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First Report of *Ranikothalia* Caudri from Middle Andaman Island, India and its Significance

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Abstract: Genus *Ranikothalia* Caudri is described for the first time from the Upper Palaeocene sediments of Middle Andaman Island. Three species *R. sidensis*, *R.* cf. *nuttalli*, *R.* cf. *tobleri* along with one species of *Discocyclina* are described here. The occurrence of *Ranikothalia* has great implication in understanding the stratigraphy of the island and in deciphering the palaeogeography of the area. This point to the extension of the Ranikot Sea at least up to Middle Andaman.

Keywords: Andaman island, Mithakhari Group, Palaeogeography, *Ranikothalia.*

INTRODUCTION

Most of the Tertiary marine sequences all over the world are interesting for their rich foraminiferal fauna. Especially the larger benthic foraminifera of Tertiary sequences drew the attention of majority of palaeontologists. Importance of some Tertiary larger benthic foraminifera as index is unquestionable. Though a fairly thick marine sedimentary Palaeogene-Neogene sequence is exposed in Andaman & Nicobar Islands, characteristic richness of foraminiferal assemblage is absent specially in the lower part of the sequence.

Andaman & Nicobar Islands lying between 6°45' - 14° N latitude and 92°15'– 94°E longitude, geologically a part of the belt extending from Arakan Yoma in Burma – Ramree Group of Islands – Sumatra – Java, has a complex geological history. In Andaman island, Tertiarty sediments are intervened by the emplacement of N-S trending dismembered ophiolite slices (Pal et al. 2003). However, the northern part of Middle Andaman, which is under study, is comparatively less disturbed. Extending towards south, in far East in Indonesia and Sumatra, the lower most Tertiary Unit (T_a) is as young as Middle Eocene (Glaessner, 1959; Adams, 1970) suggesting that whole of Palaeocene and Lower Eocene is absent in the belt. Considering the geological set up towards the south and that in Ramree islands towards north, Nagappa (1959a) opined that in Andaman also Palaeocene and Lower Eocene sequence have not developed. He summarized as "Considering that in the Ramree island area there is an unconformity between Cretaceous and the Eocene and that the Eocene of the area is of Kirthar age and also considering the possibility that the Andaman outcrops form a continuation of Ramree sequence, it is most important that fossils of Andaman Eocene be examined again to see if any further evidence is available".

Presence of Palaeocene rocks have been mentioned time and again from Andaman islands (Karunakaran et al. 1964; Mohan and Pandey, 1973; Kumar and Soodan, 1976; Kundal and Wanjarwadkar, 2002). Lower Palaeocene planktonic foraminifera were described form Baratang Formation (= Mithakhari Group), Middle Andaman (Mohan and Pandey, 1973; Kumar and Soodan, 1976). Some boulders of limestones occurring in conglomerate in south Andaman were considered as Palaeocene, based summarily on *Distichoplax biserialis* (Karunakaran et al. 1964; Chatterjee and Gururaja, 1972) though, in situ exposure of such limestones was never found in Andaman islands. However, *Distichoplax biserialis* is now known to occur from the Upper Cretaceous to Eocene (Mishra and Kumar, 1988; Badve and Kundal, 1988).

Miscellanea, a typical Palaeocene genus was reported by Gururaja (1984) from the Tugapur limestone in Middle Andaman. However, lack of proper description and photographs or figures has only lessened the significance of this report. More recently five species of *Daviesina* (*D. langhami* Smout, *D. Danieli* Smout, *D. garumensis* Tambreau, *D. tenius* Tambreau and *D. ruida* Schwager) were reported from the hard, creamy white coloured porcellanitic

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limestone exposed as detached mounds near Burmadera, Tugapur and Buddanala in Middle Andaman island suggesting Thanetian age for these limestones (Kundal and Wanjarwadkar, 2002).

Lower Eocene is not evidenced from Andaman except for the occurrence of *Assilina granulosa* described first by Tipper (1911) and later by Gee (1926). However, Nagappa (1959a) opined that the *A. granulosa* of Tipper & Gee is actually *A. papillata*, a common Kirthar species.

Present note deals with the occurrence of *Ranikothalia* from Mayabunder and Burmadera area of Middle Andaman (Fig.1). Three species *R. sidensis, R.* cf. *nuttalli, R.* cf. *tobleri* are described here for the first time from Andaman island. Implication of this finding on the stratigraphy and palaeogeography of the area has also been discussed here.

