three studied sections and it occurs common to abundantly. It is found from the base of Zone P8 to Zone P10.

Acarinina pseudotopilensis Subbotina

(Plate 21, Figure 15–17)

Acarinina pseudotopilensis Subbotina, 1953, p.227-228, pl.21, figs. 1-3; Hubber, 1985, p. 439, pl.1, figs. 17-19; Karasheninkove and Hoskin, 1973, p. 120, pl. 3, figs. 7-9.

Globorotalia pseudotopilensis (Subbotina); Stainforth et al., 1975, p. 217, fig. 78: 1-7.

Globorotalia (*Acarinina*) *pseudotopilensis* (Subbotina); Blow, 1979, p. 955-957, pl. 110, figs. 2-9; pl. 113, figs. 1-6; pl. 132, figs. 1-3.

Remarks: *Acarinina pseudotopilensis* resembles with *A. wilcoxensis* from which it can be distinguished in having more rounded axial periphery.

Stratigraphic Distribution: The reported (Satinforth et al., 1975; Blow, 1979 etc.) age of *Acarinina pseudotopilensis* is the late Paleocene to early Eocene (*Globorotalia pseudomenardii* Zone to *G. aragonensis* Zone).

In this research work, *Acarinina pseudotopilensis* is recognized from all three sections but occurs not so commonly. It is found in Zones P6A to P9 (early Eocene).

Acarinina soldadoensis angulosa (Bolli)

(Plate 22, Figures 19–20, 26)

Globigrina soldadoensis angulosa Bolli, 1957b, p. 71, pl. 16, figs. 4-6; Bolli, 1957a, p. 162, pl. 35, fig. 8.

Globigerina soldadoensis angulosa (Bolli); Stainforth et al., 1975, p. 228-229, fig. 86: 1-4.

Muricoglobigerina soldadoensis soldadoensis (Bolli); Blow, 1979, p. 1122-1123, pl. 109, figs. 9; pl. 131, figs. 4.

Acarinina soldadoensis angulosa (Bolli); Toumarkine and Luterbacher, 1985, p. 116, fig. 17: 3a-c

Remarks: *Acarinina soldadoensis angulosa* contains only four chambers in the last whorl which are axially elongate, imbricate on spiral side and have more angular relationship on both sides. These features distinguish it from *A. soldadoensis soldadoensis.*

Stratigraphic Distribution: The reported age of *Acarinina soldadoensis angulosa* is early Eocene (*M. formosa formosa* Zone to *A. pentacamerata* Zone).

In this study, all of the studied sections have yielded *A. soldadoensis angulosa* but its occurrence is not so common. Its is recorded from Zones P7 to P9.

Acarinina soldadoensis soldadoensis **(Bronnimann)**

(Plate 17, Figures 6, 11–12; 13–15)

Globigerina soldadoensis Bronniman, 1952, p. 7, 9, pl. 1, figs. 1-9; Bolli, 1957b, p. 71, pl. 16, figs. 7-9; Postuma, 1971, p. 158, figs. on p. 159.

Globigerina soldadoensis soldadoensis (Bronniman); Stainforth et al., 1975, p. 229-230, fig. 87: 1-5.

Acarinina soldadoensis (Bronniman); Krasheninnikov and Hoskins, 1973, p. 122, pl. 3, figs. 10-12; Nishi, Ashraf and Ishizaki, 1994, p. 540, fig. 6: 10-12; Berggren and Norris, 1997, p. 68, pl. 11, figs. 6, 8-15, 21; Olsson et al., 1999, p. 50, pl. 15, figs. 4, 7-8; pl. 42, figs. 1-16.

Muricoglobigerina soldadoensis soldadoensis (Bronniman); Blow, 1979, p. 1120-1121, pl. 98, figs. 1-3; pl. 107, figs. 1-5; pl. 109, figs. 8; pl. 110, fig. 1; pl. 124, figs. 1, 3, 5; pl. 131, figs. 1-3, 6; pl. 235, fig. 6.

Acarinina soldadoensis soldadoensis (Bronniman); Toumarkine and Luterbacher, 1985, p. 115, fig. 17: 1a-2c

Remarks: This species contains four to five chambers in the last whorl and has flat spiral side. *A. wilcoxensis* has more angular periphery.

Stratigraphic Distribution: The reported age of *Acarinina soldadoensis soldadoensis* ranges from late-late Paleocene (*M. velascoensis*) to late early Eocene (*A. pentacamerata* Zone) as reported by most of the workers (Stainforth et al., 1975, Toumarkine and Luterbacher, 1985, Berggren and Norris, 1997, Olsson et al., 1999 etc.)

In this study, *A. soldadoensis soldadoensis* is produced from all of the studied sections. It occurs common to abundantly. Its age ranges from Zone P5 to lower part of Zone P10.

Acarinina spinuloinflata (Bandy)

(Plate 24, Figures 19–20, 25)

Globigerina spinuloinflata Bandy, 1949, p. 122, pl. 23, figs. 1a-c.

Acarinina spinuloinflata (Bandy); Toumarkine and Luterbacher, 1985, p. 130, fig. 29: 2a-3c; Nishi, Ashraf and Ishizaki, p. 540, fig. 6: 19-21.

Globorotalia (*Acarinina*) *spinuloinflata* (Bandy); Blow, 1979, p. 959-960, pl. 249, figs. 5-7.

Remarks: This species is similar to *A. bullbrooki*, however, it differs in having rounded periphery and less angular shape of chambers in the last whorl.

Stratigraphic Distribution: The reported age of *Acarinina spinuloinflata* is from the late early Eocene to late-late middle Eocene.

In this study, a few specimens of *A. spinuloinflata* are recognized only from the Zinda Pir eastern section. It is recorded from P8 and P9 Zones.

Acarinina strabocella (Loeblich and Tappan)

(Plate 16, Figures 15–17)

Globorotalia strabocella Loeblich and Tappan, 1957, p.195, pl. 61, fig. 6a-c.

Globorotalia (*Acarinina*) *strabocella* (Loeblich and Tappan); Jenkines, 1971, p. 84, pl. 4, figs. 102-104.

Acarinina strabocella (Loeblich and Tappan); Berggren and Norris, 1997, p. 64, pl. 10, figs. 1-9; pl. 13, figs. 20-21; Olsson et al., 1999, p. 50-52, pl. 15, fig. 4, 7-8; pl. 42, fig. 1-16.

Stratigraphic Distribution: Berggren and Norris (1997) and Olsson et al. (1999) have reported the age of this species late Paleocene (lower part of Zone P3 to lower part of Zone P4).

In this study, *A. strabocella* is yielded from the Rakhi Nala and Zinda Pir eastern sections where it occurs not so commonly. It is found in the Zone P3b and lower part of Zone P4.

Acarinina subsphaerica (Subbotina)

(Plate 17, Figures 7–9)

Globigerina subsphaerica Subbotina, 1947, p. 108, pl. 5, figs. 26-28.

Globorotalia (*Acarinina*) *subsphaerica* (Subbotina); Blow, 1979, p. 960-961, pl. 91, figs. 4-6; pl. 92, figs. 1-3; pl. 93, fig. 6.

Acarinina subsphaerica (Subbotina); Berggren and Norris, 1997, p. 66, pl. 10, figs. 15,18-23; pl. 11, fig. 4; Olsson et al., 1999, p. 52, pl. 15, figs. 9-10, pl. 44, figs. 1-16.

Remarks: Some workers (Stainforth et al., 1975; Toumarkine and Luterbacher, 1985 etc.) have put this species in synonymy with *A. mckannai,* however, others (Berggren and Norris, 1997; Olsson et al., 1999) have described the two as separate species. *Acarinina mckannai* has larger test, open umbilicus and less convex spiral side compared with *A. subsphaerica*. Moreover, *Acarinina subsphaerica* has relatively high spire.

Stratigraphic Distribution: The reported age of this species is middle to late Paleocene (*Globorotalia pseudomenardii* to *M. formosa formosa* Zones). Berggren and Norris (1997) have reported very restricted age (Zones P4a). However, my results (Warraich, Ogawarara and Nishi, 1999) have shown that *A. subsphaerica* and *A. sold. soldadoensis* were found overlapping each other, and hence *A. subsphaerica* can not be used as the index fossil in the three-fold subdivision of Zone P4. Olsson et al. (1999) have also reported similar results and have given Zone P4a but have commented its extended age up to Zone P5 as reported by Lu and Keller (1995a).

In this study, all three studied sections have yielded *A. subsphaerica*. its occurrence is not so common. Its age ranges from P4A to P4B Zones.

Acarinina wilcoxensis (Cushman and Ponton)

Globorotalia wilcoxensis Cushman and Ponton, 1932, p. 71, pl. 9, figs.10a-c; Stainforth et al., 1975, p. 243, fig. 98: 1-5; Bolli, 1957b, p. 79, pl. 19, fig. 7-9; Samanta, 1973, p. 469.

Stratigraphic Distribution: Late Paleocene to early Eocene age has been reported (*M. velascoensis* to *M. formosa formosa* Zones).

In this study, *A. wilcoxensis* is recognized from all three studied sections and it occurs quite commonly. Its age ranges from P5 to P8 Zones.

7.6.2 Genus *Igorina* Davidzon, 1976

(Plate 14, Figures 11–12)

Remarks: The group of species that are neither morozovellids nor acarininids in their test morphology are treated as a different group (genus), in this study such species are grouped under the genus *Igorina*.

Igorina albeari (Cushman and Bermudez)

(Plate 16, Figures 10, 14, 18)

Globorotalia albeari Cushman and Bermudez, 1949, p. 33, pl. 6, figs. 13-15; Cifelli and Belford 1977, p. 102, pl.1, figs. 4-6.

Igorina albeari (Cushman and Bermudez); Lu and Keller, 1995, p. 102, pl. 4, figs. 1-3; Berggren and Norris 1997, p. 60-61, pl. 9, figs. 10, 14, 15, 18-19, 21-23; Olsson, Hemleben, Berggren and Huber, 1999, p. 69-70, pl. 16, figs. 1-6; pl. 56, figs. 1-16.

Morozovella albeari (Cushman and Bermudez); Berggren 1977, P.226-27, pl. 3.

Globorotalia (Globorotalia) albeari Cushman and Bermudez; Blow, 1979, p. 883-85, pl. 92, figs. 4, 8, 9; pl. 93, figs. 1-4.

Planorotalite albeari (Cushman and Bermudez); Nishi, Ashraf, and Ishizaki, 1994, p. 554-555, fig. 8-15-17.

Globorotalia pusila levigata Bolli 1957b, p. 78, pl. 20, figs. 5-7; Bolli and Cita 1960, p. 27, pl. 32, figs. 6a-c; Mckgowran 1965, p.63, pl. 6, fig. 4.

Globorotalia levigata (Bolli); Postuma, 1971, p. 196, figs. on p. 197.

Remarks: This species exhibits variation in the convexity of the spiral side. It can be separated easily from *I. pusilla* because of its distinctly more convex spiral side and very cute keel at periphery.

Stratigraphic Distribution: The reported age range of this species is from Zone P3b to P4b (Berggren and Norris, 1997, Olsson et al., 1999).

In this work, *Igorina albeari* occurs sporadically in all three sections of the Sulaiman Range. It is recorded from Zone P3B to the lower part of Zone P4B.

Igorina broadermanni (Cushman and Bermudez)

(Plate 21, Figure 18–20)

Globorotalia (Truncorotalia) broadermanni Cushman and Bermudez, 1949, p. 40, pl. 7, figs. 22-24.

Globorotalia broadermanni (Cushman and Bermudez); Bolli, 1957b, p. 80, pl.19, figs. 13-15.

Remarks: This species shows variation in size, number of chambers, degree of convexity of the dorsal side, shape of the last chamber, shape of the dorsal sutures and shape of the periphery.

Stratigraphic Distribution: The reported age of this species is from early Eocene to middle Eocene (Stainforth et al., 1975, Toumarkine and Luterbacher, 1985 etc).

