

Permo-Triassic palynoflora from Borehole NSG-3 near Sirsi, Nagpur District, Maharashtra, India

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ABSTRACT

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Palynoflora has been recorded from the Permo-Triassic sediments of Borehole NSG-3 near Sirsi, Nagpur District, Maharashtra. It has dominance of striate bisaccate genus *Striatopodocarpites* and sub-dominance of non-striate bisaccate genus *Faunipollenites*. Normally, this kind of palynofloral combination has been reported from the upper part of Raniganj Formation in Damodar Valley and also from Raniganj or its time equivalent formations of several other Indian Gondwana Basins. However, the subsistence of some of the very significant palynotaxa in this miofloral assemblage, viz. *Navalesporites*, *Lunatisporites*, *Crescentipollenites Tiwariasporis*, *Weylandites*, *Osmundacidites*, *Playfordiaspora*, *Ephedripites*, *Klausipollenites* and *Lundbladispora*, indicates that these sediments represent top-most part of the Kamthi Formation with still younger affiliation. The palynofloristic evidences therefore suggest that these sediments represent a transitional stage of Late Permian to Early Triassic. The inference drawn here has substantial supporting evidence of similar palynofloral record already known from Satpura Gondwana Basin, South Rewa Gondwana Basin, Godavari Basin, Johilla Coalfield, Talcher Coalfield and Makardhokada area of Nagpur District, Maharashtra, which have been assigned Permo-Triassic age. The depositional site experienced cold and humid climate with alternating dry and oxidizing conditions with luxuriant vegetation.

Key-words: Palynoflora, Permo-Triassic, Borehole NSG-3 near Sirsi, Nagpur District, Maharashtra, India.

INTRODUCTION

The Barakar Formation in Bandar Coalfield indicates development of eight coal horizons. A similar trend of seam splitting has also been observed in the Ramagundam and several other coalfields of the adjoining Godavari Valley, Andhra Pradesh and also in Umred Coalfield of Nagpur District, Maharashtra. Not much is known about the geology as well as palynofloristics of the Bandar Coalfield. Therefore, sub-surface samples

have been collected for palynodating as well as to infer the climatic conditions that prevailed during that regime. Recent sub-surface explorations have proved extension of Bandar Coalfield in some areas of Nagpur District, Maharashtra (Raja Rao 1982). The borehole under study also represents extension of Bandar Coalfield, and therefore, the present palynofloral evidences from Borehole NSG-3 will be helpful to delineate its age and depositional environment.

The Gondwana sediments, in this area, are generally found deposited in the form of isolated

[†]Deceased

patches, occupying the low-lying depressions formed by the metamorphic rocks exposed on the eastern and western limbs of Bandar Coalfield. These are well exposed near Bandar (Lat. 20°31'N, Long. 79°18'E), Amrori (Lat. 20°28'N, Long. 79°59'E) and Pauni (Lat. 20°47'N, Long. 79°38'E) villages in Chandrapur District, Maharashtra. Talchir Formation, which represents the basal-most stratigraphic unit of the Gondwana succession, rests upon the Precambrian basement and is found exposed in eastern and south-eastern parts of the basin. It contains compact, fine grained sandstones along with greenish shale inter-bands. The conformably overlying Barakar Formation attains thickness of over 300 m with predominance of fine to coarse grained micaceous, white, grey or buff coloured, feldspathic sandstones, containing greyish black carbonaceous shale. The basal part of the Barakar Formation, with a thickness of about 50 m, is devoid of coal seam. The sequence, unconformably overlying the Barakar, is designated as Kamthi Formation and has predominance of

