

## INVESTIGATION OF BENTHONIC FORAMINIFERAL ASSEMBLAGES FROM THE THAR COAL BASIN, SINDH, PAKISTAN

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### Abstract

The foraminiferal studies of the Thar coal Basin Sediments have been carried out on samples from 10 bore holes. Out of 100 samples from 10 holes only 30 samples from 6 holes contains benthic foraminifera and the remainder are barren. No Planktonic forams were recorded during this study.

Most of the benthic forams are agglutinated and in general are of small in size. The preservation of the fauna is rather poor; most specimens are strongly recrystallied and partly crushed. The assemblage is comprised of specimen belonging to the genera *Haplophragmoides*, *Ammobaculites*, *Trochammina*, *Osangularia* *Ammosphaeroidina* together with the rare occurrence of calcareous benthic forams. The total assemblage indicates deposition in shallow, inner neritic marine water. Sediments are dark gray shales with abundant organic matter and subordinate sandstone, the depositional environment probably was one of poorly oxygenated, slow moving bottom water with high CO<sub>2</sub> content resulting from the decomposition of organic matter. Stratigraphic data derived from the foraminifera indicate the Coal-bearing rocks of the Thar Coal field to be late Paleocene to Early Eocene in age.

**Keywords:** Benthic foraminiferal assemblages, Thar Coal, Basin.

### Introduction

The Thar Coal field is located in the eastern part of Sindh province Pakistan (Fig.1) in the Thar Desert. Discovery of this huge Coal deposit is the most important discovery after the Sui gas field in the context of energy resources of Pakistan.

The Coal occurs at an average depth of 170m .Previous work (Ahmed and Zeigham 1993) indicated, on the basis of sequence correlation via seismic sections, that only the coal-bearing *interval* is of Jurassic age. The Geology of the Thar Desert is poorly understood as the area is covered with dune sand to an average depth of approximately 80m.

The only out crop of the bed rock in the Thar Desert of Pakistan is found at Nagarparkar ( Fig.2).

The Thar Coal field rests upon a structural plate form in the eastern part of the desert.

The discovery of Thick Coal beds, based on the geophysical logging of Sazda ground water holes (Mehtab et al. 1993) and interpretation of logging data of ground water holes (Zeigham and Mehtab 1992), promoted detailed investigation for coal potential in the area. Ahmed and Zeigham (1993) provided a good representation of surface Geology of the Thar Desert.

The available seismic records in the Thar Coal field area were designed for oil and Gas exploration at depth. For this reason Ahmed and Zeigham (1993) reported that the thickest coal in the Thar field is Jurassic in age based on the physical tracing of Geological contacts on seismic sections.

Paleontological studies of the core samples from the same coal-bearing strata indicate the Coal to be of late Paleocene–Early Eocene age (San Filip 1993).

Additional studies of fossils from marine inter-beds in the Coal bearing sequence from several test holes in the western part of the field are now in progress and these studies will more narrowly define the age of the Coal-bearing rocks of Thar Coal field.

### **Material and methods:**

The studied drill holes are located at the South east and South west of the Thar Coal field, samples were collected from Geological Survey of Pakistan, Core Laboratories. Core samples were taken from drill hole STP1, STP4, STP7, STP8, STP9, STP10, STP11, STP12, STP13, TP3 and TP5 (Fig.2).

About one hundred samples were collected from 10 holes and prepared for study. Most of these are unfossiliferous. Only 6 drill holes yielded benthic forams these are poorly preserved and small in size. No planktonic forams were present in the studied material.

Mostly all the collected samples are shales with a high organic content, sandstones are rare.

### **Laboratory Techniques:**

Each sample was broken into small fragments about 5mm maximum in dimension, and about 80 grams was processed.

The samples were dried in an oven at 75°C overnight and were processed by Sodium sulphate and Naptha methods.

### **Sodium sulphate method:**

After being dried, the rock samples were added in the boiling oversaturated Sodium sulphate solution and were cooled to room temperature. The solution was decanted to get mother solution. After that the samples were left for a few days and were washed through a 200 mesh sieve. The residue was redried.