In this work, *Igorina broadermanni* occurs common to abundantly in all the studied sections. In the Sulaiman Range, it is recognized from P6A to P13 Zones.

Igorina pusilla (Bolli)

(Plate 16, Figures 19–21)

Globorotalia pusilla pusilla Bolli, 1957b, p.78, pl. 20, figs. 8-10; Bolli and Cita, 1960, p. 388-389, pl. 34, figs. 4a-c; Stainforth et al., 1975, p. 217, 220-221, fig. 79: 1-9.

Globorotalia pusilla (Bolli); Postuma, 1971, p. 206, figs. on p. 207.

Morozovella pusilla pusilla (Bolli); Snyder and Waters, 1985, p. 446, 449, 460, pl. 8, figs. 15-17.

Planorotalites pusilla pusilla (Bolli); Toumarkine and Luterbacher, 1985, p. 108, Figure 12: 13a-14c.

Igorina pusilla (Bolli); Berggren and Norris, 1997, p. 59-60, pl. 9, figs. 1-2, 5, 6, 11; Olsson et al.,1999, p. 70-71, pl. 16, figs. 7-9; pl. 57, figs. 1-16.

Stratigraphic Distribution: The reported age of this stratigraphically important species is from Zone P3 to P4 (Toumarkine and Luterbacher, 1985, Berggren and Norris, 1997, Olsson et al., 1999 etc.).

In this work, all three sections have yielded *Igorina pusilla.* It occurs commonly and is recognized from P3B to P4B Zones.

Igorina tadjikistanensis (Bykova)

(Plate 16, Figures 11–13)

Globorotalia tadjikistanensis Bykova, 1953, p.86, pl.3, figs. 5a-c; Samanta, 1973, p.466, pl. 8, figs. 10-12.

Igorina tadjikistanensis (Bykova); Berggren and Norris, 1997, p. 61-62, pl. 9, figs. 8-9, 12-13, 16-17,20, 24; Olsson et al., 1999, p. 71-72, pl. 11, figs. 1-9; pl. 58, figs. 1-12.

Globorotalia convexa Subbotina, 1953, p. 209, pl. 17, figs. 2a-c, 3a-c; Loeblich and Tappan, 1957, p. 188, pl. 48, figs. 4a-c, pl. 50, figs. 7a-c, pl. 35, figs. 6a-8c, pl. 57, figs. 5a-7c, pl. 63, figs. 4a-c.

Remarks: This species is large in size, has flat dorsal side and exhibits some muricate ornamentation especially around the umbilical portion of the test. *Igorina albeari* and *I. pusilla* are smaller but differ from *I. tadjikistanensis* in having more convex spiral sides and possess peripheral keel. Moreover, *I. tadjikistanensis* is more lobulate than other *Igorinids.*

Stratigraphic Distribution: Berggren and Norris (1997) has reported the age of this species from Zone P3b to P5, however, Olsson et al., (1999) has reported its extended age (Zone P3b to P7).

In this work, *Igorina tadjikistanensis* is yielded from all of the studied sections. Its occurrence is recorded as common to abundant. In the Sulaiman Range, it also range from P3B to P7 which is similar with the age reported by Olsson et al., (1999).

7.6.3 Genus ***Morozovella*** McGowran in Luterbacher, 1964

(Plate 13, Figures 1–2)

***Morozovella acuta* (Toulmin)**

(Plate 19, Figures 1–3; Plate 19, Figures 4–5, 10)

Globorotalia wilcoxensis Cushman and Ponton var. *acuta* Toulmin, 1941, p. 608, pl. 82, figs. 6-8.

Globorotalia acuta Toulmin; Loeblich and Tappan, 1957, p. 185-186, pl. 47, figs. 5a-c; Stainforth et al., 1975, p. 163, fig. 30: 1-5.

Morozovella acuta (Toulmin); Samanta, 1973, p. 450, pl. 10, figs. 8-10; Toumarkine and Luterbacher, 1985, p. 111, Figure 14: 7-8; Berggren and Norris, 1997, p. 82-84, pl.15, figs. 19-21; Olsson et al., 1999, p. 55-56.

Globorotalia parva (Ray); Samanta, 1970, p. 628–629, pl. 97, figs 3-4; Samanta, 1973, p. 460, pl. 9, figs 4-6.

Globorotalia (*Morozovella*) *velascoensis parva* (Rey); Blow, 1979, p. 1030-1031, pl. 95, figs. 3-6.

Remarks: This is very distinctive species with flat dorsal and conical umbilical side. It is quite similar with *M. velascoensis* in test morphology from which in mainly differs in having less chambers (four) in the last whorl and being less ornamentation around umbilicus. Moreover it also has less thicker and less ornamented keel compared to *M. velascoensis.* There are several closely similar forms of *M. velascoensis* group which are separated as different species by several workers and this is well discussed in Olsson et al., 1999. These two forms

that I consider as variation within the *M. acuta*, are separated by others (Samanata, 1970; 1973; Blow, 1979 etc).

Stratigraphic Distribution: Most of the workers (Samanta, 1973; Stainforth et al., 1975; Luterbacher and Toumarkine, 1985) have reported late-early Paleocene to earliest Eocene age of this species. More recently, Berggren and Norris (1997) and Olsson et al., 1999 have reported its age from late Paleocene (upper part of *Glb. pseudomenardi* Zone) to early Eocene (*M. velascoensis* Zone).

In this work, *M. acuta* occurs common to abundantly in all of the studied sections. Its age ranges from P4A to P6B which is similar with the age reported by Olsson et al., (1999) and others.

Morozovella acutispira (Bolli and Cita)

(Plate 19, Figures 7–9)

Globorotalia acutispira Bolli and Cita, 1960, p. 15, pl.33, figs. 3a-c.

Globorotalia kolchidica Morozova, 1961, p. 17, pl. 2, figs. 2a-c; Stainforth et al., 1975, p. 194, 197, figs. 58: 1-5; Snyder and Waters, 1985, p. 446, pl. 8, figs. 10-12.

Morozovella acutispira (Bolli and Cita); Berggren and Norris, 1997, p. 78, pl. 16, figs. 16, 18; Olsson et al., 1999, p. 56-57, pl. 46, figs. 1-15.

Remarks: This is a distinct keel bearing Paleocene *Morozovellid* species. This species resembles with *M. acuta* from which it differs in having more

ornamentation around the umbilicus like *M. velascoensis*. It is also quite similar to *M. marginodentata* but later has more pronounced and pinched peripheral keel. A detailed discussion about its taxonomy is given in Berggren and Norris, (1997) and Olsson et al. (1999).

Stratigraphic Distribution: Middle to late Paleocene (*M. angulata* to *Glb. pseudomenardii* Zone) age has been reported (Stainforth et al., 1975; Berggren and Norris, 1997, and Olsson et al., 1999).

In this work, *M. acutispira* is yielded from the Rakhi Nala and Zinda Pir western sections. It occurs in the Zones P3B and P4.

Morozovella aequa (Cushman and Renz)

(Plate 19, Figures 20–21, 25)

Globorotalia crassata (Cushman) var. *aequa* Cushman and Renz, 1942, p. 12, pl. 3, figs. 3a-c.

Globorotalia aequa Cushman and Renz; Bolli, 1957b, p. p. 74, pl. 17, figs. 1-3; pl. 18, figs. 13-15; Postuma, 1971, p. 168, figs. on p. 169; Samanta, 1973, p. 450, pl. 10, figs. 1-4; Stainforth et al. 1975, p. 163, fig. 31: 1-6.

Globorotalia (*Morozovella*) *aequa aequa* Cushman and Renz; Blow, 1979, p. 975-977, pl. 96, figs. 4-6; pl. 99, fig. 5; pl. 102, figs. 6, 9-10; pl. 103, fig. 1; pl. 18, figs. 8-10, pl. 210, figs. 1-6; pl. 211, figs. 1-5.

Morozovellaaequa (Cushman and Renz); Snyder and Waters, 1985, p. 446, pl. 7, figs. 5-7; Toumarkine and Luterbacher, 1985, p. 112, fig.. 15: 1-3.

Globorotalia (*Morozovella*) *aequa lecerti* Cushman and Renz; Blow, 1979, p. 977-979, pl. 138, figs. 1-3.

Globorotalia (*Morozovella*) *aequa tholiformis* Cushman and Renz; Blow, 1979, p. 979-981, pl. 102, figs. 7-8; pl. 119, figs. 1-3; pl. 125, figs. 1-2; pl. 127, fig. 9; pl. 129, fig. 6; pl. 133, fig. 9, pl. 137, fig. 1.

Stratigraphic Distribution: Most of the workers (Samanta, 1973; Stainforth et al., 1975; Luterbacher and Toumarkine, 1985) have reported late Paleocene to earliest Eocene age of this species. More recently, Berggren and Norris (1997) and Olsson et al. (1999) have reported its age from late Paleocene (Zone P4c) to early Eocene (Zone P7).

In this work, *M. aequa* occurs common to abundantly in all of the studied sections. Its age ranges from P3B to P7 Zones.

***Morozovella aragonensis* (Nuttal)**

(Plate 22, Figures 6, 11–12)

Globorotalia aragonensis Nuttal, 1930, p. 288, pl. 24, figs. 6-11; Subbotina, 1953, p. 215-216, pl. 18, figs. 6-7; Bolli, 1957a, p. 167, pl. 38, fig. 1; Postuma, 1971, p. 172, figs. on p. 173; Samanta, 1973, p.451, pl. 8, figs. 4-6; Stainforth et al., 1975, p. 168-169, fig. 35: 1-5.

Morozovella aragonensis (Nuttal); Toumarkine and Luterbacher, 1985, p. 114, fig. 16: 2-3.

Globorotalia (*Morozovella*) *aragonensis* (Nuttal); Blow, 1979, p. 990-993, pl. 134, fig. 6; pl. 141, figs. 1-2, 4-9; pl. 146, figs. 1-2; pl. 147, figs. 5-7; pl. 152, figs. 1-5; pl. 164, figs. 6-9; pl. 167, figs.6-9; pl. 226, fig. 6; pl. 227, figs. 1-6; pl. 228, figs. 1-6.

Remarks: *M. aragonensis* is very similar to *M. lensiformis* from which it evolved in the earliest Eocene. It differs from the *M. lensiformis* only in being bigger in size (possess five to seven chambers compared to four in *M. lensiformis*), and having more robust peripheral keel.

Stratigraphic Distribution: Most of the workers have reported its age from early Eocene (*M. formosa formosa* Zone) to middle Eocene (*Gth. subconglobata* Zone).

In this study, *M. aragonensis* is recognized from all three studied sections. It occurs in the upper part of the *M. subbotinae* Partial Range Zone (P6B), *M. formosa formosa* Zone, and *M. aragonensis* Zone. It was not recorded from younger horizons (middle Eocene).

***Morozovella angulata* (White)**

(Plate 18, Figures 1–3)

Globigerina angulata White, 1928, p. 191-192, pl. 27, figs. 13a-c.

Globorotalia angulata (White); Bolli 1957b, p. 74, pl. 17, figs. 7-9; Loeblich and Tappan 1957, p.187, pl. 45, figs. 7a-c; 48, figs. 2a-c; 50, figs. 1a-c; 55, figs. 2, 6, 7; 58, figs. 2a-c; 64, figs. 5a-c; Bolli and Cita1960, p.378-379, pl.

35, figs. 8a-c; Luterbacher 1964, p. 658-660, figs. 37-39; Said and Sabry 1964, p. 382, pl. 1, figs. 3a-c; Samanta 1973, p. 450-451, pl. 8, figs. 7-9; Postuma 1971, p. 170, figs. on page 171; Stainforth et al., 1975, p. 167, fig. 34: 1-7; Toumarkine and Luterbacher 1985, p. 111, fig. 14: 5a-c; 6a-c.

Morozovella angulata (White); Berggren 1977, p. 230, pl. 5 (a number of illusterations); Berggren and Norris 1997, p.70-71, p.14, figs. 2, 3, 9, 14, 18.