MATERIALS

The Mithakhari Group can be broadly divided into two distinct facies – lower argillaceous and upper arenaceous. The studied materials are from limestones of two different localities i.e., coastal section near Murugan Temple southwest of Mayabunder and from the nala section near Burmadera, Middle Andaman. South of the Burmadera mound in the nala three bands of cream white porcellanitic limestone alternating with thick coarse-grained sandstone beds (Fig. 2A) were observed. Lateral extensions of these limestone beds are obscure. Among the three, only one limestone bed (Sample no. L209/2) have yielded larger foraminifera. Boulders of hard, sandy limestone from conglomerate exposed towards the top of a coastal section (near Murugan temple, Fig. 2B) at southwest of Mayabunder were the other material. This section shows a sequence of coarse sandstone, sandstone-shale alternation and conglomerate. The shale-sandstone alternation is profusely bioturbated, which is otherwise unfossiliferous. The polymictic conglomerates in this section contain sub-angular to sub-rounded clasts of volcanics, chert, sandstone and vein quartz along with clasts of limestones (Sample nos. MT-1 and MT-2). The lateral extension of the conglomerate could not be traced as it extends in the seawater. Foraminiferal fauna in these hard limestones from both the localities are fused with the matrix making extraction impossible. Therefore, the forms are studied in random thin sections. Studied materials are kept in the laboratory of the Palaeontology Division, Geological Survey of India, Eastern Region, Kolkata. Three species of *Ranikothalia*

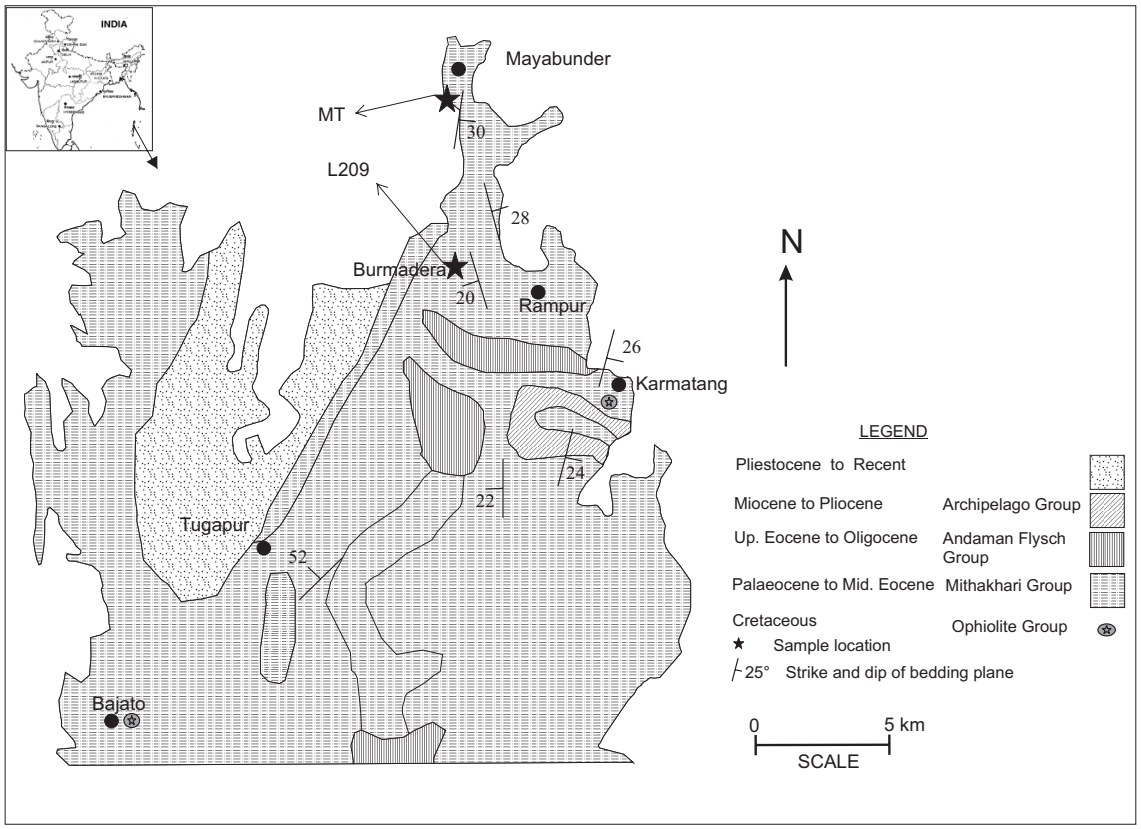

Fig.1. Geological map of northeastern part of Middle Andaman (*after* GSI, 2007)

