



## RESEARCH PAPER

## OPEN ACCESS

## Rotaliacea of tiyon formation, Kambhu Jabal, lower Indus Basin Pakistan

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### Abstract

10 species of benthic foraminifera including one new species have been identified from Eocene succession Tiyon Formation around Laki Range, Lower Indus Basin Sindh. Certain benthic species specified position to the super family Rotaliacea. On the basis of identified species the age allocate to Tiyon Formation is SBZ-14(Middle Lutetian) shallow benthic biozone.

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## Introduction

The shallow marine origin out crops is rich in Cenozoic benthic and planktonic foraminifera, in Sindh, Pakistan. The larger foraminifer has been used to divide the Cenozoic sequence into stratigraphic units, Ranikot and Laki Groups, Lower Indus Basin, by many people since beginnings, Vredenburg (1906) Nuttal (1926). These units were subsequently altered into associated lithostratigraphic unit (Shah, 1977).

The Cenozoic shallow marine carbonates successions in the Indus Basin of Pakistan contain stratigraphically important larger benthic foraminifera (LBF), which have been used for Indian subcontinent, and regional biostratigraphy (e.g. Hottinger 1960, 1971; Adams 1970; Kureshy 1978; Schaub 1981; Serra-Kiel *et al.* 1998; Jauhri & Agarwal 2001; Green *et al.* 2008; Afzal *et al.* 2011). However, subdivisions and efforts resulting from correlations in both intra- and inter-local basins had been unsure because of the shortage of facts on smaller benthic foraminifera associations. A lot of data had also been produced by other workers on larger and planktonic foraminifera of the middle Eocene of India, but nothing substantial was published on smaller benthic foraminifera (Jauhri, 1991). The present work represents detail account on smaller benthic foraminifera recorded from Tiyon formation of Eocene age.

The geology of the vicinity was first mapped and described by Blandford (1876 and 1879). Noetling (1905) took into consideration this unit to be lower part of the "Ghazij Shale". Vredenburg (1909), reported it as part of Kirthar series (Middle late Eocene to Early Oligocene). Jones (1960) (Hunting Survey Corporation, HSC) prepared the first exploration details and geological map on a scale of 1 inch to 4 miles and first documented this limestone unit between Laki and Kirthar as a separate unit and proposed the name of the Tiyon formation with the aid of Tiyon Nai (Lat 26° 08' 30" N, Long 67° 47' 15" E, toposheet 35N16).

Kambhu Jabal is located more or less 72km north of Thano Ahmed Khan with road leading to Thano bula Khan in district Jamshoro, Sindh. The investigated

area covers the Lat 25.5425° to 25.5867°, Long 67.7633°, to 67.7967°. The Kambhu asymmetric anticline NW strike, with dipping 75° to the East and 100 to the West. The section is the natural Nala cut, Minjhari ji Dhat up to 25° 33' 14 .04" N and length 67° 47' 30.02" E anticline, where 52 samples of the Tiyon formation were collected. The Tiyon formation thickness at the western limb is about 205 m lithography section of the column (Fig. 2). The Tiyon Formation features interbedded shale, marl and limestone. The distinct shale unit is calcareous and gypsiferous. The previous literature reported it as Late Ypresian to Early Lutetian and current assemblage of smaller benthic foraminifera including one new species, suggests Middle Lutetian age of the formation.

## Material and methods

The section is the natural Nala cutting, Minjhari ji Dhat up to 25° 33' 14 .04" N and length 67° 47' 30.02" E anticline, where 52 samples of the Tiyon formation were collected at half meter to a meter. Samples are labeled as TyK-W = Tiyon formation K = Kambhu Jabal and W = western member. The selected limestone, shale and marl were examined for foraminifera.

## Processing and Study Techniques

The 52 Samples were processed using typical strategies described by KUMMEL and RAUP (1965), to isolate the microfauna, the compact became first decomposed with the hammer to the rough size after which soaked in water for the night. The softer lithologies (shale and marl) were treated with hydrogen peroxide, which produced better results. The Soaked samples are boiled with sodium NaCO<sub>3</sub> (one or tablepoons) for 2 hours. The boiled samples were washed via the sieves under the jet of tap. The dried sample was sieved and well shaken for about 10 minutes using 32, 52, 85, 100 and 120 mm mesh sieves. The dried sieve fractions were studied under binocular microscope usually using 4x and 20x magnification. The collected specimens were photographed at 640LV, jeol scanning electron microscopy laboratory at the Centre Natural and Applied Geology, University of Sindh, Jamshoro Pakistan.