Globorotalia (Morozovella) angulata angulata (White), Blow 1979, p. 984, pl. 86, figs. 7-9; pl. 87, fig. 1.

Stratigraphic Distribution: Most of the workers have reported the age of *M. angulata* as late Paleocene age (Zone P3 to P4).

In this work, *M. angulata* occurs common to abundantly in all studied sections. It is found in late Paleocene (ZonesP3 to P4).

***Morozovella apanthesma* (Loeblich and Tappan)**

(Plate 19, Figures 6, 11–12)

Globorotalia apanthesma Loeblich and Tappan, 1957, p. 187, pl. 48, figs. 1a-c; pl. 55, figs. 1a-c; pl. 58, figs. 4a-c; pl. 59, figs. 1a-c; El Naggar, 1966, p. 199-200, pl. 21, figs. 1a-c; Samanta1970, p.620, pl.96, figs. 15-16; Jenkins 1971, p. 102. pl. 8, figs. 186-188; Krasheninnikove et al. 1973, p. 119, pl. 18, figs. 1-3.

Globorotalia (Morozovella) apanthesma (Loeblich and Tappan), Blow 1979, p. 988, pl.251, fig. 2.

Remarks: *Morozovella apanthesma* is very distinctive late Paleocene species. It contains five chambers in the last whorl, does not have ornamented acute peripheral keel and also is less umbilico-conical like other *Morozovella* species.

Stratigraphic Distribution: The reported age of this species is late Paleocene (Zone P3b to P4).

In this work, *M. apanthesma* is yielded from all of the studied sections. It occurs quite commonly. It is found in the *M. acuta-Glb. pseudomenardii* Sub Interval Zone and *Glb. pseudomenardii* Total Range Zone (P3B to P4).

***Morozovella conicotruncata* (Subbotina)**

(Plate 18, Figures 7-9)

Globorotalia conicotruncata Subbotina 1947, p. 115, pl. 4, figs. 11-13; pl. 9, figs. 9-11; Stainforth et al. 1975, p. 178, fig. 44: 1-7; Samanta, 1973, p. 455, pl. 8, figs. 1-3.

Morozovella conicotruncata (Subbotina); Toumarkine and Luterbacher, 1985, p. 110, figs. 6-7; 9-10; Berggren and Norris, 1997, p.71-72, pl.15, figs. 1-9; Olsson et al., 1999, p. 11, figs. 10-115; pl. 50, figs. 1-5.

Globorotalia (Morozovella) angulata conicotruncata (Subbotina); Blow, 1979, p. 986-988, pl. 87, fig. 3.

Globorotalia angulata abundcamerata Bolli, 1957b, p. 74, pl.17, figs. 4-6; Bolli and Cita, 1960, p.379-380, pl. 35, figs. 6a-c.

Globorotalia abundcamerata Bolli; Postuma, 1971, p. 166, figs. on p. 167.

Remarks: *M. conicotruncata* has usually six to eight slowly increasing (looks equal) chambers in the last whorl with flat dorsal side. It resembles with *M. velascoensis* in general but can easily be distinguished from it in not possessing distinctly ornamented umbilical shoulders and thick peripheral keel.

Stratigraphic Distribution: Berggren and Norris (1997) and Olsson et al. (1999) have reported its age from Zone P3 to lower part of Zone P4 (late Paleocene). Stainforth et al. (1975) and Blow (1979) have reported its age ranging from middle to late Paleocene. However, Toumarkine and Luterbacher (1985) has reported its more extended age as late Paleocene to earliest Eocene.

In this work, *M. conicotruncata* occurs commonly in all of the studied sections. Its age ranges from P3B to P5 Zones.

Morozovella edgari (Primoli Silva and Bolli)

(Plate 22, Figures1-3)

Globorotalia edgari Primoli Silva and Bolli, 1973, p. 526, pl. 7, figs. 10-12, pl. 8, figs. 1-12.

Remarks: *Morozovella edgari* is a small-sized species possessing acute lateral view with weakly developed keel. It can be separated from closely related

other *Morozovelle* species (*M. subbotinae, M. marginodentata* and *M. formosa gracilis*) because of its overall fragile test and more number of chambers (4 to 6).

Stratigraphic Distribution: The reported age (e.g. Toumarkine and Luterbacher, 1985) of this species is late-late Paleocene to earliest Eocene (Zone P5b to P6).

In this work, *M. edgari* is recognized only from the Rakhi Nala section where it occurs in the *M. subbotinae* Partial Range Zone (earliest Eocene).

Morozovella formosa formosa **(Bolli)**

(Plate 22, Figures 21–23)

Globorotalia formosa formosa Bolli, 1957b, p. 75, pl. 18, figs. 4-6; Samanta, 1973, p. 458, pl. 9, figs. 1-3; Stainforth et al., 1975, p. 184, fig. 48:1-6.

Morozovella formosa formosa (Bolli); Toumarkine and Luterbacher, 1985, p. 112, fig. 15: 13a-c.

Globorotalia formosa (Bolli); Postuma, 1971, p. 190, Figures on p. 191.

Stratigraphic Distribution: The reported age of this species is the early Eocene (upper part of the *M. subbotinae* Partial Range Zone (P6b) to *M. aragonensis* Zone).

In this work, *M. formosa formosa* is yielded from all three studied sections. It is recognized from the Zone P6B to the lower part of the Zone P8.

Morozovella formosa gracilis **(Bolli)**

(Plate 19, Figures 13–15)

Globorotalia formosa gracilis Bolli 1957b, p. 75-76, pl. 18, figs. 4-6; Samanta, 1973, p. 458, pl. 11, figs. 4-6; Stainforth et al., 1975, p. 184, fig. 49: 1-5.

Globorotalia gracilis (Bolli); Postuma, 1971, p. 192, figs. on p. 193.

Morozovella formosa gracilis (Bolli); Snyder and Waters, 1985, p. 446-447, pl. 8, figs. 7-9; Toumarkine and Luterbacher, 1985, p.112, fig. 15: 12a-c.

Morozovella gracilis (Bolli); Hubber, 1991, p. 440, pl. 4, figs. 8; Berggren and Norris, 1997, p. 100, pl. 16, figs. 19-20; Olsson et al., 1999, p. 61-62, pl. 54, figs. 13-15.

Globorotalia (*Morozovella*) *subbotinae gracilis* (Bolli); Blow, 1979, p. 1021-1024, pl. 111, figs. 9-10, pl. 112, figs. 1.

Stratigraphic Distribution: Most of the workers (Stainforth et al., 1975; Toumarkine and Luterbacher, 1985 etc.) have reported its age ranging from late Paleocene to early Eocene (*M. velascoensis* Zone to *M. formosa formosa* Zone). However, recently some workers (Berggren and Norris, 1997; Olsson et al., 1999) have described restricted age for this species. According to them, its age ranges from latest Paleocene to earliest Eocene (Zone P5 to P6a).

In this research, *M. formosa gracilis* is yielded from all three studied sections. It occurs in the *M. velascoensis* Zone, *M. subbotinae* Partial Range Zone, and the lower part of the *M. formosa formosa* Zone. (late Paleocene to early Eocene).

Morozovella lensiformis (Subbotina)

(Plate 22, Figures 7–9)

Globorotalia lensiformis Subbotina, 1953, p. 214, pl. 18, figs. 4-5; Stainforth et al., 1975, p. 200-201, fig. 61: 1-7.

Morozovella lensiformis (Subbotina); Toumarkine and Luterbacher, 1985, p. 112, fig. 16: 1a-b.

Remarks: Most of the workers consider *M. lensiformis* as the predecessor of *M. aragonensis,* it differs from the later in possessing less number of chambers.

Stratigraphic Distribution: Early Eocene (middle part of the *M. subbotinae* to *M. formosa formosa* Zone) age is reported by many workers (Stainforth et al., 1975; Toumarkine and Luterbacher, 1985 etc.). Berggren and Norris (1997) and Olsson et al. (1999) have reported FADs of both *M. formosa formosa* and *M. formosa gracilis* occur at the same level and take their first occurrence as basis of twofold subdivision of their *M. subbotinae* Partial Range Zone (P6a, b), and in this study, same concept is applied.

In this study, *M. lensiformis* is recognized from all three studied sections. It occurs in the upper part of *M. subbotinae* Partial Range Zone (P6B), *M. formosa formosa* Zone, and the lower part of *M. aragonensis*

Morozovella marginodentata (Subbotina)

(Plate 22, Figures 4–5,10)

Globorotalia marginodentata Subbotina, 1953, p. 212-213, pl. 17, figs. 14-16, pl.18, figs. 1-3; Stainforth, et al., 1975, p. 203-204, fig. 65: 17; Samanta, 1973, p. 460, pl. 11, figs. 1-3.

Morozovella marginodentata (Subbotina); Toumarkine and Luterbacher, 1985, p. 115, fig. 15: 7-8; Snyder and Waters, 1985, p.460, pl. 8, figs. 13-14.

Remarks: *Morozovella marginodentata* has more lenticular test shape and is characterised by a thick-keel which gives the periphery a pinched look compared to *Morozovella subbotinae.*

Stratigraphic Distribution: According to most of the workers, age of this species ranges from late Paleocene to early Eocene (upper part of *M. velascoensis* to *M. formosa formosa* Zone).

In this study, *Morozovella marginodentata* is observed from all three studied sections. It occurs in the upper part of *M. subbotinae* Partial Range Zone (P6B), *M. formosa formosa* Zone, and the lower part of *M. aragonensis* Zone.

***Morozovella occlusa* (Loeblich and Tappan)**

(Plate 19, Figures 22–24)

Globorotalia occlusa Loeblich and Tappan, 1957, p. 191, pl. 64, figs. 3a-c; Stainforth et al., 1975, p. 208-209, fig. 70: 1-6.

Globorotalia (*Morozovella*) *occlusa* (Loeblich and Tappan); Blow, 1979, p. 1007-1009, pl. 90, figs. 9-10; pl. 95; figs. 7-10; pl. 96, figs. 1-3; pl. 103, figs. 4-6;

pl. 108, figs. 8-10; pl. 118, figs. 1-7; pl. 213, fig. 6; pl. 214, figs. 1-6; pl. 215, figs. 5-6.

Morozovella occlusa (Loeblich and Tappan); Berggren and Norris, p. 76, 78, pl.16, figs. 9-15, 17; Olsson et al., 1999, p. 62-63, pl. 17, figs. 4-6; pl. 51, figs. 1-15.

Remarks: *Morozovella occlusa* is very distinctive late Paleocene species. It is very similar to *M. velascoensis* but differs from it in being more convex on dorsal side, less pronounced (cone), and less ornamented umbilical shoulders. Moreover, *Morozovella velascoensis* has more robust and strongly ornamented peripheral keel compared to *M. occlusa*.

Stratigraphic Distribution: According to most of the workers, this species occurs throughout the late Paleocene (*Glb. pseudomenardii* to *M. velascoensis* Zones). Berggren and Norris (1997) and Olsson et al. (1999) have reported that its age ranges from top of their Zone P3b to P5.

In this study, *Morozovella occlusa* is recorded from all three studied sections. It occurs from P3B to P6B (late Paleocene to earliest Eocene).

***Morozovella subbotinae* (Morozova)**

(Plate 18, Figures 4– 5, 10)

Globorotalia subbotinae Morozova, 1939, p. 80, pl. 2, figs. 16-17; Samanta, 1973, p. 465, pl. 10, figs. 14-16; Stainforth, et al., 1975, p. 230, fig. 89: 1-8.

Morozovella subbotinae (Morozova); Toumarkine and Luterbacher, 1985, p. 112, fig. 15: 9-11; Snyder and Waters, 1985, p. 442-443, pl. 9, figs. 10-12; Berggren and Norris, 1997, p. 94, pl. 16, figs. 5, 9, 14; Olsson et al., 1999, p.65, pl. 54, figs. 1-12.

