Sindh Univ. Res. Jour. (Sci. Ser.) Vol: 40 (2) 05-14 (2008)

Sindh Univ. Res. Jour.

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SMALLER FORAMINIFERAL ASSEMBLAGE OF THE KHIRTHAR FORMATION OF SUKKUR AND KOTDIJI AREA, SINDH

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(Received 24th March 2008 and Revised 15th September 2008)

Abstract

Khirthar Limestone, the most prominent ridge-forming rock unit that has derived its name from the north-south stretching range of hills, the Khirthar Ranges, that attracted Blanford (1876) to name this well developed rock unit as "Khirthar Limestone", later formalized to Khirthar Formation. It extends towards the north east to Sulaiman Range and South Waziristan. The unit is about 1270m thick in the type section, the Gaj river section, but tapers to 15-30m towards south. However, inspite of its wide-spread occurrence no effort has been made at age-dating this unit and it is vaguely placed between 'Middle to Upper Eocene to Lower Oligocene'.

As such the present study was initiated and to start with, detailed study of the smaller foraminifera of the Khirthar rocks exposed in Sukkur and Kotdiji areas was carried out with a view to determine the character of the faunal assemblage and to find out whether these rocks can be age-dated and correlated more accurately.

The investigation enabled to identify 43 species, belonging to 15 genera. These include 15 Planktonic forms. Among the species identified 17 benthonic species and 7 planktonic species have been earlier reported from various Eocene rocks of Pakistan.

The study reveals that foraminifera in rocks of Sukkur and Kotdiji areas probably represent reworked fauna derived intra-basinally. They include forms typical to both Eocene and Basal Oligocene. Further, the age of this outcrop of Khirthar Formation extends upto Lowest Oligocene.

Keywords: Khirthar rocks exposed in Sukkur, Kotdiji areas Khirthar Formation.

1. Introduction

Studies of foraminifera in Pakistan region had their beginning as early as 1861 (Carter) followed by work of other investigators. Nuttal's studies presented first a systematic account of the foraminifera of the Kirthar Series (Nuttal, 1926). This account was restricted to the larger forams. Later accounts of the foraminifera included studies by Davies (1926), Eames (1952), among others, mainly on larger foraminifera.

However, elsewhere it was realized that smaller foraminifera are far more significant particularly in interpretting Paleoecology.

Haque (1959) carried out systematic examination of the smaller foraminifera from the Eocene rocks of Sor Range. This was followed by another significant contribution on the Paleocene-Eocene smaller foraminifera of Nammal Gorge (Haque, 1962) and "On the smaller foraminifera of the basal Paleocene" (Haque, 1964). Later Samantha (1973) produced a systematic account of the Paleocene-Eocene Planktonic foraminifera of Rakhi Nala Section, Pakistan.

These advances in the study of smaller and Planktonic foraminifera were few and far between and left many more voids in the systematic micropaleontology particularly with

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respect to Sindh where comparatively undisturbed Cenozoic sequences of shallow marine origin with rich assemblages of larger as well as smaller foraminifera from the bulk of the outcrops. These larger forams have been undeniably used in subdividing the Cenozoic succession in series; however, the absence of well defined sedimentational breaks has rendered it difficult to define Formational boundaries precisely. This is particularly the case with the Kirthar Formation of the Lower Indus Basin which is reported to range from Mid Eocene to Early Oligocene (Jones, 1960) without observable sedimentational break. But earlier workers have placed it in Mid-Upper Eocene (Blanford, 1876; Noetling, 1903).

Jones (1960) distinction of Eocene Kirthar member and Oligocene Gorag member in Blanford's Kirthar Series is based on mixed fauna, mainly larger foraminifera.

The areas of Sukkur and Kotdiji were selected for present study because of their easy accessibility and secondly, because of the fact that these outcrops represent deposition on a depositional high the Jaccobabad – Khairpur high and mixed fauna, particularly planktonics bearing evidence on its diachronous nature are likely to be met here.