### **Naptha method:**

After being dried, the samples were added to organic solvent Naptha at room temperature. The naptha was taken back by filtering and boiling water was added. The samples were boiled to remove naptha completely, then again washed through 200 mesh sieve. The washed material was dried in the oven. Samples were picked for foraminifera.

The identified specimens were coated with gold and photographed by using the Zeiss DSM 940 Scanning Electron Microscope in the SEM Lab of University College London.

### **“Benthic foraminifera from the Thar Coal Basin”**

About 30 genera of benthic foraminifera with agglutinated very rare calcareous tests were recorded from the six bore holes of the Thar Coal Basin. These assemblages were recorded from STP1, STP 7, STP9, STP10, STP 13, and TP5, bore holes.

### **Below is the list of genera of benthic foraminifera :**

#### **STP1 and STP10**

*Trochammina* sp1

*Trochammina* sp2

|                              |                            |
|------------------------------|----------------------------|
| <i>Haplophragmoides</i> sp 1 | <i>Ammosphaeroidia</i> sp. |
| <i>Haplophragmoides</i> sp 2 | <i>Trochiminula</i> sp.    |
| <i>Haplophragmoides</i> sp 3 | <i>Buccierenata</i> sp.    |
| <i>Haplophragmoides</i> sp 4 | <i>Epistomina</i> sp.      |
| <i>Coryphostoma</i> sp       | <i>Buliminella</i> sp.     |
| <i>Epistomina</i> sp 1       | <i>Lenticulina</i> sp.     |
| <i>Epistomina</i> sp 2       | <i>Ammonia</i> sp.         |
| <i>Gyroidinoides</i> sp 1    | <i>Eponoides</i> sp 2      |
| <i>Gyroidinoides</i> sp 2    | <i>Trochammina</i> sp 4    |
| <i>Gyroidinoides</i> sp 3    | <i>Trochammina</i> sp 6    |
| <i>Osangularia</i> sp 2      | <i>Trochammina</i> sp7     |
| <i>Quadrимorphina</i> sp     | <i>Haeglundina</i> sp      |
| <i>Quadrимorphina</i> sp 2   | <i>Arenobulimina</i> sp    |
| <i>Praebulimina</i> sp.      | <i>Arenobulimina</i> sp    |
| <i>Cibicides</i> sp          | <i>Haplopragmoides</i> sp5 |
| <i>Globorotalites</i> sp.    | <i>Tritaxia</i> sp 2       |
| <i>Eponoides</i> sp 1        | <b>STP 9 and STP13</b>     |
| <i>Buccierenata</i> sp.      | <i>Trochammina</i> sp8     |
| <i>Tritaxia</i> sp.          | <i>Trochammina</i> sp10    |
| <i>Cassidulina</i> sp.       | <i>Trochammina</i> sp11    |
| <i>Marssonella</i> sp.       | <i>Lenticulina</i> sp3     |
| <b>STP 7 and TP 5</b>        | <i>Tritaxia</i> sp 3       |
| <i>Ammobaculites</i> sp.     | <i>Haplophragmoides</i> sp |
| <i>Trochamminoides</i> sp.   | <i>Osangularia</i> sp3     |
| <i>Triphotrocha</i> sp.      | <i>Osangularia</i> sp4     |

*Osangularia* sp5

*Spiroplectamina* sp

*Globobulimina* sp

*Gaudryina* sp.

Agglutinated foraminifera were found in 30 samples from 6 boreholes, out of 100 samples from 10 boreholes, the recorded assemblages consist of 30 genera, the main forms being *Trochammina* (a) *Osangularia* (c) *Haplophragmoides* (a) *Amosphaeroidina* (a) and *Lenticulina* (c).

The specimens could not be identified to species level due to their poor preservation.

(a) = Agglutinated, (c) = Calcareous.

### Palaeoecology:

Benthic foraminifera are responsive to variation in depositional environment Kurreshy 1969, Phleger 1960 and Murray 1973. Their distribution is controlled by various ecological factors among which the most important are temperature, salinity and oxygen. The agglutinated foraminifera in the studied samples are small, light amber to dark gray in colour, are smooth walled, dominated by trochoid and planispiral forms. These factors show these sediments have been deposited in shallow inner neritic sea. (Govindan and Bhandri 1988).

