

Palynological investigation of subsurface Lower Gondwana sediments in Gundala area, Lingala-Koyagudem Coalbelt, Godavari Graben, Andhra Pradesh, India

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ABSTRACT

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Qualitative and Quantitative analyses of the palynoflora obtained from borecores, SGK-2, SGK-3 and SGK-4, drilled near Gundala, Godavari Graben, Andhra Pradesh, have been carried out. The palynoassemblage, containing 23 genera and 38 species, is characterized by dominance of radial monosaccates (chiefly *Parasaccites*) and subdominance of non-striate disaccates (chiefly *Scheuringipollenites*). This association, along with presence of *Crucisaccites* and few striate disaccates, suggests its resemblance with palynofloras obtained from the Upper Karharbari Formation of other basins (Late Sakmarian - Early Artinskian). Presence of Upper Karharbari palynoflora has been demarcated in lithologically designated Lower Barakar Formation.

Key-words: Palynology, Upper Karharbari, Lower Gondwana, Permian, Godavari Graben. Andhra Pradesh, India.

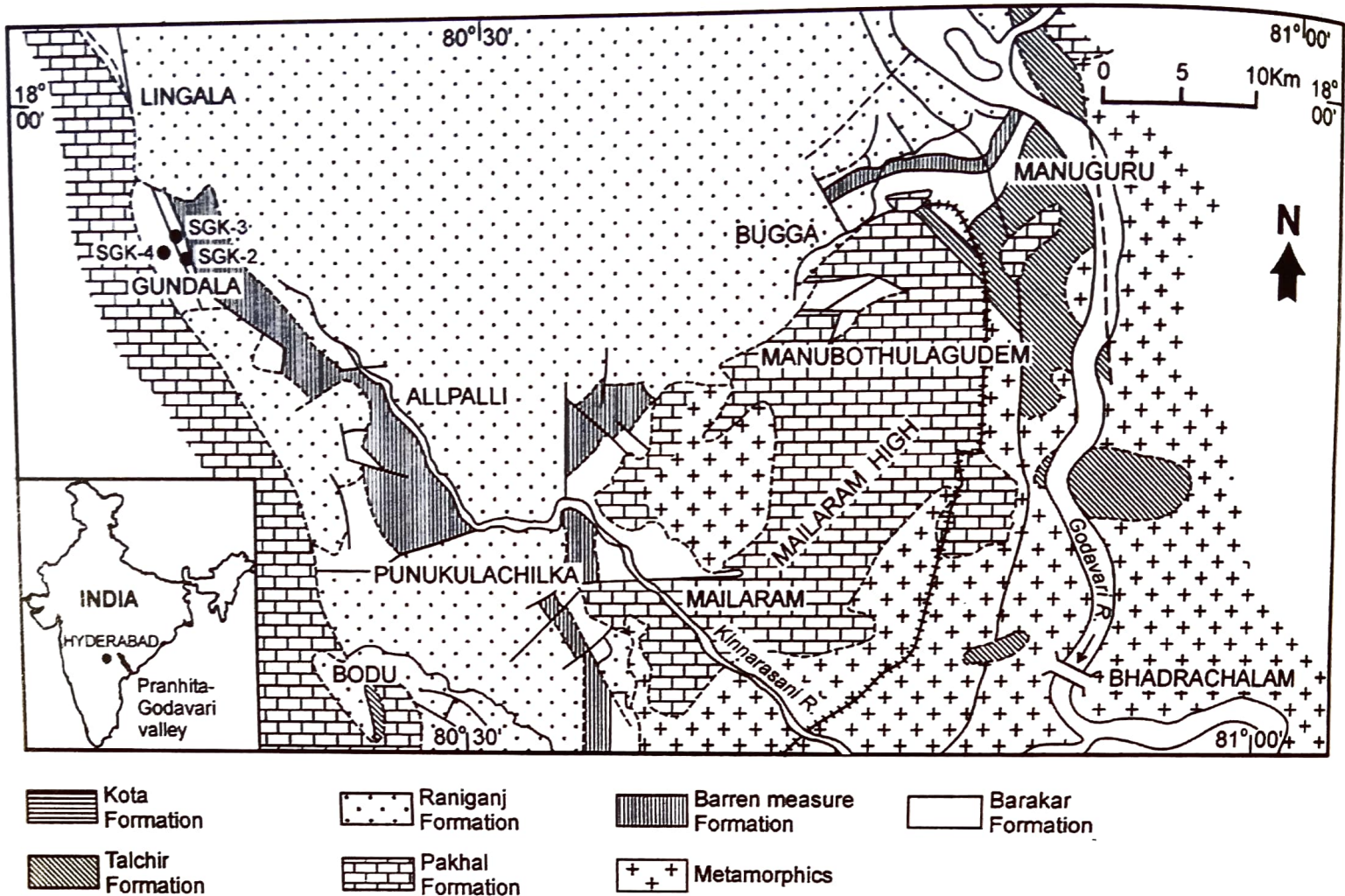
INTRODUCTION

The Lingala-Koyagudem coalbelt, situated in the south-western part of Godavari sub-basin, comprises Gundala block, which contains varied number of carbonaceous horizons (Text-figure 1). The palynological investigation carried out on three borecores near Gundala (SGK-2, SGK-3 and SGK-4), drilled by Singareni Collieries Company Limited, is presented here.