Location and accessibility

The Studied areas are easily accessible through metalled roads, and are at following latitude and longitude:

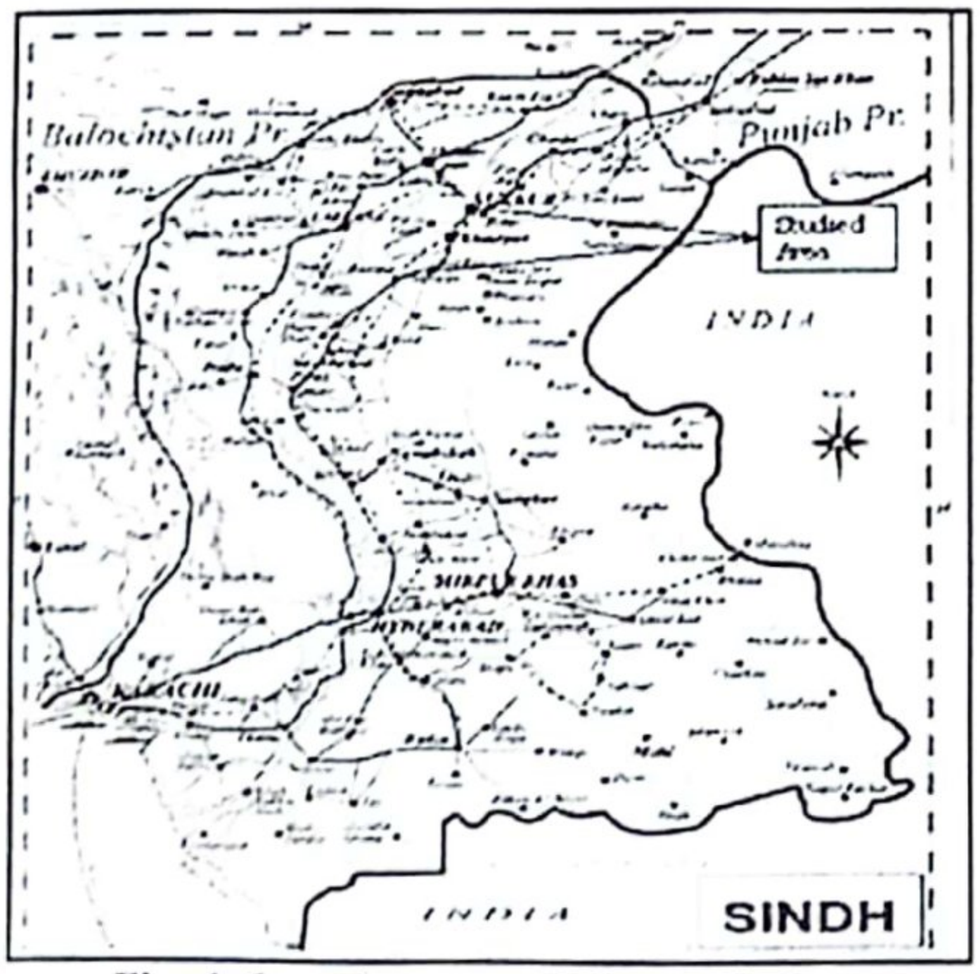


Fig: 1. Location map of the studied area.

- Sukkur Area

Latitude 27° 41' 60'' N
Longitude 68° 50' 60'' E

- Kotdiji Area

Latitude 27° 20' 24'' N
Longitude 68° 41' 24''

2. Geology of the area

Sukkur Outcrop:

A beautiful outcrop of Limestone is present in the north-east of the New Pind Sukkur. The exposure is due to the querying of Limestone for cement factory. The Limestone is light grey in color and contains chert nodules in the upper part of the outcrop. The beds are mostly 9" to 1' thick. In this section the Limestone appears unfossiliferous in hand specimen. There is 6" thick bed of clay after each 20 feet.

The total thickness of the unit is about 80 feet in Sukkur area. At the base of this section the limestone is white coloured hard and unfossiliferous. After 5 feet the color changes from light brown to dark brown. The upper beds are similar in lithology to that at the bottom. But after 15 feet the color changes from brown to milky white. Limestone is compact containing sparsely dispersed chert nodules. About 30 feet above the base there is change in color and lithology; one feet thick bed of clay is present which is deep yellow in color.