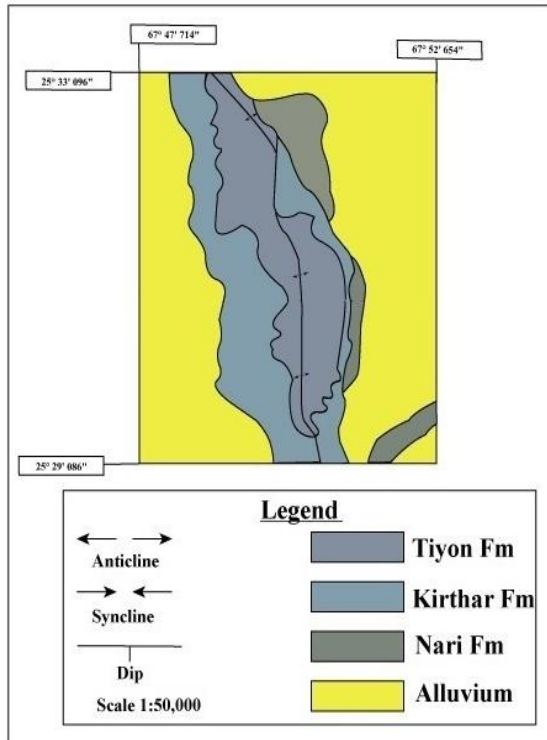


Fig. 1. Map of the area studied.

**Result and discussion**

The mainly and widespread benthic species in Tiyon formation comprise *Nonienella insecta* Cushman & Ponton, *Nonion acutidorsatum* Ten Dam, *Nonionella* sp. cf. *Nanthani* Cushman and *Appline*, *Nonion* *Leave d*, *Orbigny*, *Nonoin* sp. cf. *N. scaphum* Fichtel and Moll, *Nonionella* sp. cf. *N. africana* Le Roy. The age of the Tiyon formation in previous literature reported as Late Ypresian-Early Lutetian. The currently investigated smaller benthic assemblage based on new specie suggests its age as Middle Lutetian.

**1. Pararotalia inermis**

*Pararotalia inermis* Terquem 1883

*Pararotalia inermis* is a species of Lutetian age. This species differs from that of *Audouni paraotonia* by having a more rounded contour, being equally biconvex, with a protuberance in the umbilical portion of each room. *Pararotalia spinigera* is planoconvex and is much smaller.

**Comments**

This species was originally described in the medium (luteal) Calcaire Grossier and Grigon. The sample shown in sample No. Tm-18, 40 in Tiyon formation.