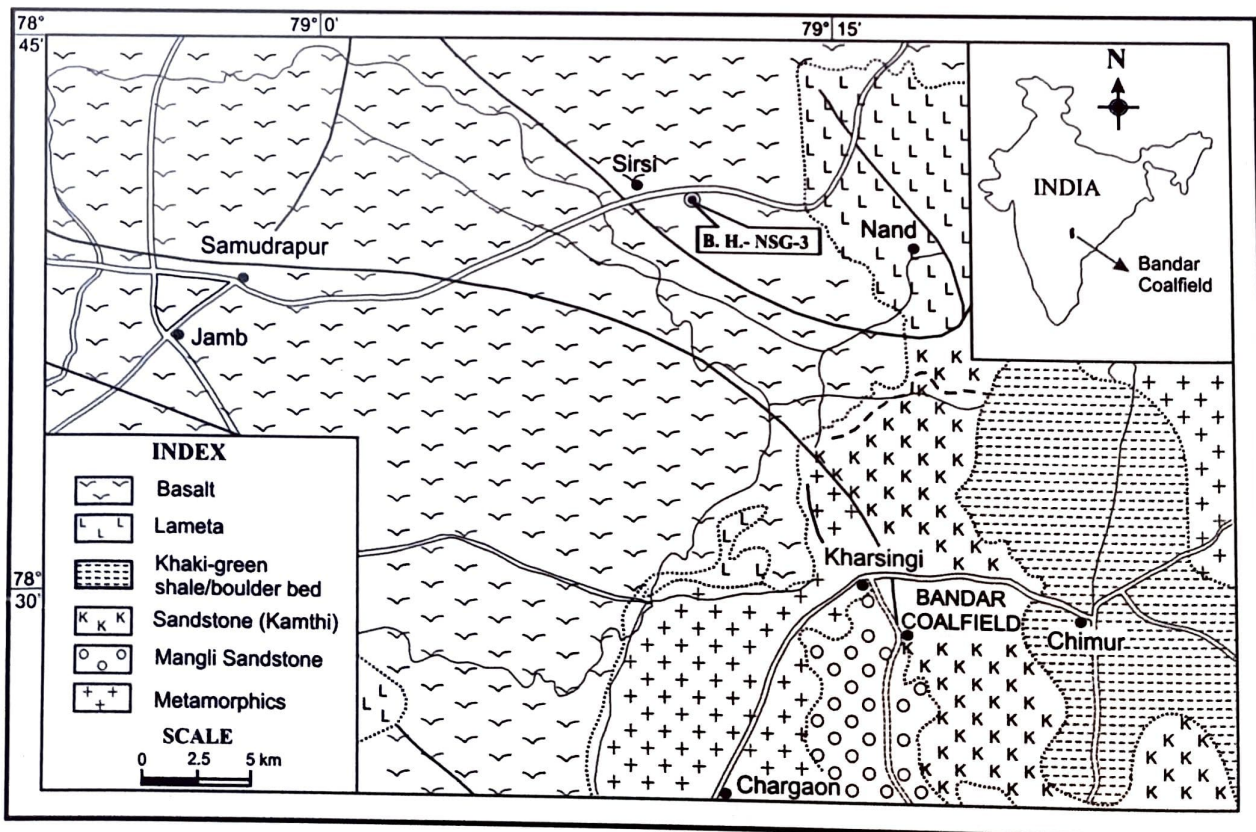
Table 1. Geological succession of Sirsi area of Nagpur District, Maharashtra (after Raja Rao 1982).

| Age | Group/Formation | Lithology |
|--------------------------------|-----------------|---|
| Recent | - | Alluvial gravel, soil |
| Eocene | Deccan Trap | Tholeiitic basalt |
| -----Unconformity----- | | |
| Cretaceous | Lameta | Limestones, cherts and silicified sandstones |
| -----Unconformity----- | | |
| Upper Permian - Lower Triassic | Kamthi | Yellow and buff sandstones, yellowish clay |
| -----Unconformity----- | | |
| Lower Permian | Barakar | Fine to coarse-grained sandstones, Grey shales and coal seams |
| Upper Carboniferous | Talchir | Fine-grained sandstones and shales |
| -----Unconformity----- | | |
| Proterozoic | Sullavai | Quartzites |
| -----Unconformity----- | | |
| Archaean | - | Metamorphites |

medium to coarse grained sandstones, displaying reddish or buff-tint along with yellowish clay and shale sequence (Table 1).

MATERIAL AND METHOD

Samples for the present study were collected from Borehole NSG-3, drilled by the Directorate of Geology & Mining, Government of



Text-figure 1. Geological map showing location of Borehole NSG-3 near Sirsi, Nagpur District, Maharashtra. (after Directorate of Geology & Mining, Government of Maharashtra, Nagpur).