Above this clay bed the lithology is similar to the other beds, i.e. limestone is white in color, slightly soft. After 50 feet the limestone is comparatively hard and more compact than the underlying units; it is dark in color nodular and contains the chert nodules.

Kotdiji Outcrop:

At this locality (KTD) the rocks are exposed along a road section in the west of the village of Kotdiji. The beds are almost horizontal and the thickness exposed here is about 110 feet. The limestone is brown, grey in color, soft and highly fossiliferous in the basal part of the outcrop; 20 feet above the color changes to cream and the limestone becomes comparatively hard. This lithology again changes at about 35 feet above this level, and,

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the limestone becomes very fine-grained. The rocks here are very thinly bedded to laminated. At about 45 feet above the base the limestone is soft, nodular and fossiliferous. From 45 to 80 feet; the lithology is similar but it changes after 80 feet the limestone becomes brown in color, hard and nodular, and is unfossiliferous upto the top of the outcrop.

Lithological Section of Sukkur Area
(Thickness in ft.)

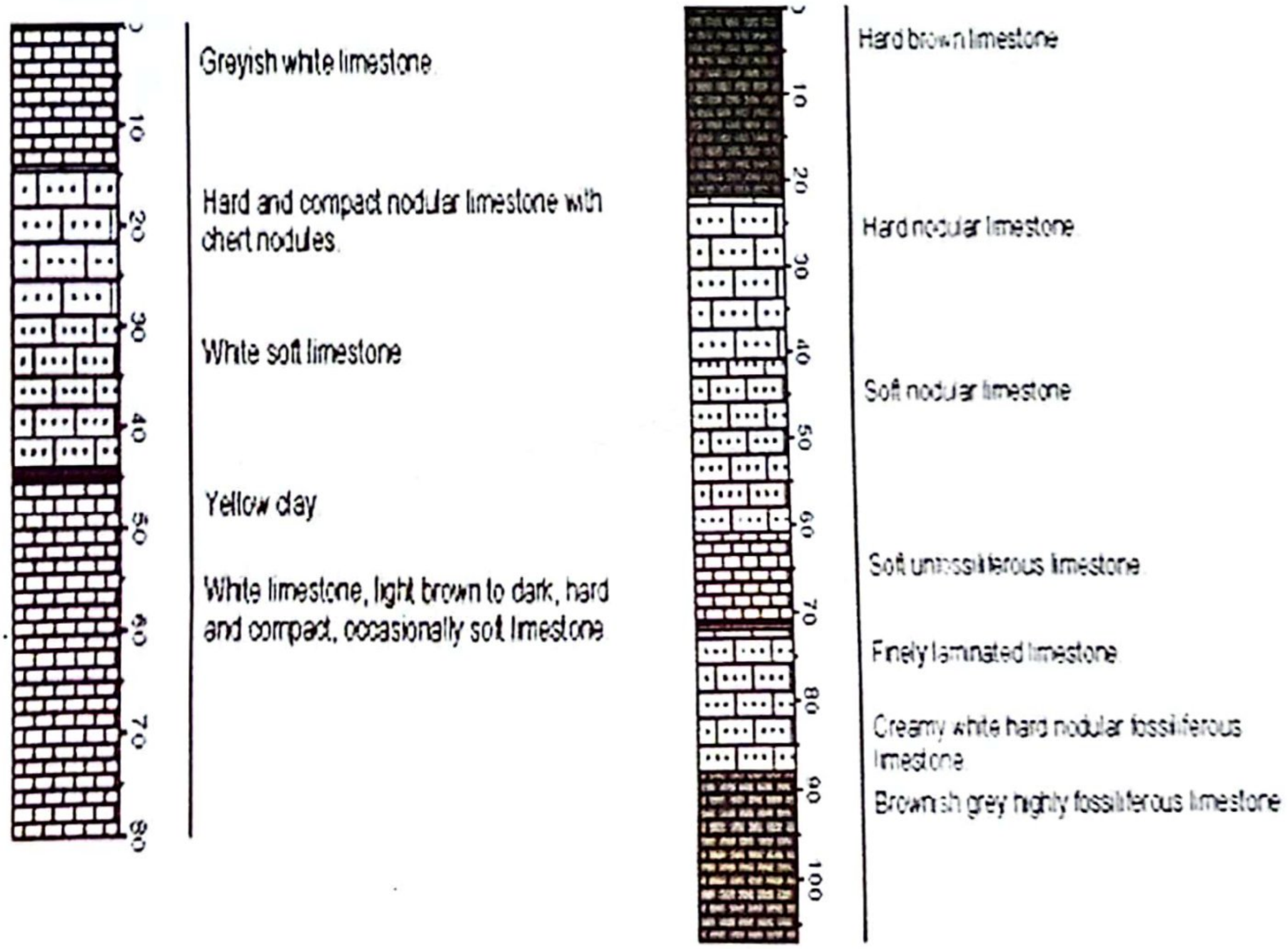


Fig: 2. Lithological sections of the studied area

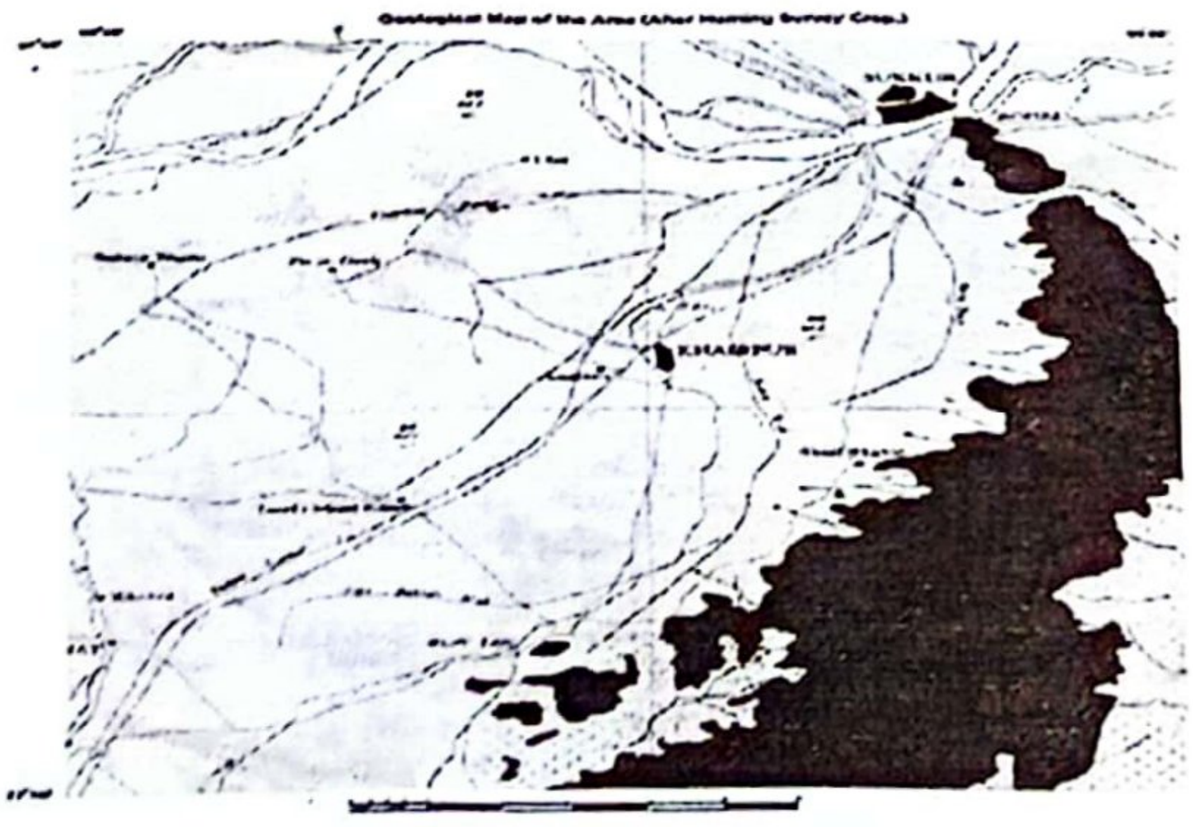


Fig. 3. Geology map of the studied area

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3. Materials and Methods

Samples were collected from the outcrops of the Kirthar Limestone in Sukkur and Kotdiji areas. Kirthar Limestone is exposed in a long range of hill starting from Sukkur in the North to South of Kotdiji. In this range only the Kirthar Limestone is exposed, the lower contact of the Formation is not exposed at any place in this area.