Globorotalia (*Morozovella*) *subbotinae subbotinae* (Morozova); Blow, 1979, p. 1018-1021, pl. 102, figs. 1-5, pl. 111, figs. 6-8, pl.115, figs. 3-5, pl. 119, figs. 4-10, pl. 127, figs. 6-7, pl. 133, fig. 8, pl. 218, figs. 1-6, pl. 219, figs. 1-6, pl. 220, figs. 1-6, pl. 221, figs. 1-7, pl.222, figs. 1-6.

Globorotalia rex Martin; Postuma, 1971, p. 210, figs. on p. 211.

Remarks: *Morozovella subbotinae* differs from *M. aequa* in being relatively bigger in size, and possessing well-developed peripheral keel bearing spines.

Stratigraphic Distribution: Most of the workers have reported its age ranging from late Paleocene to early Eocene (upper part of *M. velascoensis* to *M. formosa formosa* Zone).

In this study, *Morozovella subbotina* is observed from all three studied sections where it occurs quite commonly and is recognized from the *M. velascoensis*, *M. subbotinae*, and *M. formosa formosa* Zones.

Morozovella velascoensis **(Cushman)**

(Plate 19, Figures 17–19)

Pulvinulina velascoensis Cushman, 1925b, p. 19, pl. 3, figs. 5a-c.

Globorotalia velascoensis (Cushman); Bolli, 1957b, p. 76, pl. 20, figs. 1-3; Loeblich and Tappan, 1957, p. 196, pl. 64, figs. 1-2; Postuma, 1971, p. 218, figs. on p. 219; Samanta, 1973, p. 468, pl. 9, figs. 7-9; Stainforth et al., 1975, p. 240-240, fig. 97: 1-8.

Globorotalia (*Morozovella*) *velascoensis velascoensis* (Cushman); Bolli, 1979, p. 1027-1028, pl. 92, fig. 7; pl. 94, figs. 6-9; pl. 95, figs. 1-2; pl. 99, figs. 1-8; pl. 217, figs. 1-6.

Morozovella velascoensis (Cushman); Toumarkine and Luterbacher, 1985, p. 110, fig. 13: 1a-2c; Berggren and Norris, 1997, p. 72, pl. 15, figs. 10-15; 16-18; 22; Olsson et al., 1999, p. 66-68, pl. 17, figs. 10-12; pl. 55, figs. 1-15.

Remarks: *Morozovella velascoensis* is very distinctive and important index species of the late Paleocene. The main characteristic features of *Morozovella velascoensis* are numerous chambers in the last whorl (six to eight), raised and beaded intercameral sutures on spiral side, presence of heavy spines (muricae) which fuse to form thick keel at peripheral margin, and it has strongly ornamented umbilical shoulders. Based on these features, it can easily be separated from other species of this lineage such as *M. angulta, M. conicotruncata, M. occlusa* and *M. acuta.* However, an Eocene species (*M. caucasica*) is just homeomorph of this species which can only be identified taking into account the associated species.

Stratigraphic Distribution: Most of the workers have reported its age ranging from the *Glb. pseudomenardii* Zone to *M. velascoensis* Zone. However,

Berggern and Norris (1997), and Olsson et al. (1999) have described it from more older horizones (Zone P3b to Zone P5).

In this study, *Morozovella velascoensis* is yielded from all three studied sections where it occurs quite commonly and is identified from the P3B to P5 Zones.

Morozovella spinulosa **(Cushman)**

(Plate 25, Figures 22–24)

Globorotalia spinulosa Cushman, 1927b, p. 114, pl. 23, figs. 4a-c; Postuma, 1971, p. 212, figs. on p. 213; Stainforth, et al., 1975, p. 230, fig. 89: 1-6.

Morozovella spinulosa (Cushman); Toumarkine and Luterbacher, 1985, p. 130, fig. 30: 1-8.

Globorotalia crassata (Cushman, 1964); Samanta, 1973, p. 455, pl. 11, figs. 7-9.

Globorotalia (*Morozovella*) *spinulosa spinulosa* (Cushman, 1927); Blow, 1979, p. 1013-1014, pl. 182, figs. 1-4; pl. 185, figs, 1-4; pl. 187, figs. 1-6; pl. 229, figs. 1-4; pl. 240, figs. 1-4.

Globorotalia (*Morozovella*) *spinulosa coronata* Blow, 1979, p. 1016-1017, pl. 50, fig. 5; pl. 168, figs. 1-8; pl. 229, figs. 5-6; pl. 230, figs. 1-6.

Remarks: *Morozovella spinulosa* shows variation in convexity of the spiral side and intensity of development of muricae around the umbilicus. Toumarkine and Luterbacher (1985) has stated "several relatively small spinose *Morozovella* species with delicate to robust conicotruncate tests and afaint to distinct keel occur

during the middle Eocene and have been described under a variety of names". They have considered all of these form exhibiting some variation as intraspecific one of *M. spinulosa.* In this studies, same concept is followed.

Stratigraphic Distribution: Late-early Eocene to the top of middle Eocene age is reported by most of the workers (approximately *M. aragonensis* to *Tr. rohri* Zones).

In this study, *Morozovella spinulosa* is yielded from all three studied sections where it occurs quite commonly. It is found from Zones P9 to the top of Zone P13.

***Morozovella lehneri* (Cushman and Jarvis)**

(Plate 25, Figures 16, 20–21)

Globorotalia lehneri Cushman and Jarvis, 1929, p. 17, pl. 3, figs. 16a-c; Bolli, 1957a, p. 169, pl. 38, figs. 9-13; Postuma, 1971, p. 198, figs. on p. 199; Samanta, 1973, p. 459, pl. 14, figs. 12-14; Stainforth et al., 1975, p. 198, fig. 59: 1-8.

Morozovella lehneri (Cushman and Jarvis); Toumarkine and Luterbacher, 1985, p. 131, fig. 31: 1-13.

Globorotalia (*Morozovella*) *lehneri* (Cushman and Jarvis); Blow, 1979, p. 1002-1003, pl.50, fig. 1; pl. 188, figs. 1-10; pl. 251, figs. 3-4.

Remarks: *Morozovella lehneri* is quite similar to *M. spinulosa* from which it mainly differs in having radially elongate chambers.

Stratigraphic Distribution: The reported age of this species is described as restricted to middle Eocene and is used as index species for the middle Eocene.

In this study, *Morozovella lehneri* is recognized from all three studied sections. Its age ranges from Zones P12 and Zone P13 (lat- middle Eocene).

Genus ***Muricoglobigerina*** Blow, 1979

(Plate 13, Figures 13–14)

***Muricoglobigerina senni* (Beckmann, 1953)**

(Plate 23, Figures 20, 24, 28)

Sphaeroidinella senni Beckmann, 1953, p. 394, pl. 26, figs. 2.

Globigerina senni (Beckmann); Bolli, 1957a, p. 163, pl. 35, figs. 10-12.

Muricoglobigerina senni (Beckmann); Blow, 1979, p. 1131-1133, pl. 131, figs. 7-9; pl. 142, figs7-9; pl. 146, figs. 9-10, pl. 165, fig.8; pl. 236, figs. 1-4; Nishi et al., 1994, p. 544

Remarks: It is readily distinguished because of its small, very compact and relatively thick test, and with very robust muricae surrounding the umbilical.

Stratigraphic Distribution: Blow (1979) has reported this species from his Zone P8b to P15. Toumarkine and Luterbacher (1985) has reported its age range from P8 to P14 Zones.

In the Sulaiman Range, it is yielded from the Rakhi Nala section and it occurs from P12 and P13 Zones.

Genus ***Truncorotaloides*** Bronnimann and Bermudez, 1953

(Plate 13, Figures 17–18)

***Truncorotaloides collactea* (Finlay)**

(Plate 24, Figures 1–3)

Globorotalia collactea Finlay, 1939b, p. 327, pl. 29, figs. 164-165.

Globigerina collactea (Finlay); Postuma, 1971, p. 146, figs. on p. 147.

Truncorotaloides collactea (Finlay); Toumarkine and Luterbacher, 1985, p. 132, fig. 6-7, 9; Nishi et al., 1995, p. 546.

Remarks: Some workers such as Postuma (1971) have placed it in the genus *Globigerina* due to the similarity of its test with *Globigerina* like test and also because of its aperture being more umbilical than being extra-umbilical or peripheral. It differs from the *T. rohri* being small in size, having less angulate chambers and possessing more circular periphery.

Stratigraphic Distribution: The reported age of this species is middle Eocene.

In this study, *Truncorotaloides collactea* occur common to rarely and is recognized from all three studied sections ranging in age from Zone P10 to P14.

***Truncorotaloides rohri* Bronnimann and Bermudez**

(Plate 25, Figures 7–9)

Truncorotaloides rohri Bronnimann and Bermudez, 1953, p. 818, pl. 87, figs. 7-9; Bolli, Lowblich and Tappan, 1957, p. 42, pl. 10, fig. 5a-c; Bolli, 1957a, p.

170, pl. 39, figs. 8-12; Postuma, 1971, p. 232, figs. on p. 233; Samanta, 1973, p. 470, pl. 7, figs. 13-15; Stainforth et al., 1975, p. 221, fig. 82: 1-8; Toumarkine and Luterbacher, 1985, p.134, fig. 32: 8-9; fig. 33: 12-18; Nishi et al., 1995, p. 547, fig. 6: 22-24.

Globorotalia (Truncorotalia) rohri rohri (Bronnimann and Bermudez); Blow, 1979, p. 1037-1040, pl. 195, figs. 4-9; pl. 196, figs. 1-5; pl. 206, figs. 1-7; pl. 231, figs. 1, 2, 4.

Remarks: *Truncorotaloides rohri* has larger size than *Truncorotaloides collactea.* It has more rounded axial periphery compared to *Tr. topilensis.* It differs from *Truncorotaloides topilensis* in possessing less angular chambers in the last whorl. Well-preserved specimens show one sutural aperture on the spiral side. Some workers have differentiated several species based on the presence of accessory sutural openings and the chamber-shape of the final whorl such as Bronnimann and Bermudez (1953) <*Tr. rohri* var. *guaracaraensis, Tr. rohri* var. *mayoensis*> and Blow. (1979) <*Globorotalia (Tr.) rohri rohri, Globorotalia (Tr.). rohri mayoensis*>.

Stratigraphic Distribution: Stainforth et al., 1975 has reported its age restricted to middle Eocene (*H. aragonensis* Zone to *Tr. rohri* Zone) whereas Toumarkine and Luterbacher (1985) has described its age ranging from late early Eocene to late-middle Eocene (*A. pentacamerata* Zone to the tope of *Tr. rohri* Zone). Some workers have reported the age of this species as middle to early Eocene (e.g. Blow, 1979).

In this study, *Truncorotaloides rohri* is occurred in all three sections of the Sulaiman Range. It ranges in age from late-early Eocene to late-middle Eocene (Zone P9 to P14).

Truncorotaloides topilensis (Cushman)

(Plate 24, Figures 7–9; Plate 25, Figures 18–20)

Globigerina topilensis Cushman, 1925c, p. 7, pl. 1, fig. 9.

Truncorotaloides topilensis (Cushman); Bolli, 1957a, p. 170, pl. 39, figs. 13-16; Postuma, 1971, p. 234, figs. on p. 235; Samanta, 1973, p. 471, pl. 6, figs. 9-10; Stainforth et al., 1975, p. 234, fig. 91: 1-7; Toumarkine and Luterbacher, 1985, p.135, fig. 32: 1-7; 8-10; Nishi et al., 1995, p. 547, fig. 6: 25-27.

Globorotalia (Truncorotalia) topilensis topilensis (Cushman); Blow, 1979, p. 1042-1043, pl. 193, figs. 1-9, pl. 207, figs. 3-4; pl. 51, figs. 1-3.

Truncorotaloides libyaensis El Khaudry, 1977, p. 330, pl. 2, fig. 1.

Truncorotaloides haynesi Samanta, 1970, p. 205, pl. 3, fig. 24.