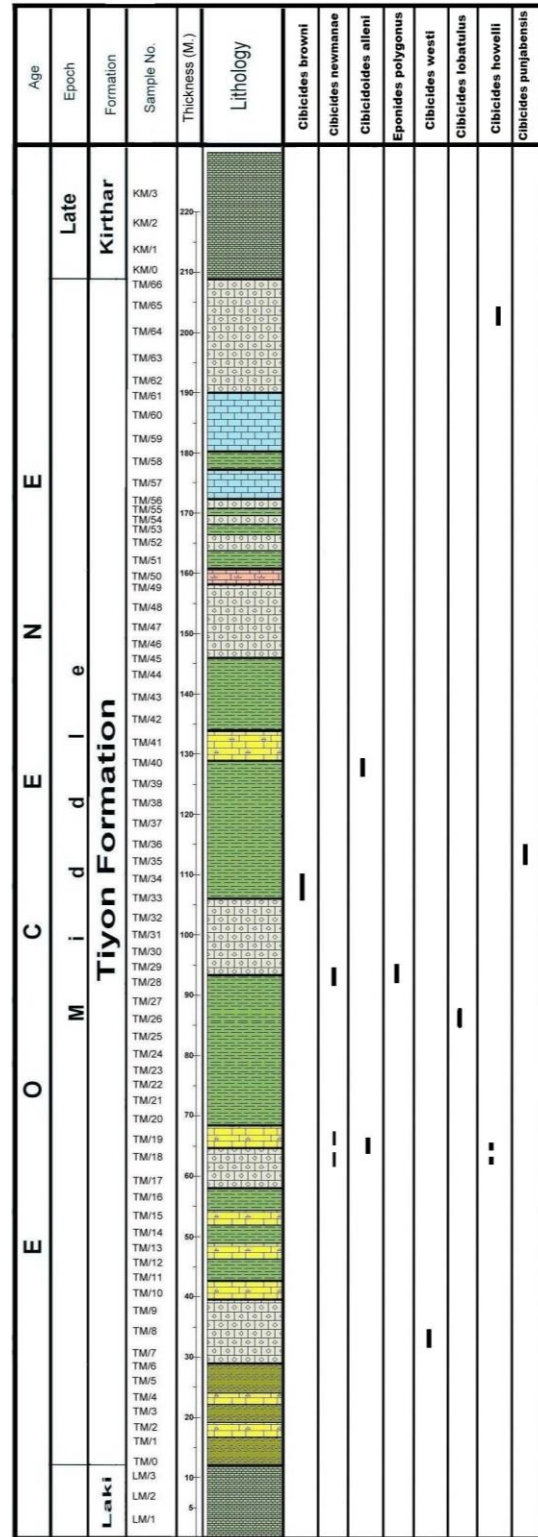


Fig. 2. Lithological columnar section of the studied area.

**2. Pararotalia spinigera (Lecalvez)**

*Globorotalia spinigera* (Terquem) Le, Calvez, 1949  
Leoblich and Tappan 1957

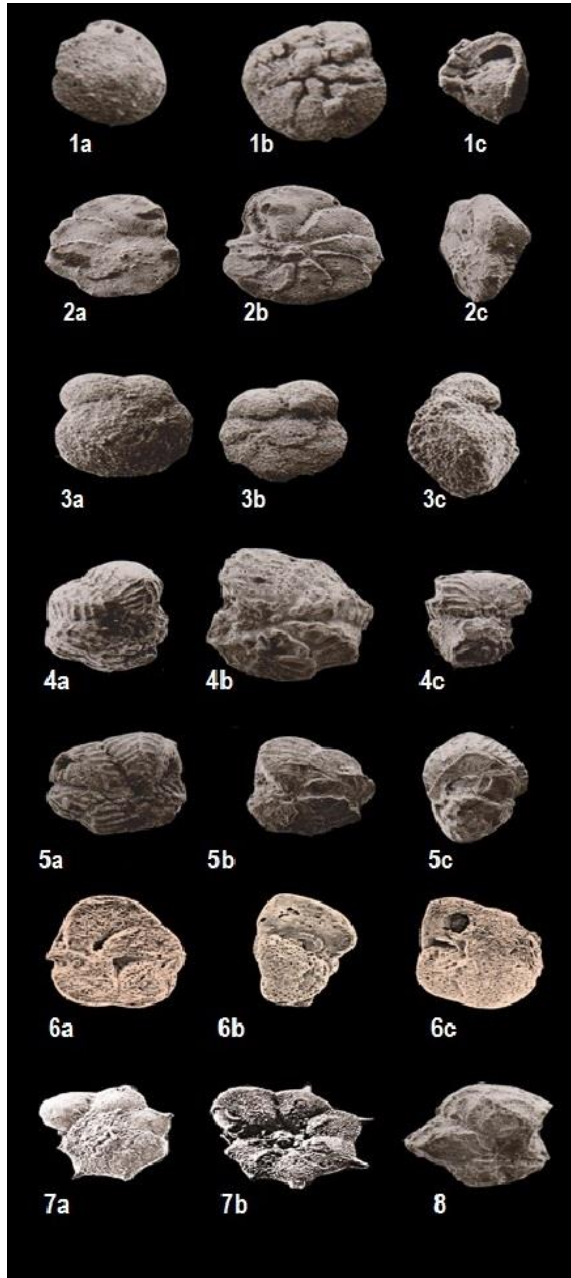
This species resembles *Pararotalia curryi*, but then is biconvex and has only incompletely arise peripheral spines.

*Comments*

This species resembles *Pararotalia curryi*, but then is biconvex and has only poorly developed peripheral spines.