The Limestone is generally grey, cream, buffor white, light brown, brown or pinkish white in color. It is soft, marly and at places nodular, hard, and splintery beds are also present. The beds are mainly 1-10 feet thick, massive or laminated. The lithology differ at both the localities. The Samples were collected at the interval of 1-5 ft. in thin bedded rocks and upto 10 ft. in thick bedded units. The samples were numbered locality wise prefixing the abbreviated locality notation.

1. Sukkur (SK) 2. Kot Diji (KTD)

The photography of micro-forams was carried out with the Zeiss Ultra microscope using magnification of 60x.

4. Classification

In this work R.C. Moore's system of classification has been followed. It is most widely accepted classification. He asserted that classification of foraminiferida as of other animal groups should be based on complete morphological data obtained by all known suitable techniques. The classification adopted by Moore (1964) is mainly based upon the life, habit, habitat and geologic ranges. He regards wall composition and microstructure of the test as of primary importance for classifying the foraminifera.

Foraminifers found (Plate 1,2,3, and 4 show the microphotographs of these foraminifers).

Family: NONIONIDAE
Genus: Florilus Transversus
Genus: Nonion
Nonion Planatum
Nonion c.f. N. Scaphum
Nonion Brunatus Hofker
Nonion Acutidorsatum
Genus: Nonionella
Nonionella wilcoxensis
Nonionella Kirthari
Nonionella Insecta
Nonionella Basipinata
Family: GLOBOROTALIDAE
Genus: Globorotalia
Globorotalia Renzi Bolli
Globorotalia Chapmani Parr
Globorotalia Compressa
Globorotalia Bolivariana
Globorotalia Cerro-Azulensis
Globorotalia Menardii D'Orbigny
Globorotalia Planoconica Subbotina
Family: GLOBIGERINIDAE
Genus: Globigerina
Globigerina Triloculinoides
Globigerina Officinalis
Family: CIBICIDAE
Genus: Planulina
Planulina Ariminensis
Genus: Cibicides
Cibicides Punjabensis Haque
Cibicides Cushmani Nuttal
Cibicides Lobatus
Cibicides Multifarous (Schwager)
Cibicides Mensilli (Schwager) Var,
Nammalensis Haque
Cibicides Natlandi Olequaensis Beck
Cibicides Hilgards Garrett
Cibicides Praecursorius
Stichocibicides Cubensis
Family: HANTKENNINIDAE
Genus: Globoanomalina
Globoanomalina Micra
Family: ANOMALINIDAE
Genus: Anomalina
Anomalina Acuta
Anomalina Castiana
Anomalina Chirana
Anomalina Grazaensis
Family: ALABAMINIDAE
Genus: Gyroidina
Gyroidina Tayyabi
Gyroidina Lottensis
Family: DISCORBIDAE
Genus: Discorbis
Discorbis Cocoaensis Cushman & Garrett
Discorbis Lamark sp. Nov.
Family: SPHAEROIDINIDAE
Genus: Sphaeroidina
Sphaeroidina Bulloides D'Orbigny
Family: DISCORBIDAE
Genus: Valvulaneria
Valvulaneria Stainforthi Hoffer

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Valvulaneria Eocenica Cushman
Family: EPONIDIDAE
Genus: Eponides
Eponides Anconeusis
Eponides Umbonatus
Lenticuline Degolyeri
Family: TEXTULARIIDAE
Genus: Textularia
Textularia Gertrodema Davis

6. Discussion.

There are some interesting aspects of the distribution of species in the samples studied. The distribution is not uniform.