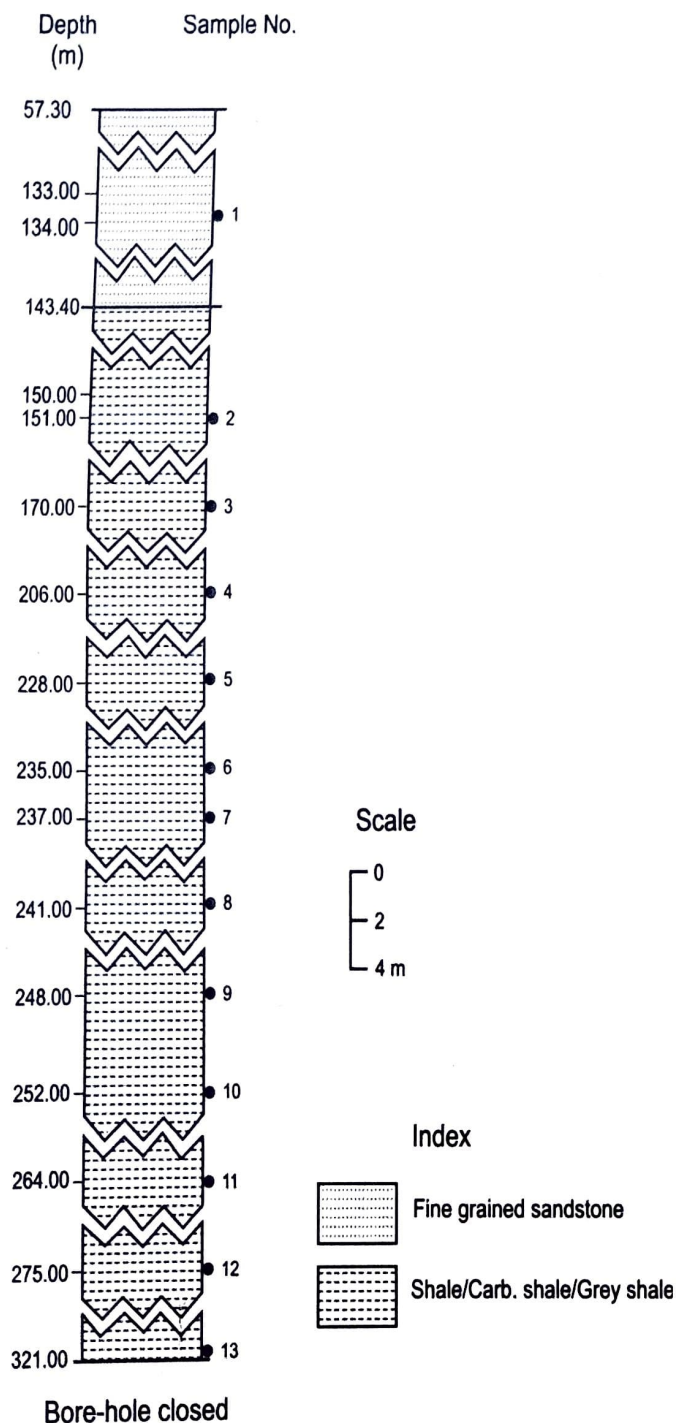
Maharashtra. This borehole is located near Sirsi village (Lat. 20°40'45"N, Long. 79°10'00"E) in Nagpur District, Maharashtra (Text-figure 1) and represents the north-eastern part of the Bandar Coalfield. The top-most 107 m part of the borehole is devoid of any workable seam. However, three or four carbonaceous shale horizons have been intersected in this region. As many as eight coal horizons showing thickness variation between

1 m and 10.06 m have been recorded from the middle region which has attained the maximum thickness of about 130 m in this region. The samples represent different lithologies, intersected in Borehole NSG-3, viz. carbonaceous shale, grey shale and sandstone (Text-figure 2).