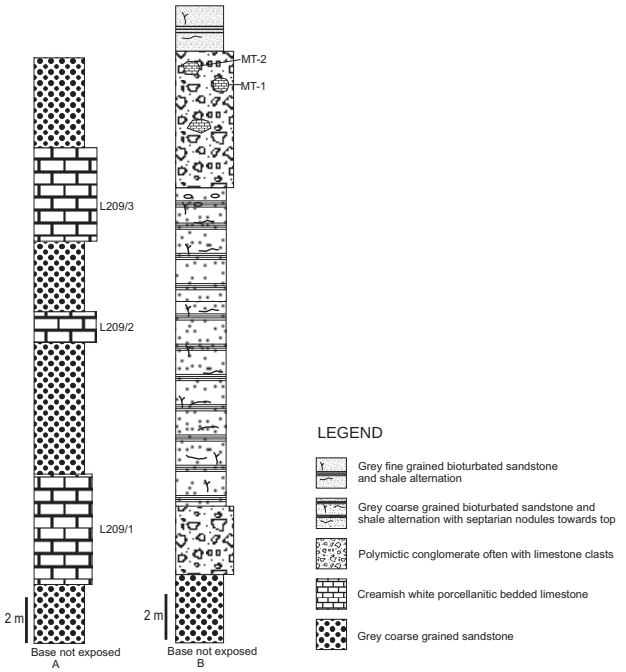

Fig.2. Lithosections of Middle Andaman. (**A**) Burmadera nala and (**B**) Near Murugan temple, Mayabunder.

and one species of *Discocyclina* observed in the materials are described here.

SYSTEMATIC DESCRIPTIONS

Order: FORAMINIFERIDA
Suborder: ROTALIINA
Superfamily: NUMMULITACEAE de Blain Ville, 1827
Family: NUMMULITIDAE de Blain Ville, 1825
Subfamily: NUMMULITINAE Carpenter, 1850

Genus: *Ranikothalia* Caudri
Type species: *Nummulites nuttalli* Davies, 1927

Caudri (1944) created genus *Ranikothalia* based on the type species *Nummulites nuttalli*, well-illustrated by Davies and Pinfold (1937). She noted that the *Ranikothalia* is "sufficiently different" from *Nummulites sensu stricto* and characterized by bluntly rounded chamber top and thick coarsely gutted supplementary skeleton. However, Caudri did not provide a detailed description of the newly created genus. There are differences in opinion on the validity of the genus *Ranikothalia*, though many workers like Cizancourt (1948), Nagappa (1959b), Hottinger (1973, 1977), Samanta (1980), Racey (1995) and Haynes et al. (2010) attest the validity of *Ranikothalia*.

Generic diagnosis: Test compressed lenticular, planispirally coiled, involute or evolute, moderately granulate; walls coarsely perforated; septa thick with prominent intraseptal canal; massive marginal cord coarsely canaliculated; alar prolongations in involute form. The present materials agree well with the characteristics of *Ranikothalia*. In our materials prominent evoluteness in the adult stage observed in some of the forms is quite striking. These forms are easily distinguishable form *Nummulites* as the later is involute throughout its life. On the other hand, Assilines are characterized by evolute planispiral coiling from juvenile to adult stage. The present forms differ from *Nummulitoides* Abrard, 1956 (Haynes et al. 2010) as the later is having discoidal tests, quasi- evolute nature of spire, spiral laminae clasping marginal cord only, moderate to lax spires.