1. No smaller forams could be retrieved from the Sukkur outcrop samples although larger forms are profuse and described fully by Nuttal (1926). In all 16 samples were analyzed. However as the material was hard and compact thin section study only was carried out.
2. Study of Kotdiji samples yielded most of the forms in samples KTD-1 to KTD-4 only, with maximum concentration in KTD-4. The treatment of the samples above this level did not yield any identifiable larger or smaller form. The sequence above this level is barren consisting mostly of soft micritic carbonate sediments.

It may be noted that the lithology of Sukkur outcrop and associated fauna suggest shelf facies. The lithology of the rocks of Kotdiji outcrops and absence of larger foraminifera in them may point to a bank to basin transition.
They comprise of 33 genera and their 70 species. Many of the species described herein have also been reported by other workers from the Paleogene rocks of Pakistan subcontinent and elsewhere in the world. Some of the forms are however anomalous in terms of their stratigraphic position, among them, is the genus described here as Pseudohyalinea after the genus Hyalinea described from the Miocene-Recent (Hofker 1951) with which it compares favorably but the stratigraphic position does not justify its assignment to Hyalinea and hence the modified generic name. Similarly the form named here as Pseudoholmanella is treated as distinct in occurrence only from its compareable form genus Holmanella described from Miocene (Leoblich and Tappan, 1962).

Among the forms described here, 24 species have already been described from the various Eocene horizons of Pakistan. The species under report that have also been described from the Khirthar Formation of Sor Range area, the Paleocene-Eocene of Nammal Gorge and the Meting Shale unit of Lower Eocene of Sindh by Haque (1956, 1959), and the Paleocene rocks of Rakhi Nala section (Samanta, 1973). These include 17 benthonic and 7 planktonic species. Among the benthonic forms Nonionella Kirthari, N.c.f.N. ansata, Nonion acutidorsatum, cibicides punjabensis, C. Hilgardi Garrett, Gyroidina Tayyabi, Eponides anconensis, are typical Middle-Late Eocene species. Also the planktonic species Globorotalia renzi bolli, G. Chapmani and Globigerina officinalis are again typical forms restricted from Middle to Late Eocene.
This comparison of the forms reported here with those earlier described from Pakistan and outside lends sufficient justification to support Middle to Late Eocene age of these rocks.

7. Conclusion

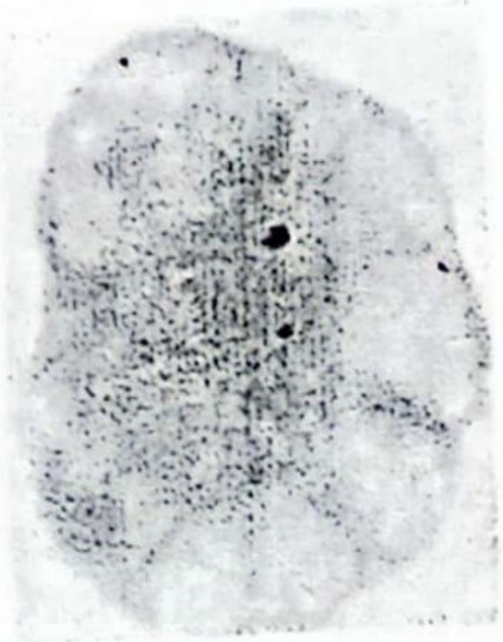
Keeping in view that the Sukkur outcrop of the rocks with associated larger foraminifera represent shelf conditions, it can be concluded that towards south of this shelf on the high, basinal conditions prevailed in which synchronous intra basinal micritic carbonate sediments derived from Paleocene and Eocene sediments developed. To this carbonate assemblage typical planktonic forms of basal Oligocene were also added. However, the deposition came to a halt following Oligocene regression (Powel & Conaghan, 1973). This interpretation would support Jones (1960) contention extending the age of Kirthar Formation, his Brahui limestone, to lower Oligocene. This interpretation would, however, have to await confirmation by a thorough investigation of not only the smaller foraminifera of the Kirthar Formation from the type area but also detailed Petrographic examination of Kirthar Formation. This was outside the scope of present study but would form a suitable topic for future research.