MATERIAL AND METHOD

Altogether, 70 samples (30 from SGK-2, 20 from SGK-3 and 20 from SGK-4) were collected. Of these,

20 samples (12 from SGK-2, 4 from SGK-3 and 4 from SGK-4) yielded palynofossils. About 20 gm of the material from each sample was first treated with conc. hydrofluoric acid (HF) for two days and then with commercial nitric acid (HNO₃) for 3-4 days followed by treatment with 10% potassium hydroxide (KOH) after thorough washing with water. The macerates were then mounted in canada balsam with the help of polyvinyl chloride (PVC) and slides were prepared. The slides are stored in the museum of the Birbal Sahni Institute of Palaeobotany, Lucknow. Two hundred specimens per sample were counted for palynofloral analysis.



Text-figure 1. Geological map of the Gundala area showing location of borecores SGK-2, SGK-3 and SGK-4

Table 1. Stratigraphic succession in Gundala block

Age	Group	Formation	Lithology
Recent	-	-	Soil Cover
Permian	Lower Gondwana	Kamthi	Sandstone with subordinate shales and coal seams
		Barren Measures	Grey to greenish grey, coarse to pebbly felspathic sandstone with shale bands
		Barakar	Predominantly medium to coarse grained, grey white sandstones, altered feldspars with subordinate clays/shales and persistent coal seams
		Talchir	Fine to medium grained, pale green sandstone with occasionally olive green shales
-----Unconformity-----			
Proterozoic		Pakhal	Quartzites, Phyllites and Dolomites

Plate 1

- Callumispora gretensis* (Balme & Hennelly) Bharadawj & Srivastava, BSIP slide no. 13939, R50-2.
- Microfoveolatispora foveolata* (Tiwari) Tiwari & Singh, BSIP slide no. 14228, K59-2.
- Parasaccites korbaensis* Bharadawj & Tiwari, BSIP slide no. 13977, S41-2.
- Parasaccites distinctus* Tiwari, BSIP slide no. 13815, O60-4.
- Parasaccites* sp., BSIP slide no. 13886, S52-2.
- Crucisaccites indicus* Srivastava, BSIP slide no. 14140, O68-3.
- Potonieisporites concinnus* Tiwari, BSIP slide no. 14229, E51-3.
- Scheuringipollenites barakarensis* (Tiwari) Tiwari, BSIP slide no. 13982, P53-3.
- Scheuringipollenites maximus* (Hart) Tiwari, BSIP slide no. 14227, Q41-3.
- Ibisporites diplosaccus* Tiwari, BSIP slide no. 13806, N65-2.
- Platysaccus densicarpus* Anand-Prakash, BSIP slide no. 14224, O48-4.
- Striatopodocarpites tiwarii* Bharadawj & Dwivedi, BSIP slide no. 14226, S38-4.
- Striatites communis* Bharadwaj & Tiwari, BSIP slide no. 13806, J63-1.
- Striatopodocarpites subcircularis* Sinha, BSIP slide no. 14225, K55-1.
- Tiwariasporis simplex* (Tiwari) Maheshwari & Kar, BSIP slide no. 13846, H35-3.

