

ANGIOSPERMIC FOSSIL POLLEN ISOLATED FROM THE SHELE OF BARA FORMATION, RANI KOT, SINDH, PAKISTAN

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Abstract

The present paper describes a variety of pollen obtained through maceration procedure from the carbonaceous shale of Bara Formation located near Ranikot Fort, Sindh, Pakistan. Pollen are attributed to following angiospermic families viz. Arecaceae, Liliaceae, Nymphaeaceae and Myricaceae. The data inferred from the research work revealed that climatic conditions of the region were warm humid tropical to sub-tropical at the time of the deposition of Bara Formation.

Key words: Pollen, Bara formation, Sindh, Pakistan, Arecaceae, Liliaceae, Nymphaeaceae and Myricaceae.

Introduction

The Ranikot has long been known as one of the most interesting and classical area both geologically and palaeontologically. The pollen described in the research work were recovered from the shale in the variegated stage of Bara Formation belonging to Ranikot Group located near Ranikot Fort Area in District Jamshoro, Sindh, Pakistan (Lat. 25° 54' 24"N & Long. 67° 54' 38"E). Bara Formation belongs to late Paleocene Epoch of Tertiary Period. Plant microfossils from present locality have not been recorded yet before so present work is an initiative of to study the angiospermic fossil from the geological remains.

Plant microfossils mainly pollen and spores from Tertiary rocks are well known from many parts of the world. During last 60 years, study of fossilized pollen and spores at various places has particularly acquired significance resulting in the emergence of palaeopalynology as an important discipline of palaeobotany. In Pakistan, study of palaeopalynology was commenced in the Institute of Plant Sciences, University of Sindh, Jamshoro, Pakistan as early as in nineteen sixties. Most of the research have so far been was restricted to the palynological examination of coal itself found in the lower tertiary horizons i.e., Paleocene rocks in Sindh. Present studies enlighten the identification and technical description of recovered palynoflora mainly comprising of pollen across various shale horizons from Bara Formation, Pakistan.

Geology of the area: Bara Formation is the second hoariest outcrop of Ranikot Anticline while the Manchar Formation is the youngest ones of the region and follow the edge of Ranikot Anticline (Fig. 1). The Ranikot anticline is the part of Lakhi Range that runs in north-south direction in the Geological Survey of Pakistan Topo sheet No. 350/B. The geological map of Ranikot Fort area and stratigraphic succession respectively are mentioned in map (Fig. 2). The exposed unit of Bara Formation in Ranikot Fort region is 250 meters thick (Hakro & Baig, 2013) and it is consisted of sand stone, shale and insignificant quantity of siltstone. The lower contact of

the formation is comformable by Khadro Formation while upper contact is uncomformable with the Lakhi Formation in the studied area (Shah, 2009).

Materials and Methods

Samples for the present palynological study were collected from shale of Bara Formation near Ranikot Fort area. Standard techniques adopted from Phipps & Playford (1984) and Doher (1980) with modifications were employed for maceration. For the recovery of pollen, nearly 100 grams of each sample was manually crushed, followed by the treatment with HF, HCl and HNO₃. Residues of macerated sample were oxidized with 5% KOH. A small quantity of material was centrifuged in the heavy liquid to remove extra inorganic residues. Slides were prepared in Canada balsam mounting medium. Palynomorphs were identified and systematically described following the literature from Virmal, 1952; Khan *et al.*, 1966; Jain & Sah, 1968; Nizamani, 1972, 1977; Nizamani & Sahito, 1972; Sahito *et al.*, 1986, 1987, 1988 and 1996). Samples and prepared slides were deposited in Palaeobotany Laboratory, Institute of Plant Sciences, University of Sindh, Jamshoro.

Systematic Description

1. *Palmidites plicatus* Singh

Pollen grain dark brown in colour, size: 50 x 71 µm, amb oval with pointed ends, Monocolpate grian, colpus indistinct due to the overlapping of associate folds, colpus 70µm long. Exine 1.3µm thick, slightly wavy and psilate (Fig. 3).

Botanical affinity: Arecaceae.