Remarks: This species is readily distinguished from other *Truncorotaloides* species due to its very angular chamber morphology. El Khoudary (1977) has described a six-chamber species *Truncorotaloides libyaensis from* Libya and Samanta (1970) has reported a six-chamber species *Truncorotaloides haynesi* from India. Now in the original description of *Truncorotalia topilensis* (Cushman, 1925c) has described four chambers in the last

whorl and El Khoudary (1977) and Samanta (1970) have described very similar species which consists of five and six chambers respectively with all other features as similar with *Tr. topilensis*. In this study all these form are considered as variations within the *Truncorotaloides topilensis*.

Stratigraphic Distribution: The reported age of this stratigraphically very important species is the entire interval of middle Eocene.

In this study, *Truncorotaloides topilensis* is recognized from all three studied sections. It occurs common to abundant and in well-preserved state throughout the middle Eocene interval (Zone P10 to P14).

Genus ***Turborotalia*** Cushman and Bermudez, 1949

(Plate 13, Figures 11–12)

***Turborotalia griffinae* Blow**

(Plate 24, Figures 13–15)

Globorotalia (Turborotalia) griffinae Blow, 1979, p. 1072, pl. 150, fig. 5-9; pl. 157, fig. 7; pl. 162, figs. 8-9, pl. 165, figs. 1-3.

Turborotalia griffinai (Blow); Toumarkine and Luterbacher, 1985, p. 127, fig. 27: 13-23; Nishi, et al., 1994, p. 547.

Remarks: *Turborotalia griffinae* is very similar in test morphology with *Turborotalia* cf. *bolivariana* but differs from it in being more lobate and possessing high arched-aperture with well-defined lip.

Stratigraphic Distribution: Blow (1979) has reported the age range of *Turborotalia griffinae* from late-early Eocene to early-middle Eocene.

In this study, *Turborotalia griffinae* is yielded from all three studied sections and range in age from late-early Eocene to middle Eocene (Zone P9 to P12).

Turborotalia cerroazulensis pomeroli

(Toumarkine & Bolli)

(Plate 24, Figures 4–5, 10)

Globorotalia cerroazulensis pomeroli Toumarkine and Bolli, 1970, p. 140, pl. 1, fig. 13; Stainforth et al., 1975, p. 258, fig. 109: 1-13.

Turborotalia cerroazulensis pomeroli (Toumarkine and Bolli); Toumarkine and Luterbacher, 1985, p. 137, fig. 34-9; fig. 35: 4-9.

Globorotalia centralis Cushman and Bermudez, 1937; Samanta, 1973, p. 454, pl. 12, figs. 10-12.

Remarks: *Turborotalia cerroazulensis pomeroli* is relatively large and robust species among the *Turborotalia cerroazulensis* lineage as it consists of four to six chambers compared to three to three-and half in other forms. It is similar to *Tur. cerroazulensis cerroazulensis* but can be disdinguished easily as it has more rounded peripheral margin.

Stratigraphic Distribution: The reported age of *Turborotalia cerroazulensis pomeroli* is middle-middle Eocene to late Eocene.

In this study, common to abundant and well-preserved species of *Turborotalia cerroazulensis pomeroli* occurred in all three studied sections. Its age ranges from middle to early late Eocene. However, some species were recognized from late early Eocene (upper part of Zone P8) from Zinda Pir eastern section.

***Turborotalia cerroazulensis cerroazulensis* (Cole)**

(Plate 25, Figures 25–27)

Globigerina cerroazulensis Cole, 1928, p. 217, pl. 1, figs. 11-13.

Globorotalia centralis Cushman and Bermudez, 1937, p. 26, pl. 2, figs. 62-64.

Globorotalia cerroazulensis cerroazulensis (Cole); Stainforth et al., 1975, p. 256, fig. 107: 1-13.

Turborotalia cerroazulensis cerroazulensis (Cole); Toumarkine and Loeblich, 1985, p. 137, fig. 34: 3-4, Figure 36: 16-18.

Remarks: *Turborotalia cerroazulensis cerroazulensis* has distinctly flattened dorsal side and possess more angular side view without any true keel and based on these features, it can be distinguished easily from *Tur. cerroazulensis pomerolie. Turbrotalia cerroazulensis cunialensis* has more cute lateral view than *Tur. cerroazulensis cerroazulensis.*

Stratigraphic Distribution: Toumarkine and Luterbacher (1985) has reported its age from late-middle Eocene to early-late Eocene. Stainforth et al. (1975) has described younger age for this species (late Eocene).

In this study, *Turborotalia cerroazulensis cerroazulensis* occurs common to abundantly in all three sections. Its age ranges from late-middle Eocene to early-late Eocene. However, some species were recognized from one sample (Zinda Pir eastern section, sample ZPE-77) which belongs to early-middle Eocene.

Turborotalia cerroazulensis frontosa (Subbotina)

(Plate 24, Figures 21, 26–27)

Globigerina frontosa Subbotina, 1953, p. 84, pl. 12, figs. 3a-c.

Turborotalia cerroazulensis frontosa (Subbotina); Toumarkine and Luterbacher, 1985, p. 135, fig. 34:11a-b; fig. 35: 16-18.

Globorotalia bowerei Bolli, 1957c, p. 163, pl. 36, figs. 1a-c.

Remarks: Toumarkine and Luterbacher (1985) has stated "the rather high arch-like aperture with a faint lip separates this form from species of Eocene *Globigerina* with which it may share the general morphology of the test." This is quite similar with *Subbotinids* in test morphology but it has smooth and finely porous test surface compared to very cancellate test surface in *Subbotinids* forms.

Stratigraphic Distribution: The reported age of this species is late-early Eocene to middle-middle Eocene.

In this study *Turborotalia cerroazulensis frontosa* is recorded from all three sections. It ranges in age from late early Eocene to middle Eocene (Zones P9 to P14).

Turborotalia cerroazulensis possagnoensis

(Toumarkine & Bolli)

(Plate 25, Figures 1–3)

Globorotalia cerroazulensis possagnoensis Toumarkine & Bolli, 1970, p. 139, pl. 1, fig. 4.

Turborotalia cerroazulensis possagnoensis (Toumarkine & Bolli); Toumarkine and Luterbacher, 1985, p. 137, fig. 34:10a-b; fig. 35: 13-15.

Remarks: The phelogeny of this species is well discussed by Toumarkine and Luterbacher (1985). It closely resembles with *Turborotalia cerroazulensis frontosa* but it can be easily distinguished from the later in having flattened and elongated last chamber as the final chamber in *Turborotalia cerroazulensis frontosa* is more globular.

Stratigraphic Distribution: The reported age of this species is middle Eocene.

In this study *Turborotalia possagnoensis* is recorded from both sides of the Zinda Pir Anticline. It range in age from late-early Eocene to middle-middle Eocene (Zones P9 to P12).

Turborotalia cerroazulensis cunialensis (Toumarkine & Bolli)

(Plate 13, Figures 11–12; Plate 24, Figures 6, 11–12)

Globorotalia cerroazulensis cunialensis Toumarkine & Bolli, 1970, p. 144, pl. 1, fig.37.

Turborotalia cerroazulensis cunialensis (Toumarkine & Bolli); Toumarkine and Luterbacher, 1985, p. 138, fig. 34: 1a-b, fig. 36: 1-6.

Remarks: Toumarkine and Luterbacher (1985) has stated that *Turborotalia cerroazulensis cunialensis* is the end member of the *Turborotalia cerroazulensis* lineage. It is readily distinguished from all other *Turborotalia cerroazulensis* species due to its very cute peripheral keel.

Stratigraphic Distribution: Toumarkine and Luterbacher (1985) has described early Eocene age for this species.

In this study, only sample (ZPE-128) from Zinda Pir western section has produced few species of *Turborotalia cunialensis.* Its age is early Eocene (Zone P15).

Turborotalia precentralis Blow

Globorotalia (Turborotalia) praecentralis Blow, 1979, p. 1094, pl. 135, figs. 7-9; pl. 136, figs. 1-6; pl. 233, fig. 6.

Remarks: *Turborotalia praecentralis* recovered and identified from the Zinda Pir western section resembles closely with the original illustrations of Blow (1979).

Stratigraphic Distribution: Blow (1979) has reported this species from his Zones P8b to P11 (late-early Eocene to early-middle Eocene).

In this study, only three specimens of *Turborotalia praecentralis* are recognized from one sample (R-38) from Rakhi Nala section. Its age is late-early Eocene.

***Turborotalia wilsoni* (Cole)**

Globigerina wilsoni Cole, 1927, p. 34, pl. 4, figs. 8-9.

Turborotalia wilsoni (Cole); Toumarkine and Luterbacher, 1985, p. 126, fig. 27: 1-4; Nishi et al., 1994, p. 547.

Remarks: For the identification of *Turborotalia wilsoni* discussion and illustrations by Toumarkine and Loeblich (1985) are followed.

Stratigraphic Distribution: The reported age of *Turborotalia wilsoni* is middle Eocene.

In this study, a few number of species of *Turborotalia wilsoni* occurred from the Rakhi Nala section from the early middle Eocene (Zone P10).

7.7 Family **Hedbergellidae** Loeblich and Tappan 1961

7.7.1 Genus ***Globanomalina*** Haque, 1956, emended

(Plate 13, Figures 3–4; Plate 15, Figures 12–20)

***Globanomalina chapmani* (Parr)**

(Plate 16, Figures 1–3)

Globorotalia chapmani Parr, 1938, p. 87, pl. 9, figs. 8-9; Berggren, Olsson, and Reyment, 1967, p. 277, text-figs. 1, 3-1a-c, 4-a-c, pl. 1, figs. 1-6.

Globorotalia elongata Glaessner; Bolli, 1957b, p. 77, pl. 20, figs. 11-13.

Planorotalites chapmani (Parr); Huber, 1991, p. 440, pl. 6, figs. 19-20.

Globanomalina chapmani (Parr); Olsson, Hemleben, Berggren and Huber, 1999, p. 39-40, pl. 34, figs. 1-7.

Remarks: This is very important late Paleocene species and is considered direct ancestor of *Pseudohastigerina wilcoxensis,* a completely equatorial genus (Berggren, Olsson, & Reyment, 1967). This species has slighlty compressed to cute lateral view based. *Globanomalina pseudomenardii* has well-developed peripheral keel.

Stratigraphic Distribution: The reported age of this species is early Paleocene to earliest Eocene.

In the Sulaiman Range, this species is occurred from all three sections from late Paleocene age that is from the *Glb. pseudomenardii* Total Range Zone to *M. velascoensis* Interval Zone (Zone P4 to P5).

Globanomalina compressa (Plummer)

Globigerina compressa Plummer, 1926, p. 135, pl. 8, figs. 11a-c; Subbotina, 1953, p. 55-56, pl. 2, figs. 2a-5c.

Globorotalia compressa (Plummer); Bolli, 1957b, p. 77, pl. 20, figs. 21-23; Loeblich and Tappan, 1957, p. 188, pl. 44, figs. 9a-c; Stainforth, et al., 1975, p. 117, fig. 43:1-9.

Globorotalia (Turborotalia) compressa compressa (Plummer); Blow, 1979, p. 1062-1064, pl. 75, figs. 10-11, pl. 233, figs. 1-3.

Planorotalites compressa (Plummer); McGowran, 1968, pl. 4, figs. 10-11; Toumarkine and Luterbacher, 1985, p. 107, fig. 12-1a-c; 2a-c.

Globanomalina compressa (Plummer); Berggren, 1992, p. 563, pl. 1, figs. 14-16; Berggren and Norris, 1997, p. 50-51, pl. 7, figs. 15-21; Olsson et al., 1999, p. 40-41, pl. 14, figs. 1-3; pl. 32, figs. 11-16; pl. 35, figs. 1-13, 17.

Remarks: *Globanomalina compressa* occurs very rarely as few specimens were recognized from only one sample (ZPE-1) from Zinda Pir eastern section.