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PLATE 01



Nonion Planatum



Nonion Planatum



Norzoella Kuthan



Nonion Brunatus Hofker



Nonion Acundorsatum



Nonion Acundorsatum



Norzoella wilcoxensis



Nonionella Basipunta



Globorotalia Renz Bolli



Globorotalia Congrexa



Globorotalia Bolivariana



Anomalina Clirana



Anomalina Chirana



Anomalina Grazaensis



Anomalina Grazaensis

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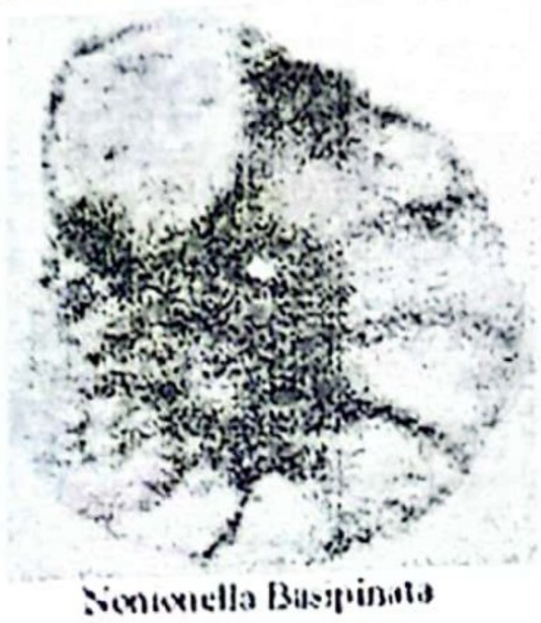
PLATE 02