Distribution: Ranikothalia is reported from Venezuela, Gulf of Mexico, Caribbean region, Lybia, Southern France, Sicily, Turkey, Iran, Iraq, Oman, Pakistan, Tibet, India, and Western Burma (Fig. 3). In India Ranikothalia is reported from the Palaeocene rocks of Pondicherry and of Khasi – Jaintia Hills of eastern India. Report of *Ranikothalia* from East Indies (NE Borneo) needs to be mentioned separately because of its disputed history. Van der Vlerk (1929) reported *Nummulites nuttalli* Davies and *Nummulites thalicus* Davies (megalospheric form of *N. nuttalli*) along with *Lepidocyclina*, *Heterostegina*, *Spiroclypeus* from NE Borneo. This report of *Ranikothalia* is not convincing (Cole, 1960; Adams, 1970 and Samanta, 1980). Nagappa (1959a) also opined that the presence of *Ranikothalia* in NE Borneo reported by Van der Vlerk (op. cit.) does not fit in with the rest of the assemblage. Haynes et al. (2010) considered that these two forms of Van der Vlerk belong to genus *Palaeonummulites*.

Ranikothalia cf. *tobleri* Caudri
(Plate I, Figs. 6, 7 and 8)

Description: 'A' form, flattened lenticular, axial length in thin section 1.9mm to 2.6mm, width in thin section 0.63mm to 0.88mm, two sides are almost parallel, small polar pustule prominent, slightly granulate, planispiral, inner whorls involute, the last whorl evolute, spiral sheet becomes thin in the outer whorl, fairly coarse pronounced marginal cord absent in the outermost whorl, proloculus large oval.

Remarks: The present species from Middle Andaman is slightly different from *Ranikothalia tobleri* Caudri in having thinner spiral sheet in the last whorl. *R. savitriae* (the megalospheric form of *R. sahnii* Davies) described by Davies (1952) differs from the present material in having involute spires throughout its life.