***Globanomalina ehrenbergi* (Bolli)**

(Plate 18, Figures 18–20)

Globorotalia ehrenbergi Bolli, 1957b, p. 77, pl. 20, figs. 18-20; Bolli and Cita, 1960, p. 383, pl. 35, figs. 4a-c; Postuma, 1970, p. 188, figs. on p. 189.

Globanomalina ehrenbergi (Bolli); Berggren and Norris, 1997, p. 51-52, pl. 8, figs. 1-5; Olsson et al., 1999, p. 42, pl. 14, figs. 4, 8, 12; pl. 35, figs. 14-16.

Remarks: *Globanomalina ehrenbergi* is very similar to *Globanomalina pseudomenardii* in general test morphology, however, the later has very cute keel and has more limbate chambers on the spiral side.

Stratigraphic Distribution: Most of the workers have reported this species from late-early Paleocene to early-late Paleocene age (Zone P2 to P4).

In the Sulaiman Range, this species is yielded from all three studied sections and its age is restricted to late Paleocene (Zone P3 to P4).

Globanomalina imitata (Subbotina)

(Plate 18, Figures13–15)

Globorotalia imitata Subbotina, 1953, p. 206-207, pl. 16, figs. 14a-c; 16a-c; Loeblich and Tappan 1957, p. 190, pl. 54, figs. 8a-c.

Globanomalina imitata (Subbotina); Berggren and Norris, 1997, p. 52-53, pl. 8, figs. 17-22; Olsson et al.,1999, p. 42, pl. 10, figs. 12-14; pl. 12, figs. 10-12, pl. 36, figs. 7-12, 16.

Remarks: *Globanomalina imitata* is small-sized and biconvex species. It is easily separated from other *Globanomalina* species in having compressed lateral view without any peripheral keel.

Stratigraphic Distribution: Berggren and Norris (1997) has reported the age of this species as early Paleocene to early Eocene (Zone P1b to P6).

In this study, this species was recognized from all three sections and it is present in Zones P3A to P5 (late Paleocene).

Globanomalina palmerae Cushman and Bermudez

(Plate 25, Figure 13–15)

Globorotalia palmerae Cushman and Bermudez, 1937, p. 26, pl. 2, figs. 51-53; Stainforth et al., 1975, p. 212, fig. 72: 1-5.

Planorotalites palmerae (Cushman and Bermudez); Toumarkine and Luterbacher, 1985, p. 117, fig. 20: 14-29.

Remarks: This is very distinctive Eocene species and can readily be separated from other *Globanomalina* species because of its chambers ending in the form of tube-like spines. It is quite similar with *Globanomalina pseudoscitula* in general test morphology but differ in possessing less number of chambers in the last whorl and also in having tubulspine at the end of chambers in the last whorl. Some workers have pointed out its close similarity with species of benthic foraminiferal genus such as *Rutalia or Pararotalia.* This difference between the two has been discussed in detail the Schmidt and Raju (1973).

Stratigraphic Distribution: Most of the workers (Stainforth et al., 1975; Toumarkine and Luterbacher, 1985) have reported its age restricted to the late-early Eocene (lower part of *Globorotalia palmerae* Zone= *Acarinina pentacamerata*).

In the Sulaiman Range, this species is occurred from all three sections where its age is also found restricted to late early Eocene.

***Globanomalina pseudomenardii* (Bolli)**

(Plate 13, Figures 3–4; Plate 18, Figures 16–17, 21)

Globorotalia pseudomenardii Bolli, 1957b, p. 77, pl. 20, figs. 14-17.

Globorotalia membranacea (Ehrenberg); White 1928, p. 280, 281, pl.38, figs. 1a-c; Toulmin 1941, p. 608, pl. 82, figs. 4,5; Subbotina1953, p. 205, 206, pl. 16, figs. 11a-c, 13a-c.

Globorotalia pseudomenardii Bolli 1957, p.77, pl. 20, figs. 14-17; Loeblich and Tappan 1957, p. 193, pl. 49, figs. 6a-c; pl. 54, figs. 10a-13c; pl. 59, figs. 3a-c; pl. 60, figs. 8a-c; pl. 63, figs. 1a-c; Postuma 1971, p. 204, fig. on p. 205; Stainforth et al., 1975, p. 217, fig. 77: 1-3, 5-7.

Globanomalina pseudomenardii (Bolli); Berggren and Norris, 1997, p. 54-55, pl. 8, figs. 6-10, 14-15; Olsson et al., 1999, p. 45, pl. 18, figs. 5-7; pl. 38, figs. 1-16.

Remarks: This is very important index species of the late Paleocene. Most of the workers have used the total range of this species to define the *Globanomalina pseudomenardii* Total Range Zone (Stainforth et al., 1975; Toumarkine and Luterbacher, 1985; Berggren and Miller, 1988, Berggren and Noriss, 1997; Olisson, et al., 1999). Blow (1979) has, however, reported it extended age (P4 to P7 Zones of Blow, 1979). It resembles with *Glb. chapmani* from which it differs in having imperforate well-defined keel.

Stratigraphic Distribution: The worldwide accepted age of this species is late Paleocene (Zone P4), except Blow (1979) who has reported its age ranging from late Paleocene to early Eocene.

In the Sulaiman Range, this species is recognized from all three sections where it occurs commonly. The age of the *Glb. pseudomenardii* is restricted to late Paleocen (*Globanomalina pseudomenardii* Total Range Zone = Zone P4)

Globanomalina pseudoscitula (Glaessner)

(Plate 21, Figure 23–25)

Globorotalia pseudoscitula Glaessner, 1937, p. 32, figs. 3a-c.

Globorotalia renzi Bolli, 1957a, p. 168, pl. 38, figs. 3a; Stainforth et al., 1975, p. 221, fig.81: 1-5.

Planorotalites pseudoimitata (Blow); Toumarkine and Luterbacher, 1985, p. 118, fig. 20: 2-10.

Remarks: *Globanomalina pseudoscitula* is small-sized lenticular species. In the Sulaiman material it shows variation in size and in the convexity of the dorsal side. This species can be easily identified because of its small test having numerous chambers in the last whorl with smooth test-surface and very fragile peripheral keel. Some workers have put *Glb. renzi* in its synonymy (Blow, 1979; Toumarkine and Luterbacher, 1985) whereas others have separated the two based on the test surface (e.g. Stainforth et al., 1975).

Stratigraphic Distribution: The reported age of this species range from early Eocene to entire middle Eocene.

In the Sulaiman Range, this species is occurred from all three sections where it occurs quite common to abundantly and range in age early Eocene to middle Eocene (Zones P7 to P14).

Globanomalina pseudoimitata (Blow)

(Plate 18, Figures 22–24)

Globorotalia (Turborotalia) pseudoimitata Blow, 1979, p. 1104, pl. 101, figs. 1-3, pl.106, figs. 2-10, pl. 108, figs 1-3.

Remarks: *Globanomalina pseudoimitata* is bigger in size, have more embracing chambers, relatively compressed test compared to *Glb. imitata.*

Stratigraphic Distribution: Blow (1979) has reported it age late-late Paleocene to early Eocene (his Zones P5 to P7).

In the Sulaiman Range, this species is occurred from only from Rakhi Nala section from late early Eocene that is *M. aragonensis* Interval Zone (P8).

Globanomalina rakhiensis sp. nov.

(Plate 15, Figures 12–20)

Description: Test very small, spiral side flat to slightly convex, umbilical side low convex; equatorial periphery elongate, distinctly lobulate; peripheral margin acute, strongly to moderately compressed with a keel; fourteen or fifteen chambers arranged in three whorls, all visible from spiral side; commonly five (rarely six) chambers in last whorl increase very rapidly in size; on umbilical side intercameral sutures depressed and weakly curved whereas strongly recurved and limbate on spiral side; test surface finely perforate; umbilicus narrow and shallow; aperture low arch-shaped, interiomarginal, umbilical- extraumbilical with distinct lip.

Type and material: Holotype, IGUT (Institute of Geosciences, University of Tsukuba) coll. cat. no, 50101, from sample R41, Dunghan Formation, Rakhi Nala section, maximum diameter 0.27 mm, width 0.20 mm. Paratype, IGUT coll. Cat. no. 50102, from sample R41, Dunghan Formation, Rakhi Nala section, maximum diameter 0.27 mm, width 0.20 mm.

Remarks: This species is quite common in sample R-41. The large specimen is 0.27 mm in diameter, but usually less than 0.15 mm. *Globanomalina rakhiensis* sp. nov. is small but very distinctive species and might have been overlooked due to its small size in previous studies. It can be missed while using 150μm size fraction. This species shows variation in size and degree of compression of the peripheral margin. The holotype (Figure 9-1-3) is less compressed compared to the paratype (Figure 9-6-8). *Globanomalina pseudoscitula* (Glaessner, 1937) is very similar to *Glb. rakhiensis* sp. nov. but differs in having more chambers in the last whorl (six or seven), and a circular periphery, and in being more lenticular.

Glb. rakhiensis sp. nov. is a homeomorph of the late Paleocene *Globanomalina pseudomenardii* (Bolli, 1957) as both forms possess a compressed planoconvex test, five chambers in the last whorl, and a low arched umbilical-extraumbilical aperture that bears a lip. *Glb. rakhiensis* sp. nov. is easily distinguished from *Glb. pseudomenardii* by its small size and relatively weak keel.

There has been ongoing discussion over the stratigraphic range of *Glb. pseudomenardii* as most workers (Luterbacher et al., 1985; Berggren and Miller,

1988, Berggren et al., 1995; Berggren and Norris,1997; Olsson et al., 1999, etc) have described its age as late Paleocene (Zone P4). Blow (1979), however, has extended the age range of this species to his Zone P7 (early Eocene). I suggest that *Glb. pseudomenardii* like-forms identified by Blow (1979) as *Glb. pseudomenardii* are quite similar to my new species. Therefore, he might have misidentified *Glb. rakhiensis* sp. nov.

This new species is named after a local river, Rakhi Nala along which this section is exposed.

Stratigraphic range: *Globanomalina rakhiensis* sp. nov. is yielde from all of the studied sections. It occurs quite commonly in all sections. Its age ranges from *M. formosa formosa* Zone to lower part of *Glb. palmerae-A. sold. soldadoensis/ A. sold. angulosa* Zone (P7 to Zone P9 (lower part).

7.7.2 Genus ***Pseudohastigerina*** Banner and Blow, 1959

(Plate 13, Figure 19–20)

***Pseudohastigerina micra* (Cole)**

(Plate 13, Figure 19–20; Plate 26, Figures 19–21)

Nonion micra Cole, 1927, p. 22, pl. 5, fig. 12.

Pseudohastigerina micra (Cole); Banner and Blow, 1959, p. 19-20, figs. 4(g-i); Stainforth et al., 1975, p. 207, fig. 68-1-5; Toumarkine and Luterbacher, 1985, p. 118, fig. 21:1-8.

Globanomalina micra (Cole): Jenkins, 1971, p. 78-79, pl.2, figs. 50-54.

Remarks: This species has relatively compressed test in lateral view, smaller in size compared to *Pseudohastigerina micra.*

Stratigraphic Distribution: The reported age of this species range from late-early Eocene to early Oligocene.

In this study *Pseudohastigerina micra* is observed and recorded from all of the studied sections. Its age ranges from late-early Eocene to early-late Eocene (Zones P8 to P15).

***Pseudohastigerina sharkriverensis* Berggren and Olsson**

(Plate 26, Figures 17–18, 22)

Pseudohastigerina sharkriverensis Berggren and Olsson 1967, p. 280, pl. 1, figs. 7-11, fig. 7-1a-6c; fig. 8-10a-14c; -11.

Remarks: This species is characterized by globular and inflated last two chambers which make more than half of the test.

Stratigraphic Distribution: The reported age of this species is middle Eocene.

In this study *Pseudohastigerina sharkriverense* is recognized from all three studied sections. It is recognized from middle Eocene (Zones P12 to P14).

***Pseudohastigerina wilcoxensis* (Cushman and Ponton)**

(Plate 18, Figure 6, 11–12)

Nonion wilcoxensis Cushman and Ponton, 1932, p. 64, pl. 8, figs. 11a-b.