Remarks: The specimen found from Bara Formation of Ranikot is smaller than that reported by Singh (1974) from Tura Formation exposed at Garo Hills from the Tertiary Succession India.

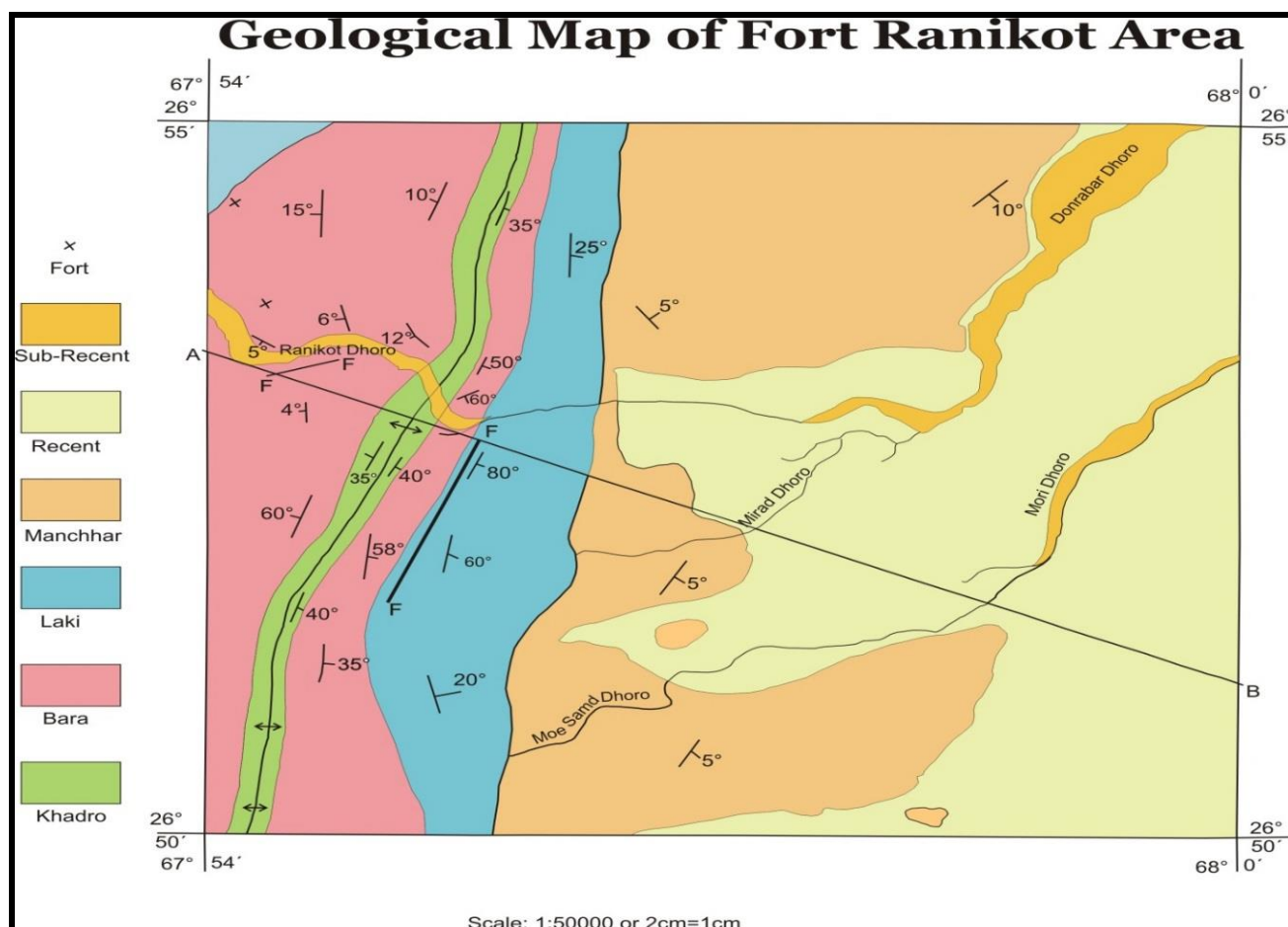


Fig. 1. Geological Map of Ranikot Area exhibiting various Tertiary outcrops after Dahar (2013).