Globorotalia Bolivariana Subbotina



Nonionella Insecta



Nonionella Bispinata



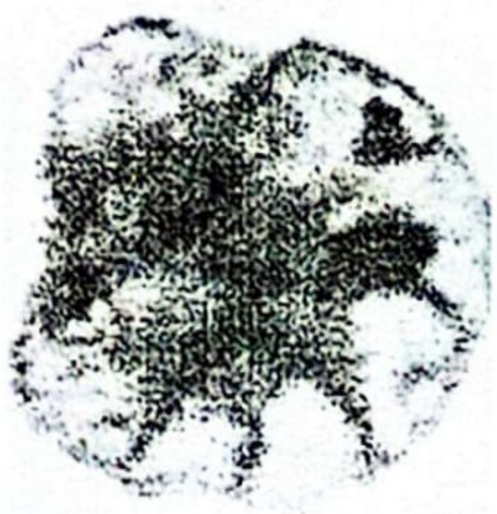
Globorotalia Planoconica



Globorotalia Cerro-Azulensis



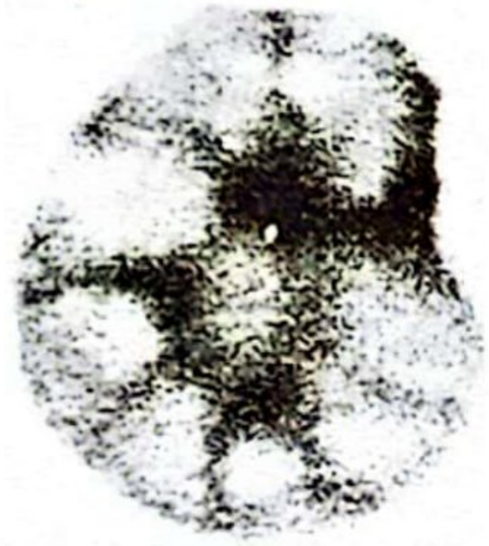
Globorotalia Cerro-Azulensis



Globorotalia Menardi D'Orbigny



Globorotalia Menardi D'Orbigny



Globorotalia Planoconica Subbotina



Sphaeroidina Bulloides D'Orbigny



Nonionella Insecta



Globigerina Triloculinoides



Globigerina Triloculinoides



Planulina Ariminensis



Planulina Ariminensis



Valvulineria Eocenica Cushman



Eponides Umbonatus



Eponides Antemarginis



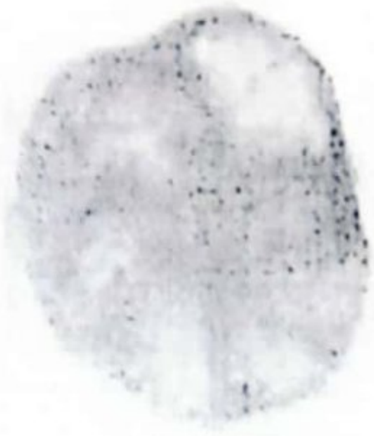
Lenticulina Degolyeri

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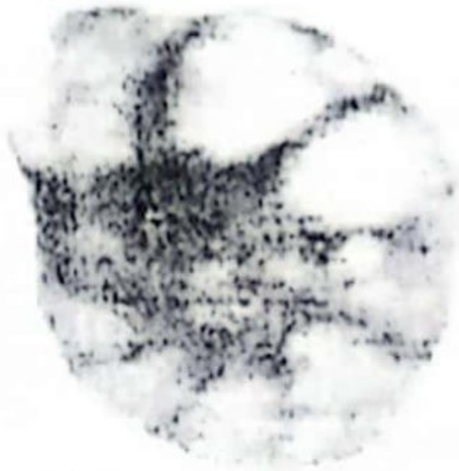
PLATE 01



Globoxtemalina Micra



Globoxtemalina Micra



Globoxtemalina Micra



Globoxtemalina Micra



Cibicides Cushman Nuttal



Cibicides Cushman Nuttal



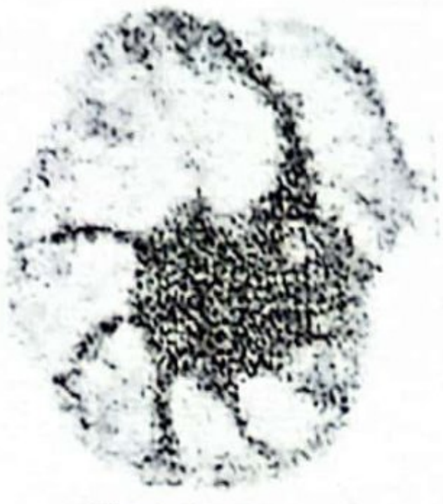
Cibicides Punjabensis Haque



Discorbis Lamark sp



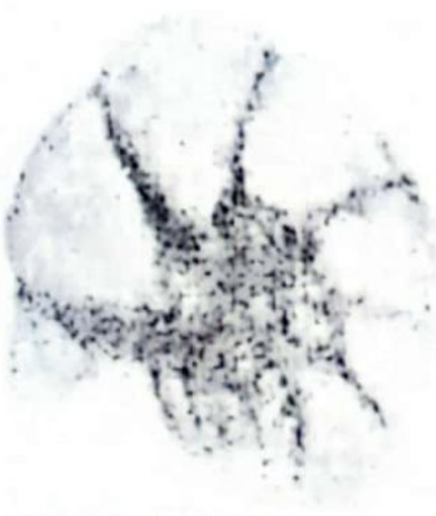
Cibicides Lobatus



Cibicides Lobatus



Cibicides Lobatus



Cibicides Lobatus



Cibicides Multitaeatus Schwager



Cibicides Multitaeatus Schwager



Cibicides Mensilli



Cibicides Mensilli



Cyroidina Flyyaba



Gyroidina Lorteneis



Gyroidina Lorteneis



Valvulineria Saulcyeni Hollker

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PLATE 94



Cibicides Hodsonli Cheguenata Hook



Cibicides Hodsonli Cheguenata Hook



Cibicides Hilgardi Cushman



Cibicides Hilgardi Cushman



Cibicides Praecursorius



Cibicides Praecursorius



Trichocubicides Cubensis



Trichocubicides Cubensis



Anomalina Acuta



Anomalina Acuta



Anomalina Acuta



Anomalina Acuta



Anomalina Cartiea

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