Hastigerina eocaenica Berggren, 1960, p. 85-91, pl. 5, figs. 1-2.

Pseudohastigerina wilcoxensis (Cushman and Ponton); Berggren, Olsson, and Reyment, 1967, p. 278-280, figs. 2-a-v; figs. 3-2a-5; figs. 4-2a-5c; figs. 5-1a-9c; 6-1a-6c; Stainforth et al, 1975, p. 243, fig. 99-1-6c; Toumarkine and Luterbacher, 1985, p. 108, fig.12: 9a-12c.

Remarks: *Pseudohastigerina wilcoxensis* is the first species of the planispiral genus *Pseudohastigerina* that is reported to evolve from late Paleocene *Glb. chapmani*. It differs from the *Glb. chapmani* in being completely planespiral possessing peripheral aperture whereas in *Glb. chapmani* the aperture umbilical-extraumbilical. Moreover the axial periphery is rounded in *Pseudohastigerina wilcoxensis* and is compressed to cute in *Glb. chapmani*. This species is quite similar to *Pseud. micra* from which it mainly differs in being bigger in size.

Stratigraphic Distribution: Late Paleocene to middle Eocene (*M. velascoensis* to *M. lehneri* Zone) age has been reported by most of the workers (Stainforth et al., 1975; Toumarkine and Luterbacher, 1985.

In this study *Pseudohastigerina wilcoxensis* is occurred in all studied sections and is abundant to common. It ranges in age from late-late Paleocene to early-middle Eocene (Zones P5 to P10).

7.8 Family **Globigerinidae** Carpenter, Parker and Jones, 1862

7.8.1 Genus ***Parasubbotina*** Olsson, Hemleben, Berggren and Liu, 1992

***Parasubbotina varianta* (Subbotina)**

(Plate 16, Figures 6–8)

Globigerina varianta Subbotina, 1953, p. 63, pl. 3, figs. 5a-7c, 10a-12c.

Parasubbotina varianta (Subbotina); Olsson et al., 1999, p. 26-27, pl. 9, figs. 16-18; pl. 22, figs. 6-16.

Subbotina varianta (Subbotina); Berggren, 1992, p. 563, pl. 1, fig. 3.

Stratigraphic Distribution: Olsson et al. (1999) has described its age ranging from Zone P1c to P5.

In the Sulaiman Range, this species is found in all three studied sections and is recorded from Zones P3B and P4A.

7.8.2 Genus ***Subbotina*** Brotzen and Pozaryska, 1961

(Plate 14, Figures 17–20)

***Subbotina angustiumbilicata* (Bolli)**

(Plate 20, Figures 22–24)

Globigerina ciperoensis angustiumbilicata Bolli, 1957c, p. 109, pl. 22, figs. 12a-13c; Samanta, 1973, p. 434, pl. 1, figs. 1-3; Stainforth et al., 1975, p. 253, fig. 105: 1-5; Bolli, 1957a, p. 164, pl. 36, fig. 6.

Globigerina angustiumbilicata (Bolli); Blow and Banner, 1962, p. 85, pl. 9, fig. x-z.

Globigerina (*Globigerina*) *ciperoensis angustiumbilicata* (Bolli); Jenkines, 1971, p. 144, pl. 15, figs. 151-453.

Stratigraphic Distribution: This species has been described having long range from late Eocene to Pliestocene or Holocene (e.g. Stainforth et al., 1975).

In this work, this species is yielded only from the Rakhi Nala section. It is recognized from P12 to P15 Zones.

Subbotina baylissi (Samanta)

(Plate 20, Figures 10–11, 16)

Globigerina baylissi Samanta, 1973, p. 436, pl. 2, figs. 4-6.

Remarks: This species has trilobate shape with inflated chamber and possess low but wide arch-shaped aperture.

Stratigraphic Distribution: Samanta (1973) has described its age restricted to *Truncorotaloides rohri* Zone.

In this work, this species is recognized from the Rakhi Nala and Zinda Pir west sections and occurs in P13 and P14 Zones.

Subbotina ciperoensis (Bolli)

(Plate 20, Figures 7–8)

Globigerina ciperoensis Bolli, 1954, pl. 1-3, figs. 3-4; Samanta, 1973, p. 437, pl. 2, figs, 10-12; Stainforth et al., 1975, p. 263, fig. 111: 1-7; Bolli and Saunders, 1985, p. 182, fig. 13: 1-3.

Globigerina ciperoensis ciperoensis Bolli; Bolli, 1957c, p. 109, pl. 22, figs. 10a-b.

Globigerina ciperoensis angulisuturalis Bolli, 1957c, p. 109, pl. 22, figs. 11a-c.

Remarks: This species shows variations in shape, size, number of chambers in the last whorl. Bolli (1957c) has described three subspecies

(*ciperoensis, angustiumbilicata and angulisuturalis*). In this work, the material from the Sulaiman Range has produced specimens that closely resemble with *Globigerina ciperoensis* with some variations but here treated within the variation of *Subbotina ciperoensis* (Bolli).

Stratigraphic Distribution: Late Eocene to early Miocene age is reported for this species.

In this work, this species is occurred in all of the studied sections. it is recorded from P12 to P15 Zones.

***Subbotina corpulenta* (Subbotina)**

(Plate 24, Figures 6, 11–12)

Globigerina corpulenta Subbotina, 1953, p. 76, pl. 9, figs. 5-7; pl. 10, figs. 1-4; Stainforth et al., 1975, p. 263, 265, fig. 112: 1-5.

Remarks: *Subbotina corpulenta* has a large test with rapidly increasing four chambers in the last whorl. It usually possesses a small last chamber due to which it resembles with *Subbotina cryptomphala* but differs from the later in having raised (high) spire.

Stratigraphic Distribution: The reported age of this species is latest middle Eocene to late Eocene.

In this work, few samples produced well-preserved specimens of this species from the Rakhi Nala and the Zinda Pir west sections. It ranges in age from Zone P12 to P15.

***Subbotina cryptomphala* (Glaessner)**

(Plate 24, Figures 22–24)

Globigerina cryptomphala Glaessner, 1937, p.29, pl. 1, fig. 1; Toumarkine and Luterbacher, 1985, p. 149, fig. 42: 5-6; Van Ejden and Smit, 1991, p. 110.

Remarks: *Subbotina cryptomphala* possesses small bulla-like last chamber covering the umbilicus, is the characteristic feature of this species.

Stratigraphic Distribution: Middle Eocene to Oligocene age is reported for this species (Toumarkine and Luterbacher, 1985)

In this work, few specimens of this species were recovered from one sample (ZPE-117) from Zinda Pir east section from Zone P12.

***Subbotina hagni* (Gohrbandt)**

(Plate 20, Figures 19–21)

Globigerina hagni Gohrbandt 1967, p. 324, pl. 1, figs. 1-3; Toumarkine and Luterbacher, 1985, p. 150, fig. 42: 7-9.

Remarks: *Subbotina hagni* is separated from others species based on its equal sized four chambers in the last whorl with open umbilicus.

Stratigraphic Distribution: Toumarkine and Luterbacher (1985) has reported late-late Eocene to early Eocene age of this species.

In this work, few specimens of this species were observed from the Rakhi Nala and Zinda Pir west sections . It occurs in P12 to P15 Zones.

Subbotina inaquispira (Subbotina)

(Plate 21, Figures 6–8)

Globigerina inaquispira Subbotina, 1953, p. 69, pl. 6, figs. 1-4; Stainforth et al., 1975, p. 191-192, fig. 54: 1-5; Toumarkine and Luterbacher, 1985, p. 117, fig. 19: 5a-c; Samanta, 1973, p. 438, pl. 2, figs. 7-9.

Remarks: *Subbotina inaquispira* is very distinctive species in having very tightly coiled inner spire and very loosely coiled final whorl with very open and shallow umbilicus.

Stratigraphic Distribution: Early Eocene to middle Eocene (*M. aragonensis* to *M. lehneri* Zone) age has been reported for this species (e.g. Stainforth et al., 1975; Toumarkine and Luterbacher, 1985).

In this work, this species is recognized from all of the studied sections and it occurs quite commonly. It is present in P7 to P13 Zones.

Subbotina linaperta (Finlay)

(Plate 20, Figure 4–6)

Globigerina linaperta Finlay, 1939a, p. 125, pl. 13, figs. 54-55; Bolli, 1957a, p. 163, pl. 36, fig. 5.

Stratigraphic Distribution: Late Paleocene to late Eocene age has been reported for this species (e.g. Stainforth et al., 1975).

In this work, this species is occurred in all of the studied sections. Its age ranges from P8 to P15 Zones.

Subbotina lozanoi (Colom)

(Plate 21, Figure 1–3)

Globigerina lozanoi Colom, 1954, p.149, pl. 2. figs. 1-48; Toumarkine and Luterbacher, 1985, p. 127, fig. 28: 6-11.

Globigerina lozanoi lozanoi (Colom); Blow, 1979, p. 854-855, pl. 145, figs. 2-9, pl. 250, fig. 1.

Remarks: *Subbotina lozanoi* has a large test with high spire. It differs from *S. prolata* in being bigger in size and possessing high spire.

Stratigraphic Distribution: Early Eocene to middle Eocene (*M. aragonensis* to *H. nutali* Zone) age has been reported for this species (e.g. Blow, 1979; Toumarkine and Luterbacher, 1985).

In this work, well-preserved and commonly occurring specimens of this species are recorded from all of the studied sections. Its age ranges from P7 to P8 Zones.

Subbotina officinalis (Subbotina)

(Plate 20, Figure 25–27)

Globigerina officinalis Subbotina, 1953, p. 78, pl. 11, figs. 1-7; Samanta, 1973, p. 440, pl. 4, figs. 4-6; Stainforth et al., 1975, p.211, fig. 71:1- 7; Blow and Banner, 1962, p. 88, pl. 9, figs. A-C.

Remarks: *Subbotina officinalis* has a small test with low to moderate spire. It differs from *S. ouachitaensis* in having small umbilicus and low aperture covered with a fine lip whereas in the later the aperture is a broad arch.

Stratigraphic Distribution: The Late-middle Eocene to Oligocene age is reported (Bolli, 1957c; Stainforth et al., 1975).

In this work, well-preserved and common to abundantly occurring specimens of this species are recognized from all of the studied sections. Its age ranges from P12 to P15 Zones.

***Subbotina ouachitaensis* (Howe and Wallace)**

(Plate 20, Figure 13–15)

Subbotina ouachitaensis Howe and Wallace, 1932, p. 74, pl. 10, figs. 7a-b; Postuma, 1971, p. 152, figs. on p. 153; Bolli and Saunders, 1985, p. 182, fig. 13: 15-16.

Stratigraphic Distribution: The reported age of this species is middle Eocene to Miocene.

In this work, this species is occurred in all of the studied sections. Its age ranges from P12 to P15 Zones.

***Subbotina patagonica* (Todd and Kniker)**

(Plate 21, Figure 4–5; 11)

Globigrina patagonica Todd and Kniker, 1952, p. 26, pl. 32, figs. 32a-c.

Subbotina patagonica (Todd and Kniker); Hubber, 1991, p. 441, pl. 4, figs. 16-17; Berggren and Norris, 1997, p. 45-46, pl. 5, fig. 10.

Remarks: This species is differentiated from *S. triangularis* in being bigger in size

Stratigraphic Distribution: Berggren and Norris (1997) has reported the age of this species as earliest Eocene to middle Eocene (Zone P5/6 to Zone P11).

In this work, this species is yielded from all of the studied sections. It occurs common to abundantly and its age ranges from P6A to P9 Zones.

Subbotina praebulloides occlusa **(Blow and Banner)**

(Plate 20, Figure 1–3)

Globigrina praebulloides occlusa Blow and Banner, 1962, p. 93, pl. 9, figs. r-u.

Stratigraphic Distribution: The reported age of this species is middle to late Eocene.