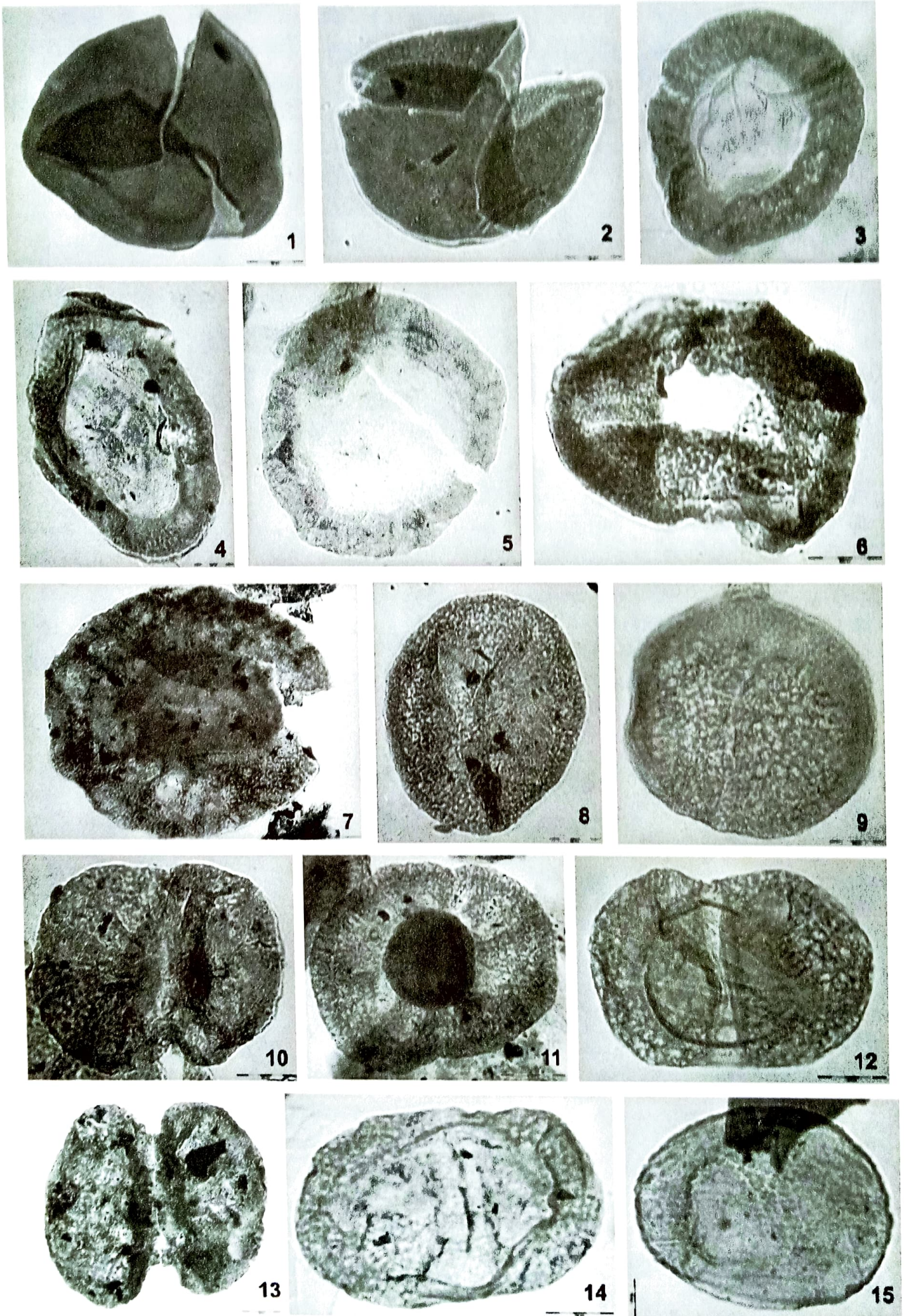


Plate 1

PALYNOFLORA

The palynoflora obtained from the carbonaceous horizons of the borecores of Gundala block comprises 23 genera and 38 species of palynofossils (Text-figure 2, Plate 1). The following spore pollen species have been recorded.

Trilete spores: *Brevitriletes communis* (Bharadwaj & Srivastava) Tiwari & Singh, *B. unicus* (Bharadwaj & Srivastava) Tiwari & Singh, *Callumispora barakarensis* (Bharadwaj & Srivastava) Tiwari et al., *C. gretensis* (Balme & Hennelly) Bharadwaj & Srivastava, *C. tenuis* Bharadwaj & Srivastava, *Horriditriletes rampurensis* Tiwari, *H. ramosus* (Balme & Hennelly) Bharadwaj & Salujha, *Leiotriletes rectus* Bharadwaj & Salujha, *Lophotriletes rectus* Bharadwaj & Salujha, *Microbaculispora barakarensis* (Tiwari) Tiwari & Singh, *M. tentula* Tiwari, *Microfoveolatispora foveolata* (Tiwari) Tiwari & Singh.