2. *Couperipollis brevispinosus* Venkatachala & Kar

Pollen grain dark brown in color, size: $40 \times 53 \mu\text{m}$, sub-circular amb. Monocolpate grain, colpus indistinct, extending almost from one end to other very thin $30 \mu\text{m}$ long. Exine: $1.3 \mu\text{m}$ thick, echinate, spines $3-4 \mu\text{m}$ long (Fig. 4).

Botanical affinity: Arecaceae.

Remarks: The exine of the present pollen is thicker than described by Saxena from Matanomadh Formation, North Western Kutch, India.

3. *Couperipollis punctitectatus* Rao & Ramanujam

Pollen grain light brown in color, weakly heteropolar, elliptical in shape, $50 \times 60 \mu\text{m}$ in size along with spines. Monosulcate grain, sulcus long lengthen ahead the long axis of pollen, wider at the mid region and tapers toward the end. Exine $5 \mu\text{m}$ thick. Exine surface is echinate, spines $5 \mu\text{m}$ thick and $2 \mu\text{m}$ apart from each other with punctate and interspinal areas (Fig. 5).

Botanical affinity: Arecaceae.

Remarks: The present specimen of Bara Formation shows close resemblance with the specimen described by Rao & Ramanujam (1981) from Quilon bed of Miocene age of Kerala, India but the present specimen is larger in size.

4. *Monocolpopollenites areolatus* Potonie

Pollen grain light brown in color, oval in outline, $41 \times 50 \mu\text{m}$ in size. Monocolpate, colpus $34 \mu\text{m}$ in length and $3 \mu\text{m}$ in width, extending from all extremities of the pollen. Exine $1 \mu\text{m}$ thick and have small gemmae (Fig. 6).

Botanical affinity: Arecaceae.

Remarks: The present specimen is larger in size than that of described by Thomson & Pflug (1953) from the tertiary sediments of north western Krefled, Germany.

5. *Palmaepollenites plicatus* Sah & Kar

Pollen grain dark brown in colour, amb oval-elliptical with equally broad lateral ends, $37 \times 36 \mu\text{m}$ in size. Monocolpate, germinal suture (colpus) is closed but slightly open at end. Exine $1.6-5 \mu\text{m}$ thick and laevigate (Fig. 7).

Botanical affinity: Arecaceae.

Remarks: The present specimen exhibit close resemblances with the pollen described by Sah & Kar (1969) and Saxena (1977) from Laki sediments in Kutch and Paleocene Matanomadh Formation North Western Kutch, India but present specimen exhibits only laevigate surface sculpturing.