About 5-10 g of each sample was used for the maceration purpose. Samples were first treated with hydrofluoric acid for 2-3 days to dissolve the silica contents and then were subjected to repeated washing to make them acid-free. The samples were subsequently treated for 3-4 days with commercial nitric acid followed by repeated washing. The acid-free samples were sieved using 150 and 400 mesh sieves. Residue collected over 400 mesh sieve was subjected to mild KOH treatment in order to make

Table 2. Frequency of the palynomorphs recorded from Borehole NSG-3 of Sirsi Area.

| Genera | Sample No./Depth (m) | | |
|-----------------------------|----------------------|--------|---------|
| | 13/ 321 | 8/ 241 | 12/ 151 |
| <i>Cyclogranisporites</i> | 3 | 1 | 2 |
| <i>Callumispora</i> | - | - | 2 |
| <i>Brevitriletes</i> | 2 | | 2 |
| <i>Cyclobaculisporites</i> | 5 | 3 | 5 |
| <i>Playfordiaspora</i> | - | 1 | - |
| <i>Parasaccites</i> | 2 | 5 | 5 |
| <i>Osmundacidites</i> | - | - | 2 |
| <i>Verrucosisporites</i> | - | - | 2 |
| <i>Plicatipollenites</i> | - | - | 2 |
| <i>Potonieisporites</i> | - | 3 | - |
| <i>Densipollenites</i> | 2 | 3 | 6 |
| <i>Striamonosaccites</i> | 10 | 7 | 8 |
| <i>Chordasporites</i> | - | 5 | 3 |
| <i>Ephedripites</i> | - | 3 | 3 |
| <i>Navalesporites</i> | - | - | 2 |
| <i>Rhizomaspora</i> | 2 | 3 | 2 |
| <i>Verticypollenites</i> | 3 | 1 | 2 |
| <i>Lahirites</i> | - | - | 1 |
| <i>Faunipollenites</i> | 19 | 13 | 5 |
| <i>Striatopodocarpites</i> | 26 | 34 | 21 |
| <i>Crescentipollenites</i> | 5 | 7 | 4 |
| <i>Klausipollenites</i> | 2 | 2 | 2 |
| <i>Distriatites</i> | 5 | 1 | - |
| <i>Lunatisporites</i> | 7 | 5 | 8 |
| <i>Lundbladispota</i> | - | - | 2 |
| <i>Scheuringipollenites</i> | - | - | 3 |
| <i>Ibisporites</i> | 2 | 1 | - |
| <i>Alisporites</i> | - | 1 | 2 |
| <i>Inaperturopollenites</i> | 3 | - | - |
| <i>Tiwariasporis</i> | - | - | 3 |
| <i>Weylandites</i> | 2 | 1 | 2 |



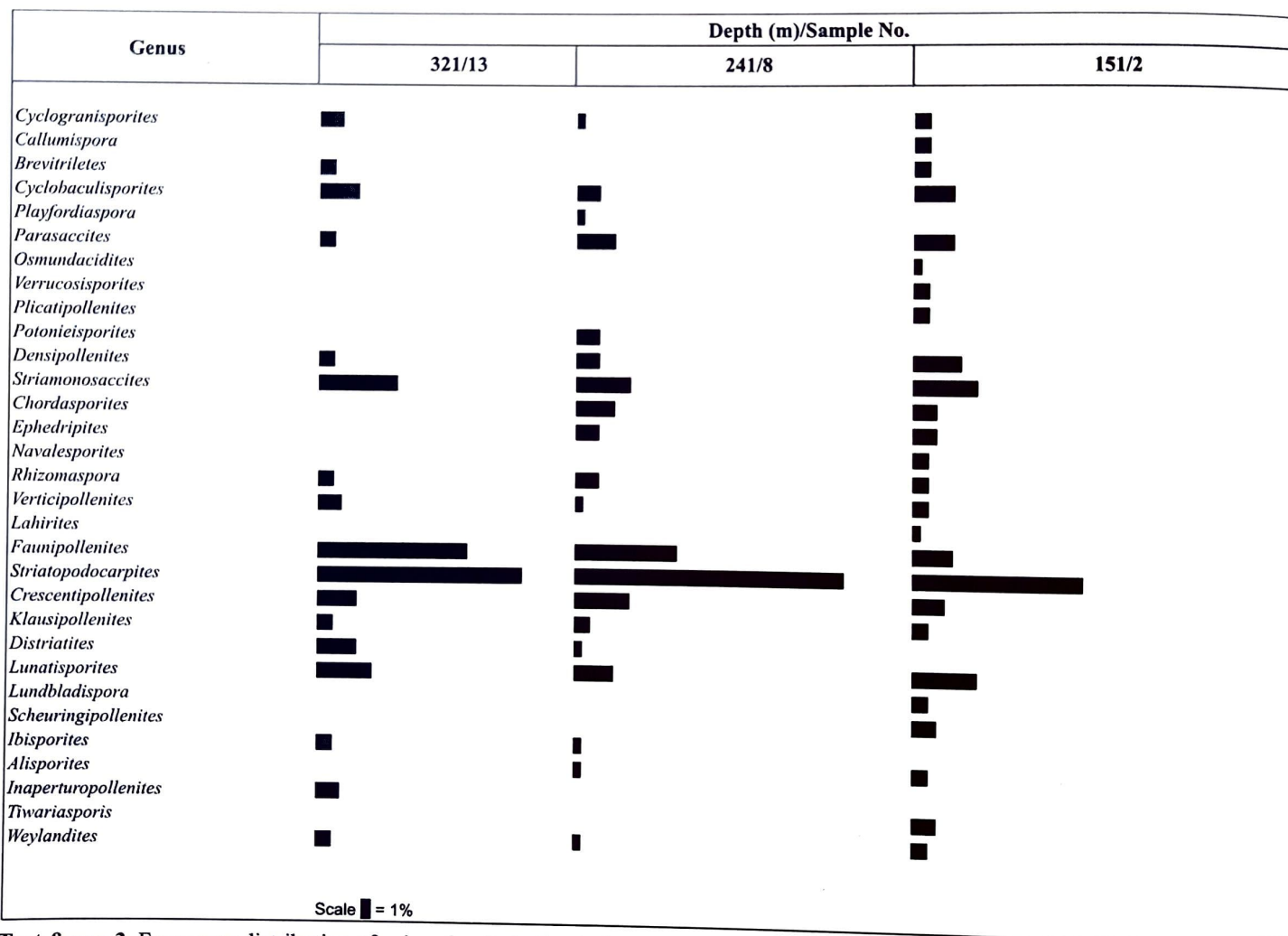
Text-figure 2. Lithocolumn of Borehole NSG-3 near Sirsi, Nagpur District, Maharashtra showing location of palynological samples.