The enclosing sediment of shales with abundant organic matter indicates that this type of environment was under stagnant or slow moving bottom water with small quantity of dissolved oxygen and high content of CO<sub>2</sub> resulting from the decomposition of organic matter.

### Conclusions:

1. The occurrence of agglutinated assemblage consisting predominantly of plainispiral forams (*Haplophragmoides*, *Trochamminoides*) and trochospiral form (*Trochammina*) suggest the deposition of these sediments occurred in a shallow, inner neritic sea. Since the enclosing sediment are organic rich. The possible environment would be stagnant or slow moving bottom water with low dissolved oxygen and high CO<sub>2</sub> content, resulting from the deposition of organic matter.
2. Such reducing conditions could give rise to gasprone sediments, foraminiferal assemblages consisting of agglutinated Benthic taxa found in core samples **STP1, STP7, STP9, STP13, and STP5** from the Thar Coal Basin show affinities with benthic taxa from the Midway formation of the United States Gulf Coastal plain and benthic foraminifera from Sinai, Egypt.
3. The taxa from the Thar Coal Basin, compared with those of the Midway formation, indicate the sediments to be Late Paleocene Early Eocene in age.

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### Plate 1.

Fig. 1 *Trochammina* sp1 (Sample 10)

Fig. 2 *Trochammina* sp2 (Sample 10)

Fig. 3 *Haplophragmoides* sp1 (Sample 10)

Fig. 4 *Haplophragmoides* sp2 (Sample 10)

Fig. 5 *Haplophragmoides* sp3 (Sample STP1)

Fig. 6 *Haplophragmoides* sp4 (Sample STP1)

Fig. 7 *Coryphostoma* sp (STP1)

Fig. 8 *Epistomina* sp 1 (STP 10)

Fig. 9 *Epistomina* sp 2 (STP 10)

Fig. 10 *Gyroidinoides* sp 1 (STP 10)

Fig. 11 *Gyroidinoides* sp 2 (STP 10)

Fig. 12 *Gyroidinoides* sp 3 (STP 1)

Fig. 13 *Osangularia* sp 1 (STP 1)

Fig. 14 *Osangularia* sp 2 (STP 1)

Fig. 15 *Quadrinorphina* sp1 (STP 10)

Fig. 16 *Quadrinorphina* sp 2 (STP 10)

Fig. 17 *Cibicides* sp. (STP 10)

Fig. 18 *Globorotalites* sp. (STP 1)

Fig. 19 *Anomalinoidea* sp. (STP 1)

Fig. 20 *Eponoides* sp (STP 1)

Fig. 21 *Buccierenata* sp. (STP 1)

Fig. 22 *Tritaxia* sp. (STP 1)

Fig. 23 *Cassidulina* sp. (STP 1)

Fig. 24 *Marssonella* sp. (STP 1)

Fig. 25 *Sphaerannuba* sp. (STP 10)

Fig. 26 *Ceritabulimina* sp. (STP1)

### Plate 2.

Fig. 1 *Ammobaculites* sp. (STP7)

Fig. 2 *Trochamminoides* sp. (STP5)

Fig. 3 *Triphotrocha* sp. (TP5)

Fig. 4 *Ammosphaeroidia* sp. {(a) Dorsal view  
(b) Side view (TP 5)}

Fig. 5 *Trochiminula* sp1 (TP 5)

Fig. 6 *Bucrinata* sp. (STP 7)

Fig. 7 *Epistomina* sp. (TP 5)

Fig. 8 *Buliminella* sp. (STP 7)

Fig. 9 *Lenticulina* sp1 (STP 7)

Fig. 10 *Lenticulina* sp2 (STP7)

- Fig. 11 *Ammonia* sp1 (STP 7)
- Fig. 12 *Eponoides* sp 2 (STP 5)
- Fig. 13 *Trochammina* sp 4 (TP 5)
- Fig. 14 *Trochammina* sp 5 (TP 5)
- Fig. 15 *Trochammina* sp 6 (TP 5)
- Fig. 16 *Trochammina* sp7 (STP 7)
- Fig. 17 *Ammpsphearoidina* sp 2 (STP 7)
- Fig. 18 *Ammpsphearoidina* sp 3 (TP 5)
- Fig. 19 *Ammpsphearoidina* sp 4 (STP 7) Mg.200
- Fig. 20 *Arenobulimina* sp1 {(a) Dorsal view (b) Lateral view TP \* 240}
- Fig. 21 *Arenobulimina* sp2 (STP 7\* 200)
- Fig. 22 *Haplopragmoides* sp5 (STP 7\*250)
- Fig. 23 *Haplopragmoides* sp5 (TP5)
- Fig. 24 *Ammunigerina* sp (TP5)
- Fig. 25 *Dorothia* sp. (TP 5)
- Fig. 26 *Discammina* sp. (STP 7)