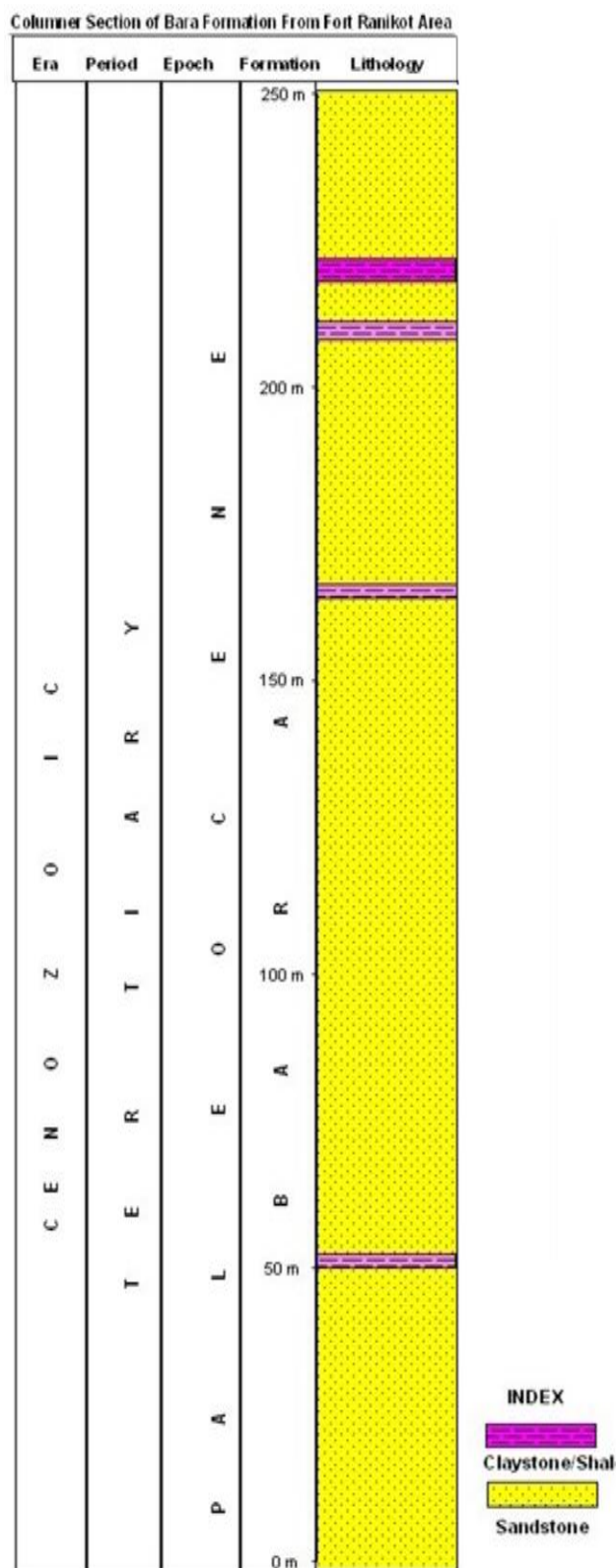


Fig. 2. Columnar Section of Bara Formation from Ranikot Fort Area, Sindh Pakistan.

6. *Palmaepollenites neyveliensis* Ramanujam

Pollen grain, dark brown in colour, heteropolar, amb ovoid, 20x35µm in size. Monosulcate grain, sulcus 17µmlong reaching at both ends, uniformly narrow, margin thickened, ends blunt. Exine 33 µm thick, psilate (Fig. 8).

Botanical affinity: Arecaceae.

Remarks: The present specimen slightly smaller in size than that described by Rao & Ramanujam (1976) from Neogene Quilon beds of Kerala state in south India.

7. *Arecipites bellus* Sah & Kar

Pollen grain light brown in color, elongated and oval with equally rounded lateral ends 56x 91µm in size. Monocolpate grain, colpus closed and 52µmlong almost reaching up to the mid of the. Surface punctate, puncta 0.75µm in size. Exine 4µm thick, punctate, sculpturing elements are closely placed (Fig. 9).

Botanical affinity: Arecaceae.

Remarks: The present specimen is large in size than that described by Sah & Kar (1969) from Laki sediments in Kutch and also described by Kar & Bhattacharya (1990) from Rajpardi Lignites and Akri Lignites of lower Eocene age from Kutch Basin, India.

8. *Arecipites punctatus* Wodehouse

Pollen grain dark brown in color, amb oval-elliptical, 27x69 µm in size. Monosulcate pollen, sulcus 60µmlong and 3µm wide, extending end to end of the, narrow and tapered at both ends. Exine 3µm thick and psilate (Fig. 10).

Botanical affinity: Arecaceae.

Remark: The present specimen is larger in size than that described by Naskar & Baski (1976) reported from Akli Lignite of Paleocene – Eocene age from Rajashtan, India.

9. *Neocouperipollis ankeleshwarensis* Kar & Bhattacharya

Pollen grain brownish yellow in colour, amb oval, 53x 90 µm in size. Monocolpate grain, colpus long, extending from end to end of the. Exine 3µm thick spinous, spines well built with bulbous base and pointed tips, 3 µm long and 2 µm broad at the base. Interspinal exine more or less laevigate (Fig. 11).

Botanical affinity: Arecaceae.