*Distribution*

The figurative sample documented from the sample Tm-17, 65 in the Tiyon formation.



### 3. *Rotalia audouini* d'Orbigny 1850

*Rotalia audouini* d'Orbigny, 1850, vol. 2, p. 407.

*Comments*

*Rotunda audouini* differs from the material studied with *Rotalia lithothamnica* in that it presents a

prominent keel and the surface is slightly ornamented with spines and peripheral carnations.

*Distribution*

This species was recorded from the sample Tm-17, Tm-29 in Tiyon formation.

4. *Rotalia* sp*Comments*

This specimen appears to be close to *Rotalia trochidiformis* (Lamarck), but it differs from having a beak-shaped projection in the last formed chamber. Only two copies of the material studied.

*Distribution*

The figurative sample recorded in the Tm-33, Tm35 sample of the Tiyon formation.

5. *Orantanomalina geei*

*Orantanomalina geei*, Haque, A.F.M., 1956, v.1, p.197, p.18, fig.18-c.

*Comments*

The specimen is similar to *Orananomalina geei*, reported by Haque 1956 from Nammal Formation (Pakistan). This species differs from other known *Ornatanomaline* species in the high granules along the sigmoidal opening transversal costs.

*Distribution*

This species originally described by Haque 1956, Nammal Gorge Section, Pakistan. The figurative specimen recorded from Laki's and Tiyon's contact in samples no. Tm-28 and Tm-29.



### 6. *Gaudryina* aff. *G. quaternary* Cushman 1936

*Comments*

This species differs from Gaudry's quadrilateral, with a much lower height of the room, the wall is less thick.

*Distribution*

Only a sample of the sample Tm-25, 26 of the Mari Nai section, Tiyon's formation.

*7. Orantanomalina Hafeezi Haque 1956*

*Orantanomalina Hafeezi Haque, A.F.M.M., 1956, 1, p. 200, Pl. 18, Fig. 6a-c*

The specimen of Tiyon formation appears to be identical to Haque species registered in Namcm Canyon (Paleocen). These specimens are inadequately preserved, but have typical characteristics of this species. This species differs from *Orantanomalina geei* in the most compressed test, in the form of the test, in the number of ribs on the surface of each chamber.

*Distribution*

The cipheral specimen was collected from the Tiyon formation in sample no. Tm-7, 8.

*8. Elegant Orantanomalina Haque 1956 Elegant Oranganomalina Haque, A.F.M., 1956, 1, p. 201,**Comments*

Some poorly preserved specimens of the Tiyon Formation seem to be identical to the Haanka Haunted Orananomalina species at the top of the Shala of Patala (Formation Ranikot, Paleocen) Gola Nammal, the salt range. This species resembles superficially in Orananomalina geei, but differs in the most compressed that evolves the dorsal plane part and completely reverses the ventral part of the test. *Orantanomalina hafeezi* is compressed and umbilicado, which differs from this species, in the absence of the fully evolving dorsal side and the ventral side.

*Distribution*

The figurative samples were recorded from the Tiyon formation in the Tm-34, 35 samples.

*Plate Descriptions*

*Rotalia sp. of the sample Tm-3, a spiral view, a side views 3-b, a 3-cumm x 100 view.*

*Rotalia auduini d'orbigny 1846 from Tm-40. Spiral 4-th view, umbilical view 4-b, axial view 4-c x 100.*

*Parachute Inermis Terquem 1883 Tm-12, 1-a spiral view showing 1-b umbilical view, axial view 1. x 100.*

*Orantanomalina Geei Haque 1956, from sample Tm-3. 3 - a spiral view, an umbilical view 3 - b. Axial view 3. X 100.*

*Orantanomalina hafeezi Haque 1956, from sample Tm-3. 5-a spiral view, umbilical view 5-b, peripheral view 5-x x 70.*

*Gyroidnella magna Le Calvez 1949 from the trial Tm-13. 7th, Umbilical View 7-b. Axial view of 7th century. X 100.*

*Spinigera spinach Tm-26, 1-a spiral view showing, umbilical view 1-b, 1-axial view. x 100.*

*The elegant Orananomalina Haque 1956, from the Tm-3 sample. X 100.*

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