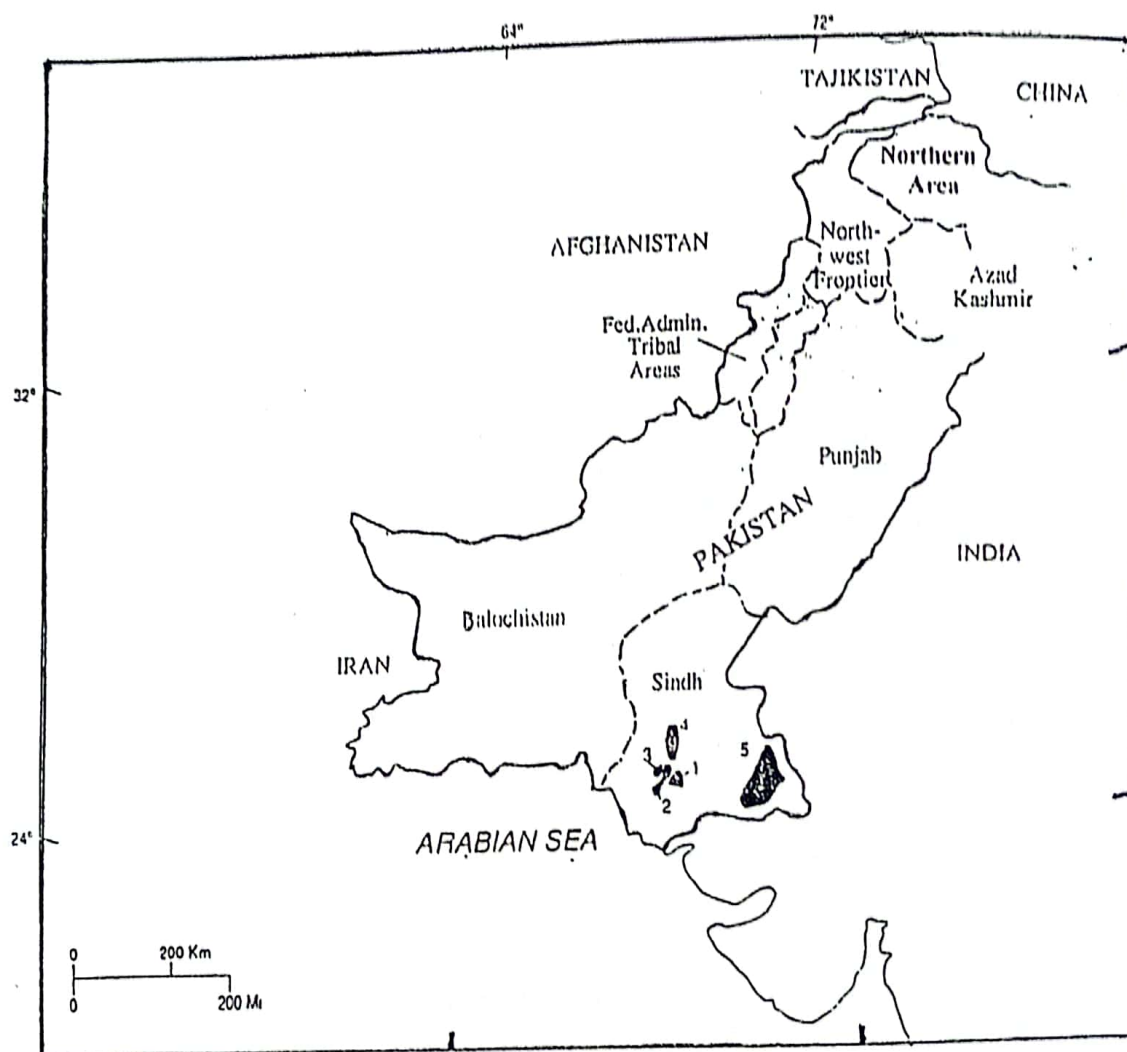


**Fig.1. Index Map of Pakistan showing the studied areas**