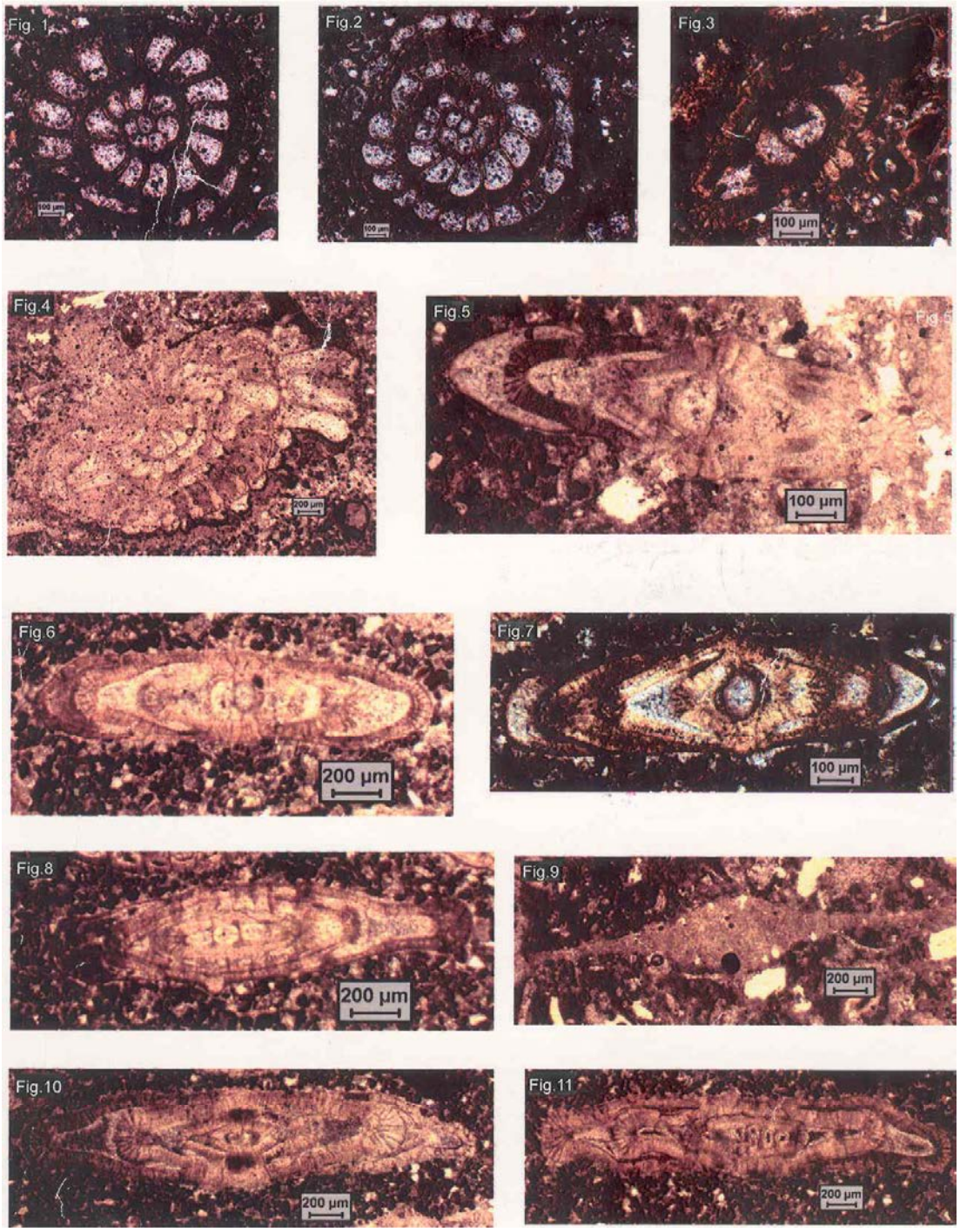

Plate 1. (1) *Ranikothalia sidensis* showing thick perforated outer and smooth inner wall, "A"- form, equatorial section (MT-1). **(2)** *Ranikothalia sidensis*, showing thick perforated outer and smooth inner wall, "A"- form, equatorial section (MT-1). **(3)** *Ranikothalia sidensis*, showing canaliculated marginal cord and polar plug like structure, "A"- form, oblique section (MT-1). **(4)** *Ranikothalia sidensis*, showing perforated wall and narrow high chambers, "B"- form, oblique section (MT-1). **(5)** *Ranikothalia sidensis*, showing evolute last outer whorl and very thick marginal cord, "A"-form, Axial section (MT-1). **(6)** *Ranikothalia* cf. *tobleri*, showing perforated wall and evolute outer whorl, "A" –form, axial section (209/2). **(7)** *Ranikothalia* cf. *tobleri*, showing perforated wall and evolute outer whorl, and small polar pustules, "A" –form, axial section (209/2). **(8)** *Ranikothalia* cf. *tobleri*, showing massive marginal cord, "A" –form, oblique axial section (209/2). **(9)** *Discocyclina* sp., near axial section, (MT-2). **(10)** *Ranikothalia* cf. *nuttalli*, showing fan-shaped bulged marginal cord, thin alar prolongation and polar plug, "B"–form, axial section (MT-1). **(11)** *Ranikothalia* cf. *nuttalli*, showing granulate test with fan-shaped bulged marginal cord, "B"–form, near axial section (MT-1).

Distribution: Upper part of the lower argillaceous facies (= Lipa Black Shale Formation) of Mithakhari Group exposed near Burmadera, Middle Andaman.

Ranikothalia sidensis Davies
(Plate I, Figs. 1, 2, 3, 4 & 5)

Operculina sidensis Davies 1927, pp. 274, pl. 19, figs. 10-13
Ranikothalia sidensis, Caudri 1944, pp.18.
Ranikothalia sidensis, Nagappa 1959b, pp.156, pl. 22, figs. 4,5; pl. 23 fig. 1.

Description: 'A' form, test small, in thin section diameter is 2.05 mm – 2.17 mm, flattened lenticular, periphery rounded, planispiral, involute, in axial section last whorl evolute, spire regularly opening, coarsely granulate, thick coarse pronounced marginal cord, spiral sheet divided into two distinct layers, outer layer coarsely perforate and inner smooth, thick perpendicular septa with prominent intraseptal canal, chamber curved with rounded top, two times higher than long in the adult chambers, 6-7 chambers in the first whorl, 11-13 chambers in the second and about 20 in the last whorl, marginal cord thick, coarsely canaliculated, proloculus diameter 0.248 - 0.263mm, protoconch (0.93-0.120mm) and deuteroconch (0.124- 0.121mm) circular, sub-equal in size separated by thin straight wall. An off-centered section of "B"- form shows coarsely perforated spiral sheet and rectangular much higher than long chambers.

Remarks: From Kala Chitta Range of North Pakistan Butt (1991) described *R. sidensis* as completely evolute, complanate form. Haynes et al (2010) opined that Butt's *R. sidensis* is actually a species of *Nummulitoides*. Davies's *R. sidensis* is involute through out. The present from has been identified as *R. sidensis* Davies, though these are having evolute final whorl.