In this work, this species is recognized from the Rakhi Nala and Zinda Pir west sections. Its age ranges from P13 to P15 Zones.

Subbotina posttriloculinoides clinata **(Khalilove)**

Globigrina posttriloculinoides Khalilove var. *clinata*, 1956, p. 243, pl. 3, figs. 3a-c.

Stratigraphic Distribution: The reported age of this species is late Eocene.

In this work, this species is observed only from the Zinda Pir west section. Its age ranges from P14 to P15 Zones.

Subbotina prolata (Bolli)

(Plate 21, Figure 12–14)

Globigerina prolata Bolli, 1957b, p. 72, pl. 15, figs. 24-26; Bolli, 1957a, p. 162, pl. 35, figs. 7a-b; Samanta, 1973, p. 442, pl. 1, figs. 10-12; Krasheninnikove and Hoskins, 1973, p. 121, pl. 10, figs. 2-3.

Globigerina lozanoi prolata (Colom); Blow, 1979, p. 856-858, pl. 145, fig. 1, pl. 250, fig. 10.

Stratigraphic Distribution: The reported age of *Subbotina prolata* is early to middle Eocene.

In this work, *Subbotina prolata* is observed from all three studied sections. Its age ranges from P6B to lower par of P10 Zones.

Subbotina turgida (Finlay)

Globigerina turgida Finlay 1939a, p. 19-21, pl. 3, figs. 1-3; Samanta, 1973, p. 445, pl. 3, figs. 4-6.

Remarks: The feature of*Subbotina turgida* is the presence of bulla covering the umbilical portion.

Stratigraphic Distribution: The reported age of this species is middle Eocene.

In this work, a few well-preserved specimens of *Subbotina turgida* are recognized only from the Rakhi Nala section. It is not observed from the other two sections. It is present in the middle part of Zone P8.

***Subbotina triangularis* (White)**

(Plate 17, Figures 22–24)

Globigerina triangularis White, 1928, p. 195, pl. 28, figs. 1a-c; Samanta, 1973, p. 443, pl. 2, figs. 13-15; Bolli, 1957b, p. 71, p. 15, figs. 12-14.

Subbotina triangularis triangularis (White); Blow, 1979, p. 1281-1284, pl. 91, figs. 7, 9; pl. 98, fig. 6; pl. 107, figs. 8-9.

Subbotina triangularis (White); Berggren and Norris, 1997, p. 43-44, pl. 5, figs. 1, 5, 9; Olsson et al., 1999, p. 30-31, p. 26, figs. 1-13.

Remarks: This species can be distinguished from other species (*S. triloculinoides, S. velascoensis*) based on its relatively compressed chambers which join each other at right angles on the spiral side. Moreover, it usually has final chamber smaller than the penultimate chamber.

Stratigraphic Distribution: Bolli (1957b) has reported its age ranging from early Paleocene (*G. pusilla pusilla* Zone) to early Eocene (*M. aragonensis* Zone). However, Berggren and Norris (1997) and Olsson et al. (1999) have reported the age of this species is late Paleocene to earliest Eocene (Zone P2 or P3 to P6).

In this work, this species occurs common to abundant in all of the studied sections. Its age ranges from Zone P3B to lower part of Zone P8.

Subbotina triloculinoides (Plummer)

(Plate 17, Figures 25–27)

Globigerina triloculinoides Plummer, 1926, p. 134-135, pl. 8, figs. 10a-c; Stainforth et al., 1975, p. 234, fig. 92: 1-6; Loeblich and Tappan, 1957, p. 183, pl. 40, figs. 4a-c; pl. 41, figs. 2a-c, pl. 42, figs. 2a-c; pl. 43, figs. 5a-c; pl. 43, figs. 8-9; pl. 45, figs. 3a-c; Toumarkine and Luterbacher, 1985, p. 117, fig. 19: 1a-2c.

Subbotina triloculinoides triloculinoides (Plummer); Blow, 1979, p. 1287-1292, pl. 74, fig. 6; pl. 80, fig. 1; pl. 98, fig. 7; pl. 238, fig. 5; pl. 248, figs. 9-10; pl. 255, fig. 9; pl. 257, fig. 9.

Subbotina triloculinoides (Plummer); Berggren and Norris, 1997, p. 42-43, pl. 4, figs. 1-3, 5-7, 9-10, 21-22; Olsson et al., 1999, p. 31-32, pl. 9, figs. 13-15; pl. 14, figs. 15-16; pl. 27, figs. 1-13.

Remarks: This species is very similar to *S. velascoensis* but differs from it in having trilobate test with axial periphery broadly rounded.

Stratigraphic Distribution: Most of the workers have reported its age restricted to Paleocene (Satinforth et al., 1975; Toumarkine and Luterbacher, 1985). Recently, Berggren and Norris (1997) and Olsson et al. (1999) have reported that it ranges from Zone P1b to top of Zone P4.

In this work, this species occurs commonly in all of the studied sections. Its age ranges from Zone P3A to lower part of Zone P5.

Subbotina velascoensis (Cushman)

(Plate 17, Figures 16, 20–21)

Globigerina velascoensis Cushman, 1925b, p. 19, pl. 3, figs. 6a-c; Bolli, 1957a, p. 71, pl. 15, 9-11; Samanta, 1973, p. 445, pl. 3, figs. 10-12; Stainforth et al., 1975, p. 239, fig. 96:1-4; Toumarkine and Luterbacher, 1985, p. 117, fig. 19: 3a-4c.

Subbotina velascoensis (Cushman); Snyder and Waters, 1985, p. 443, pl. 11, figs. 13-15; Berggren and Norris, 1997, p. 44-45, pl. 5, figs. 2, 6-7, 11; Olsson et al., 1999, p.33-34, pl. 29, figs. 1-12.

Remarks: *Subbotina velascoensis* differs from *Subbotina triloculinoides* in having laterally compressed chambers in the last whorl.

Stratigraphic Distribution: Most of the workers have reported its age late Paleocene to early Eocene (Satinforth et al., 1975; Toumarkine and Luterbacher, 1985). Recently, Berggren and Norris (1997) and Olsson et al. (1999) have reported that it ranges from Zone P3b to Zone P6a.

In this work, this species is yielded from all of the studied sections. Its age ranges from Zone P3B to lower part of Zone P6B.

Subbotina yeguaensis (Weinzierl and Applin)

(Plate 20, Figures 12, 17–18)

Globigerina yeguaensis Weinzierl and Applin, 1929, p. 408, pl. 43, figs. 1a-b; Samanta, 1973, p. 446, pl. 3, figs. 1-3.

Remarks: Main characteristic feature of this species is the large test consisting of four chambers from umbilical side. It shows a trilobate-shaped test from spiral side and has deep umbilical.

Stratigraphic Distribution: The reported age of this species is from early Eocene to Oligocene

In this work, this species is yielded from the Rakhi Nala and Zinda Pir west sections. Its age ranges from Zone P12 to lower part of Zone P13.

7.8.1 Subfamily **Porticulasphaerainae** Banner, 1982

7.8.1.1 Genus ***Globigerinatheka*** Bronnimann, 1952

Remarks: Originally Bolli, Loeblich and Tappan, 1957 introduced a genus *Globigeropsis* and included all *Globigrina* like forms with large final chamber that embraces most part of the test but without any possession of bulla. Later this genus is put in synonymy with *Globigerinatheka* Bronnimann, 1952 (Proto Decima and Bolli, 1970; Stainforth et al., 1975; Toumarkine and Luterbacher, 1985). However, Blow (1979) has separated the two genera based on the spines on the surface of the *Globigerinatheka* along with having true bulla, and muricae on *Globigeropsis* with no true bulla. Similar remarks are made by Loeblich and Tappan (1988), therefore they also have taken the two genera separately.

In this study, both of the genera with or without bulla are considered together under the genus *Globigerinatheka* and the concept of Toumarkine and Luterbacher (1985) is followed.

Globigerinatheka mexicana bari (Bronnimann)

(Plate 23, Figures 21–23)

Globigerinatheka bari Bronnimann, 1952, p.27, text-figs. 3a-c.

Remarks: This species is characterized by very tightly coiled and delicate shell. It differs from other species of the genus *Globegerinatheka* because of its compact, less inflated test with numerous secondary well-defined sutural apertures.

Stratigraphic Distribution: The reported range of this species is from middle Eocene to lower part of the upper Eocene.

In this work, *Globigerinatheka bari* is yielded from all three sections. It is present in Zones P12 and P13.

Globigerinatheka mexicana kugleri (Bolli, Loeblich and Tappan)

(Plate 23, Figures 6, 11–12)

Globigeropsis kugleri Bolli, Loeblich and Tappan, 1957, p. 34, pl. 6, figs. 6a-c.

Remarks: *Globigeropsis mexicana kugleri* is very distinctive species with loosely coiled test and posses no bullas. It can be easily distinguished from *Globigeropsis mexicana bari* being devoid of bullas. *Globigeropsis mexicana*

mexicana is quite similar to this species but differ in being loosely coiled and less compact test.

Stratigraphic Distribution: The reported age of this species is middle Eocene (Zone P11 to top of Zone P14).

In this work, *Globigeropsis mexicana kugleri* is recognized from all of the studied sections and occurs rare to common. It is restricted to the *M. lehneri* Zone (P12).

***Globigerinatheka mexicana mexicana* (Cushman)**

Globigerina mexicana Cushman, 1925c, p. 61, pl. 1, figs. 8a-b.

Remarks: *Globigeropsis mexicana mexicana* is very similar to *Globigeropsis mexicana kugleri* , however, differs from the later in being more compact and with more tightly coiled initial spire. It differs from *Globigeropsis mexicana bari* in lacking peripheral bullas

Stratigraphic Distribution: It is reported from middle Eocene to early part of the late Eocene.

In this work, *Globigeropsis mexicana mexicana* is yielded from all three sections but its age is restricted to the *M. lehneri* Zone (P12).

7.8.1.2 Genus ***Orbulinoides*** Cordey, 1968

(Plate 15, Figures 5-6)

Type Species: *Porticulasphaera beckmanni* Saito, 1962.

This is a monotypic genus. Test spherical, subglobular early chambers form a trochospiral coil, chambers 5 to 6 per whorl, final chamber strongly inflated, completely overlap the umbilical side, wall perforate, surface finely spinose, numerous apetural openings at the base of the final chamber.

Remarks: Bolli, Loeblich and Tappan (1957) grouped all the large sized forms with spherical test-shape having several sutural apertures under the genus *Porticulasphaera*. Blow and Saito (1968) re-examined the *Porticulasphaera* type species and then they introduced the generic name as *Orbulinoides* for *Porticulasphaera* that was later used by many workers (Cordey, 1968; Postuma, 1971; Toumarkine and Luterbacher, 1985). However, Blow (1979) has placed the genus *Porticulasphaera* in synonymy with genus *Globigeropsis*.

Surface texture obtained from the specimens yielded from the Sulaiman Range material show coarsely perforate surface texture (Plate 15, Figures 5-6).

***Orbulinoides beckmanni* (Saito)**

(Plate 15, Figures 5–6, Plate 23, Figures 25-27)

Porticulasphaerica beckmanni Saito, 1962, p. 221, pl. 34, figs. 1a-c.

Globigerina mexicana Cushman, 1925d, p. 309, pl. 2, fig. 15.

Globigerinoides mexicana Cushman, Beckmann, 1954, p. 393-394, pl. 25, figs. 18-19.

Porticlasphaera mexicana (Cushman); Bolli, Loeblich and Tappan, 1957, p. 35, pl. 6, figs. 8-9b; Bolli, 1957a, p. 165, pl. 37, figs. 1a-b.

Remarks: This is very distinctive species and can easily be identified from other similar species of *Globigerinatheka* because of it more rounded test with very large final chamber embracing the entire test.

Stratigraphic Distribution: The reported age of this species is restricted to the *Orbulinoides beckmanni* Zone.

In the Sulaiman Range it is found in all three studied sections and is restricted to the *O. beckmanni* Zone.