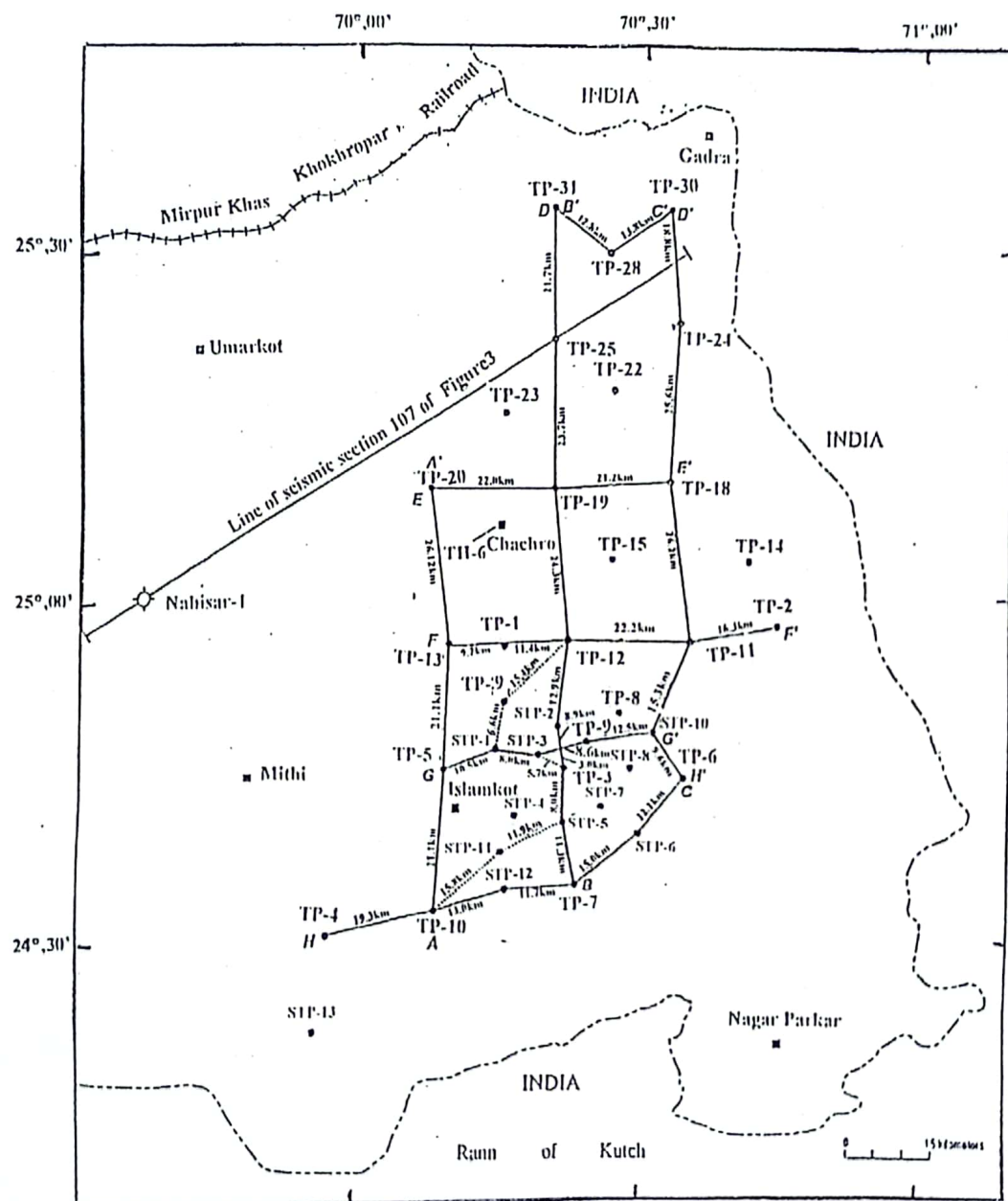


Fig. 2. Map showing the location of different wells