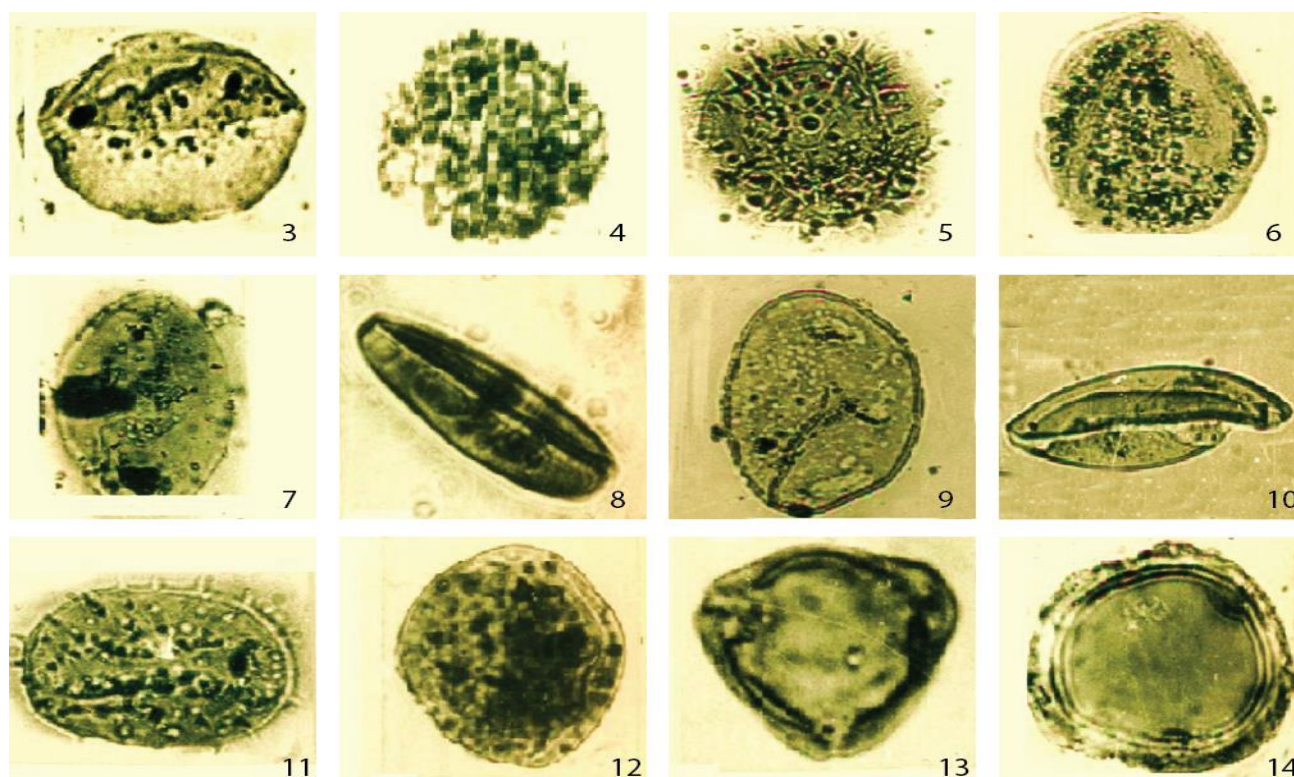
Remarks: The present specimen larger in size than that described by Kar & Bhattacharya (1992) reported from Rajpardi lignite, Akri lignite of lower Eocene age in Kutch Basin, India.

10. *Liliacidites ellipticus* Venkatachala & Kar

Pollen light brown in color, amb oval with equally broad ends, 30x40µm in size. Monosulcate, sulcus wide, broader from middle and narrow at both ends and give a boat-shaped appearance. Exine 1.7µm thick and reticulate, (Fig. 12).

Botanical affinity: Liliaceae.

Remarks: The present specimen is smaller in size than that described by Venkatachala & Kar (1969) reported from tertiary sediments of Kutch, Laki Stage. Laki stage represent an important rock unit in Kutch Gujarat State, India it is equivalent to Eocene in age.