Distribution: Upper part of the lower argillaceous facies (= Lipa Black Shale Formation) of Mithakhari Group exposed in the coastal section near Murugan Temple, Mayabunder, Middle Andaman.

Ranikothalia cf. *nuttalli*
(Plate I, Figs 10 and 11)

Description: 'B' form, thin flattened lenticular planispiraly coiled involute test, surface very gently sloping from the polar region, periphery slightly flexed, axial length in thin section is 4.3 mm to 4.6 mm, width in thin section is 1 mm to 1.2 mm, alar prolongation reaches upto the wedge shaped polar plug, coarsely granulate, spiral sheet coarsely perforated, thick pronounced coarse bulged marginal cord.

Remarks: This from bears close resemblance with *Ranikothalia nuttalli* described by Racey (1995) from Oman; but slightly smaller in size. It differs from *R. nuttalli* described by Samanta (1980) from Pondicherry in having alar prolongations equal in both side and reach upto the polar region.

Distribution: Upper part of the lower argillaceous facies (= Lipa Black Shale Formation) of Mithakhari Group exposed in the coastal section near Murugan temple, Mayabunder, Middle Andaman.

Superfamily : ORBITOIDACEAE Schwager, 1876
Family : DISCOCYCLINIDAE Galloway, 1928

Genus: *Discocyclina* Gümbel, 1868
Discocyclina sp.
(Plate I, Fig 9)

Description: Test simple with broad rounded umbo and long thin flange, axial length in thin section 4.2 mm, width in thin section is 0.9 mm, pillars few, concentrated in the umbonal area, in flange area lateral chambers arranged in tiers, rectangular, bounded by thin roof and floor, in umbonal area rectangular lateral chambers arranged in tiers, bounded by thick roof and floor.

Remarks: Due to less abundance and paucity of well-preserved sections in our present material specific identification or comparison was not possible.

Distribution: Upper part of the lower argillaceous facies (= Lipa Black Shale Formation) of Mithakhari Group exposed in the coastal section near Murugan temple, Mayabunder, Middle Andaman.

DISCUSSION

Ranikothalia is widely distributed lower Tertiary larger foraminifera. Due to its worldwide occurrence this genus is important for regional correlation and deciphering palaeogeography. Caudri (1944) tentatively considered *Ranikothalia* ranges from Maestritchtian to Palaeocene in Caribbean and the Gulf of Mexico. Racey (1995) and Haynes et al., (2010) considered the range of *Ranikothalia* as Palaeocene to Early Eocene on the basis of Samanta's