the palynomorphs free from humic debris. The slides were prepared using polyvinyl alcohol and mounted in canada balsam.

PALYNOLOGICAL COMPOSITION

Of the seventeen samples collected from Borehole NSG-3, only three have been found to be sufficiently productive for their utilization in palynodating (Table 2). The palynoflora is characterized by dominance of striate bisaccate genus *Striatopodocarpites* (22-34%) and sub-dominance of non-striate bisaccate genus

Faunipollenites (5-19%) indicating sharp decline in their percentage distribution in the younger horizons. *Striamonosaccites* (7-10%) also indicates a similar trend of palyno-distribution. *Lunatisporites* (7-8%) and *Crescentipollenites* (4-7%) are consistent in their appearance. *Parasaccites* (2-5%) and *Cyclobaculispora* (3-5%) have scanty distribution. The palynoassemblage composition indicates that these sediments represent the top part of Kamthi Formation (Upper Permian) in this area. However, the existence of *Tiwariaspis*, *Weylandites*, *Osmundacidites*, *Playfordiaspora*,



Text-figure 3. Frequency distribution of palynofossils in Borehole NSG-3 near Sirsi, Nagpur District, Maharashtra.

Plate 1

1. *Verrucosiporites narminanus*. 2-4. *Gondisporites raniganjensis*. 5. *Playfordiaspora crenulata*. 6. *Playfordiaspora cancellosa*.
7. *Parasaccites distinctus*. 8-9. *Densipollenites indicus*. 10. *Guttallapollenites hannonicus*. 11. *Corisaccites alutas*. 12. *Faunipollenites selligii*.
- 17-18. *Scheuringipollenites tentulus*. 19. *Praecolpites nidpurensis*. 20. *Weylandites irregularis*. 21. *Tiwariaspis flavatus*.
22. *Inaperturopollenites nebulosus*. 23. *Latosporites intragranulosus*