Angiospermic fossil pollen isolated from Shele of Bara formation, Rani Kot, Sindh, Pakistan.

Figs. 3–14 (x40) 3. *Palmidites plicatus*, 4. *Couperipollis brevispinosus*, 5. *Couperipollis punctitectatus*, 6. *Monocolpopollenites areolatus*, 7. *Palmaepollenites plicatus*, 8. *Palmaepollenites neyveliensis*, 9. *Arecipites bellus*, 10. *Arecipites punctatus*, 11. *Neocouperipollis ankeleshwarensis*, 12. *Liliacidites ellipticus*, 13. *Myricipites harrisii* and 14. *Nymphaeidites clarus*.

11. *Myricipites harrisii* Couper, Dutta & Sah

Pollen s brown in colour, shape sub-triangular, sides are slightly convex, pollen size is 24x28 μm . Triporate, pores circular, 0.65- 1.6 μm in diameter. Exine 1.3 μm and granulate, granulae are prominent at apertural region, (Fig. 13).

Botanical affinity: Myricaceae.

Remarks: The present specimen shows close resemblance with the specimen described by Rao & Ramanujam (1981) reported from Quilon beds of lower middle Miocene age but the present specimen is slightly larger.

12. *Nymphaeidites clarus* Dutta & Sah

Pollen dark brown in color, spheroidal amb, size 67x70 μm . Monoporate, pore wide, equatorial distinctly operculate. Exine 46 μm thick. Sexine is generally as thick as nexine. Surface sculpturing is psilate, (Fig. 14).

Botanical affinity: Nymphaeaceae.

Remarks: The present pollen is large compared to pollen s described by Dutta & Sah (1970) from tertiary deposits of Assam, lower Eocene of Shillong Plateau India.

Discussion

The angiospermic pollen are the most dominant elements of microfossil flora investigated during the present study. The important angiosperm taxa identified were *Palmidites*

plicatus Singh 1977, *Couperipollis brevispinosus* Venkatachala & Kar 1969, *Couperipollis punctitectatus* Rao & Ramanujam 1976, *Monocolpopollenites areolatus* Potonie 1934, *Palmaepollenites plicatus* Sah & Kar 1969, *Palmaepollenites neyveliensis* Ramanujam 1966, *Arecipites bellus* Sah & Kar 1969, *Arecipites punctatus* Wodehouse 1933, *Liliacidites ellipticus* Venkatachala & Kar 1969, *Myricipites harrisii* (Couper 1953) Dutta & Sah 1970 and *Nymphaeidites clarus* Dutta & Sah 1970. The quite resemblance of palynomorphs obtained from the Bara Formation exhibited their affinities to modern day families viz., Arecaceae, Liliaceae, Myricaceae and Nymphaeaceae.

The fossil flora obtained from the studied area was the best source indicator of the climate of that area during the depositional phase of Bara Formation. The rich assemblage of fossil pollen of Arecaceae revealed the coastal placement of vegetation during sedimentation. Fossil pollen of families Liliaceae and Nymphaeaceae indicated the occurrence of fresh water environment. The presence of pollen forms affinities with Myricaceae family in the investigated material indicated the prevalence of brackish water mangrove swamps along the coastal belt.

From the overall angiospermic floral figure, the environment was evidently appeared to be of near shore with sufficient fresh water supply or fresh water marsh nearby or both. The occurrence of equatorial to sub-equatorial climatic belt with massive rain fall during the sedimentation in Bara Formation was evident by the composition and assembly of various microfloral forms. The prevalence of such depositional environment was also in accordance with the findings of Hakro & Baig (2013).

Palynofloral indices were correlated with the contemporary counterparts from the other geological outcrops on regional and global scale in order to observe the authenticity of palynological data obtained during present investigations. It was revealed that the palynofloral remains of Bara Formation exhibited similarities with the published literature from Frederiksen (1994), Arshad (2010), Mandaokar & Mukherjee (2012, 2014), Sexena & Trivedi (2009), Verma *et al.* (2013).

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