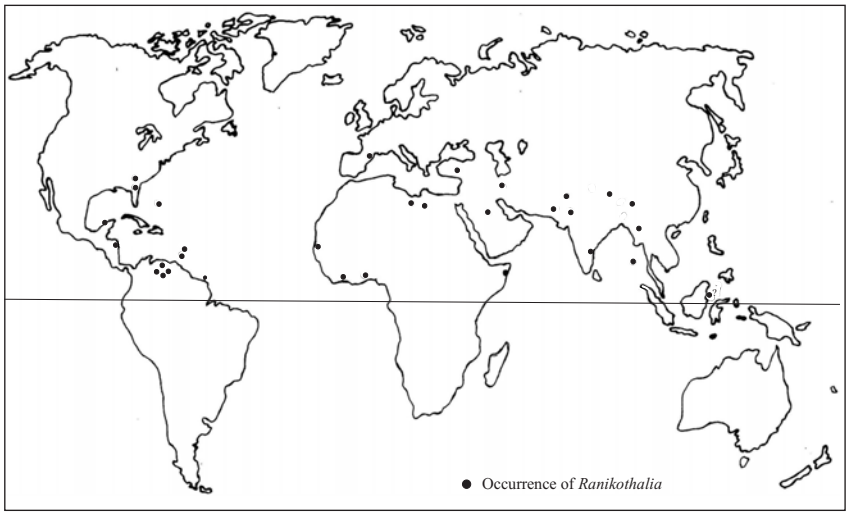

Fig.3. Geographic distribution of *Ranikothalia*

(1980) report of *R. nuttalli* from *Globorotalia aequa* zone from Pondicherry. However, the species of Oman described by Racey (1995) are from Upper Palaeocene. Samanta (1980) concluded that the range of *Ranikothalia* is limited from the base of Middle Palaeocene *Globorotalia angulata* zone to the Upper Palaeocene *Globorotalia aequa* zone. However, he emphasized that *Ranikothalia* extinction datum is a readily recognizable criterion for deciphering Palaeocene – Eocene boundary in India and Pakistan, which, indicates the occurrence of *Ranikothalia* is restricted up to the lower part of the *Globorotalia aequa* zone; this was over sighted by Racey (op cit.). In Salt Range *Ranikothalia* (*Nummulites*) *nuttalli* and *R.* (*Nummulites*) *thalicus* are reported to be confined in Upper Palaeocene Ranikot beds (Davies and Pinfold, 1937). Presence of *Ranikothalia* Davies, 1949 comparable to *R. shanii* Davies (1952) and *R. savitriae* Davies (1952) led him to accept the presence of Palaeocene bed in Togoland though no other supportive Nummulitids were found. Nagappa (1959a) considered that in India, Pakistan and Burma region, *Ranikothalia* is restricted to the Palaeocene. Definite *Ranikothalia* bearing horizons in India are from Pondicherry, Khasi-Jaintia Hills of Assam and Meghalaya. In Pondicherry *Ranikothalia nuttalli* is predominant, whereas in Meghalaya *R. sidensis* is frequent (Samanta, 1980). Gogoi et al. (2009) reported *Ranikothalia sidensis* in association with *Miscellanea miscella*, *M. juliettae* and *M. yvettae* from Lakadong Limestone Member of Sylhet Formation of Meghalaya and placed the assemblage in the Shallow Benthic Zone (SBZ)-3 of Serra-Kiel et al. (1998). The present work shows species comparable to *R. nuttalli*, *R. sidensis* and *R. tobleri* are present in Middle Andaman area and the eastern limit of occurrence of *R. nuttalli* can be extended up to Middle Andaman island.

In Middle Andaman island Early Palaeocene is well represented by planktonic foraminiferal assemblage from the lower argillaceous facies (=Lipa Black Shale Formation) of Mithakhari Group (=Baratang Formation) (Mohan and Pandey, 1973; Kumar and Soodan, 1976). Since Kumar and Soodan (1976) recorded Early Palaeocene planktonic foraminifera from horizons stratigraphically lower to the present horizon, occurrence of *Ranikothalia* probably indicates upper Palaeocene age to the sediments. Limestones of Thanetian age observed towards the top of the sequence (Kundal and Wanjarwadkar, 2002) are in continuation of the limestone horizon of Burmadera nala section. Therefore, this advocates that whole of the Palaeocene is represented in Middle Andaman. The occurrence of *Discocyclina* in association with *Ranikothalia* observed in limestone boulders (Sample nos. M-1 & M-2) of Murugan temple section and fossil calcareous algal assemblage and corals in association with benthic foraminiferal fauna observed in Burmadera nala section (Sample no. 209/2) indicate reef environment prevailed during the deposition of these limestones. From the records of Palaeocene fauna of Assam, Meghalaya, Burma and now from Andaman, it is evident that the Tethys Sea extended through these areas at least up to the Middle Andaman if not up to the full length of the Andaman Nicobar islands. Probably the Palaeocene in the studied area culminated either with the upliftment of the basin or with the regression that set in at the end of Palaeocene (Nagappa 1959a; Haque, 1987) as evidenced by the presence of conglomerate in the upper part of the sequence in which limestone boulders containing the described *Ranikothalia* were observed. This conglomerate is the base for the upper arenaceous facies (Namunagarh Grit Formation) of Mithakhari Group (=Baratang Formation) in the study area. Nevertheless, the question, how Palaeocene is not developed in Ramree Island area is not clear. Convincing Palaeocene fauna is absent from the Far East. *Ranikothalia* and *Miscellanea* of Van der Vlerk (1929) described from Borneo is not accepted by later workers and it does not fit with the associated fauna. Adams (1970) also reported *Miscellanea* from Sarawak, which is not supported by proper description and figures. As in Indonesia and Sumatra the lower most Tertiary Unit (T_a) is of Middle Eocene, this finding of the Palaeocene larger benthic fauna form Middle Andaman suggests for thorough

search towards south particularly in South Andaman and Nicobar islands for establishing extension of the Ranikot sea.

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