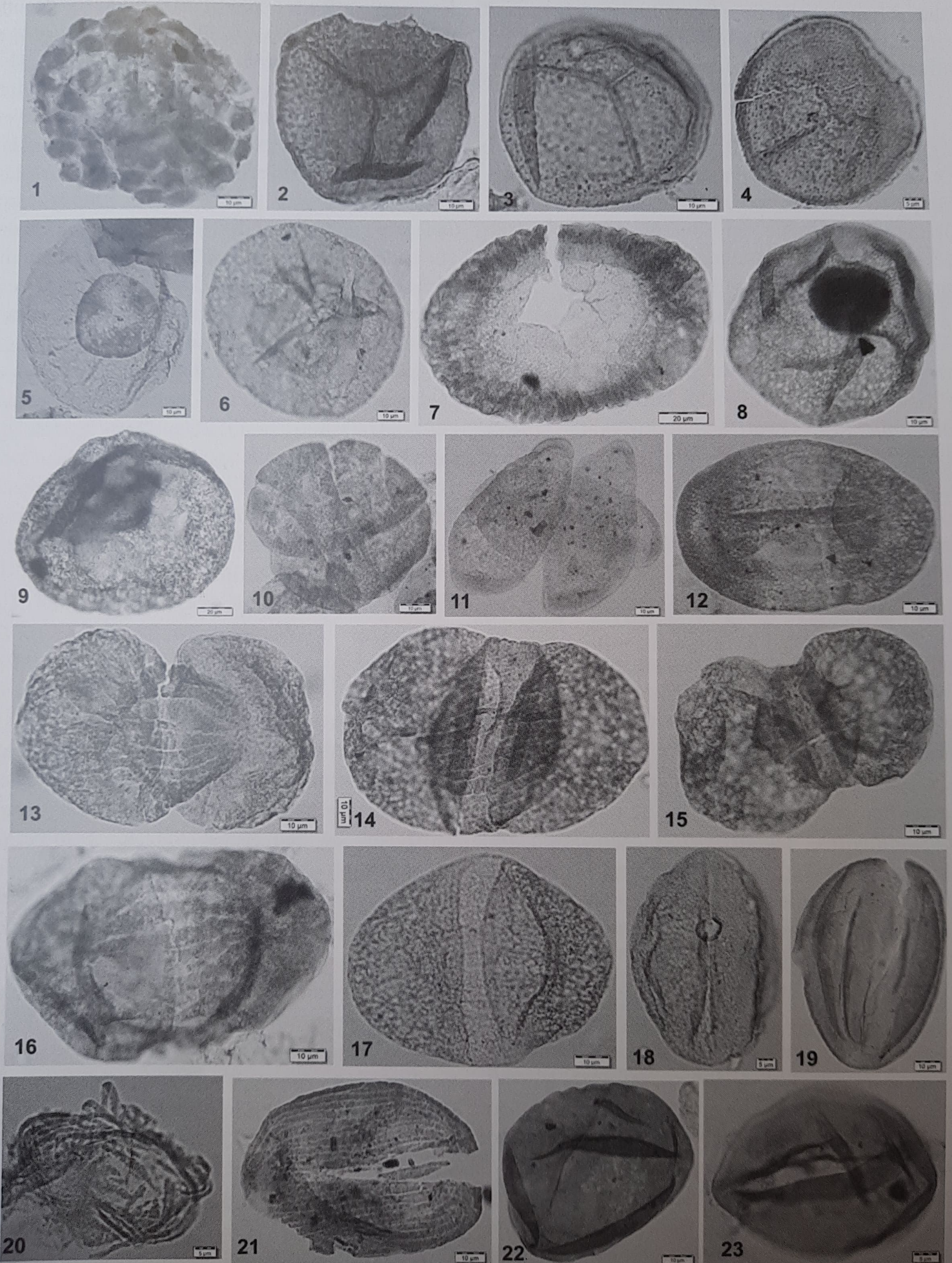


Plate 1

Ephedripites, *Lunatisporites*, *Lundbladispota* and *Klausipollenites* suggests their Permo-Triassic affinity (Table 2, Text-figure 3, Plate 1, figures 1-23).

COMPARISON AND DISCUSSION

The present palynoassemblage has been compared with other homotaxial Lower Gondwana assemblages. Bharadwaj et al. (1986) recorded microfioral assemblage from the upper part of Raniganj Formation in Borehole GGK-27 in Ramagundam-Mantheni area of Godavari Valley. This assemblage compares well with the present finding, with respect to dominance of *Striatopodocarpites* and sub-dominance of *Faunipollenites*. Tiwari and Ram-Awatar (1987) recovered Permo-Triassic miospore assemblage from Supra-Barakar exposures along Johilla River, overlying Pali Formation of South Rewa Gondwana Basin. This assemblage is also comparable with the present palynoflora with respect to dominance of *Striatopodocarpites* followed by *Faunipollenites* and presence of *Lunatisporites* and *Lundbladispota*, etc. Similarly, palynoflora from the Bijori Formation exposed near Harshdwar area of Satpura Gondwana Basin (Sarate & Patil 1994) shows dominant association of *Striatopodocarpites*, *Faunipollenites* and *Crescentipollenites* along with the emergence of *Klausipollenites*, *Lunatisporites*, *Navalesporites* and *Osmundacidites*, etc. and is closely similar to the one recorded here. Tripathi and Bhattacharya (2001) described Late Permian palynoassemblage 7 (377 to 404 m depth) from Talcher Coalfield. This assemblage is characterized by dominance of *Striatopodocarpites*, sub-dominance of *Faunipollenites* and presence of *Lunatisporites* (*Arcuatipollenites*), *Navalesporites* and *Verticipollenites*, etc. The present assemblage also exhibits closely similar palynofloral composition and therefore indicates Permo-Triassic affinity. Late Permian palynoassemblage II, recorded by Ram-Awatar et al. (2003) from Pali sediments of Sohagpur Coalfield, also shows similarity with the present assemblage with respect to the

dominance of striate pollen in association with *Navalesporites*, *Lunatisporites* (*Arcuatipollenites*), *Klausipollenites*, and *Distriatites*, etc. The present assemblage is also comparable with Assemblage 1 recorded by Jha (2004) between 171 and 200 m depths, from the Bottapagudem area of Chintalapudi Sub-basin, Godavari Valley, as it also contains the dominant association of *Striatopodocarpites* followed by *Faunipollenites*. The other important associated palynotaxa are *Chordasporites*, *Osmundacidites*, *Klausipollenites* and *Lunatisporites*, which indicate Raniganj affiliation. Kalkar et al. (2010) recorded palynoflora from Makardhokada area of Nagpur District, Maharashtra, which has been assigned Permo-Triassic age. Since this assemblage shows close resemblance with the present one, similar climatic conditions are suggested in both these areas. Jha and Aggarwal (2011) recorded Late Permian (Assemblage E) palynoflora from bore-cores MLG-24 (36 m) and MLG-28 (144-18 m) of Gundala area of Godavari Valley. This assemblage is characterized by dominance of *Striatopodocarpites* followed by *Faunipollenites*. In addition, *Klausipollenites*, *Playfordiaspora*, *Navalesporites* and *Lundbladispota*, having Permo-Triassic affiliation, have been recorded. These palynomorphs are also found in the present assemblage.

Analogous palynomorphs, showing Permo-Triassic affiliation, exist in present as well as assemblage from Makardhokada locality in the north-western edge of Umred Coalfield, Maharashtra (Kalkar et al. 2010). Similar trend of palynoassemblage is also recorded from Ramagundam and Mantheni areas of Godavari Valley (Bharadwaj et al. 1986) and Bottapagudem locality of Chintalapudi sub-basin of the Godavari Valley (Jha 2004). There also exists similarity in seam splitting (5-7 seams) in both these areas, which apparently suggests the existence of similar climatic and depositional conditions. However, Wardha Valley Coalfield, in most of the areas, has shown development of only one seam (Main Seam) which is confined to the Barakar

Formation. However, splitting of the Main Seam is also observed in Kosar, Dongargaon and Mahadoli areas of Yeotmal District, Maharashtra (Sarate 2004), which indicates that these areas witnessed similar palaeodepositional set-up as observed in the Umred, Bandar and Nand areas. Similarly, the existence of genus *Navalesporites* Sarate & Ram-Awatar (1984) in the present palynoassemblage can safely be taken as a conclusive evidence for its Permo-Triassic affinity, because of the established fact that this genus has consistently been recorded from the Permo-Triassic sequences of the several Indian Gondwana basins. It is therefore inferred that cold and humid climatic conditions mostly prevailed in the study area with alternating dry spells (King 1958, 1961, Kräusel 1961, Chandra & Chandra 1987). The climate mostly suited for the luxuriant growth of vegetation which accumulated in the basin through the agencies like floods and in due course transformed into the present day coal resource. Similar climatic conditions also prevailed in adjoining Satpura and South Rewa basins during the same span.

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