Monosaccate pollen: *Crucisaccites indicus* Srivastava, *C. monoletus* Maithy, *Divarisaccus lelei* Venkatachala & Kar, *Divarisaccus* sp., *Parasaccites*

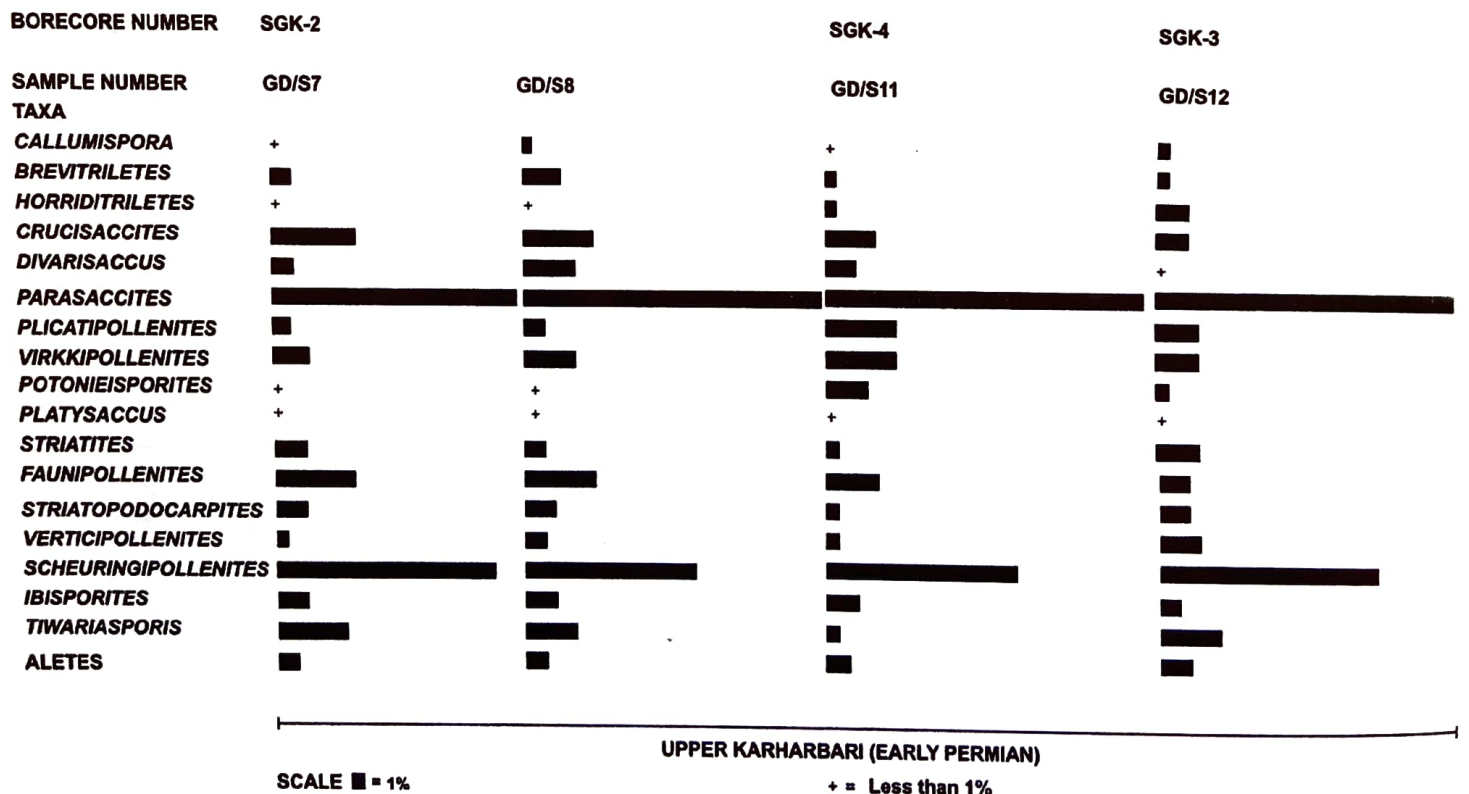
diffusus Tiwari, *P. distinctus* Tiwari, *P. korbaensis* Bharadwaj & Tiwari, *P. obscurus* Tiwari, *Parasaccites* sp., *Plicatipollenites indicus* Lele, *Potonieisporites concinnus* Tiwari, *Virkkipollenites orientalis* Tiwari.

Striate disaccate pollen: *Faunipollenites bharadwajii* Maheshwari, *F. parvus* Tiwari, *F. varius* Bharadwaj, *Striatites communis* Bharadwaj & Tiwari, *Striatopodocarpites decorus* Bharadwaj & Salujha, *S. diffusus* Bharadwaj & Salujha, *S. subcircularis* Sinha, *S. tiwarii* Bharadwaj & Dwivedi, *Verticipollenites crassus* Bharadwaj & Salujha.

Non-striate disaccate pollen: *Ibisporites diplosaccus* Tiwari, *Platysaccus densicarpus* Anand-Prakash, *Scheuringipollenites barakarensis* (Tiwari) Tiwari, *S. maximus* (Hart) Tiwari, *S. tentulus* (Tiwari) Tiwari.

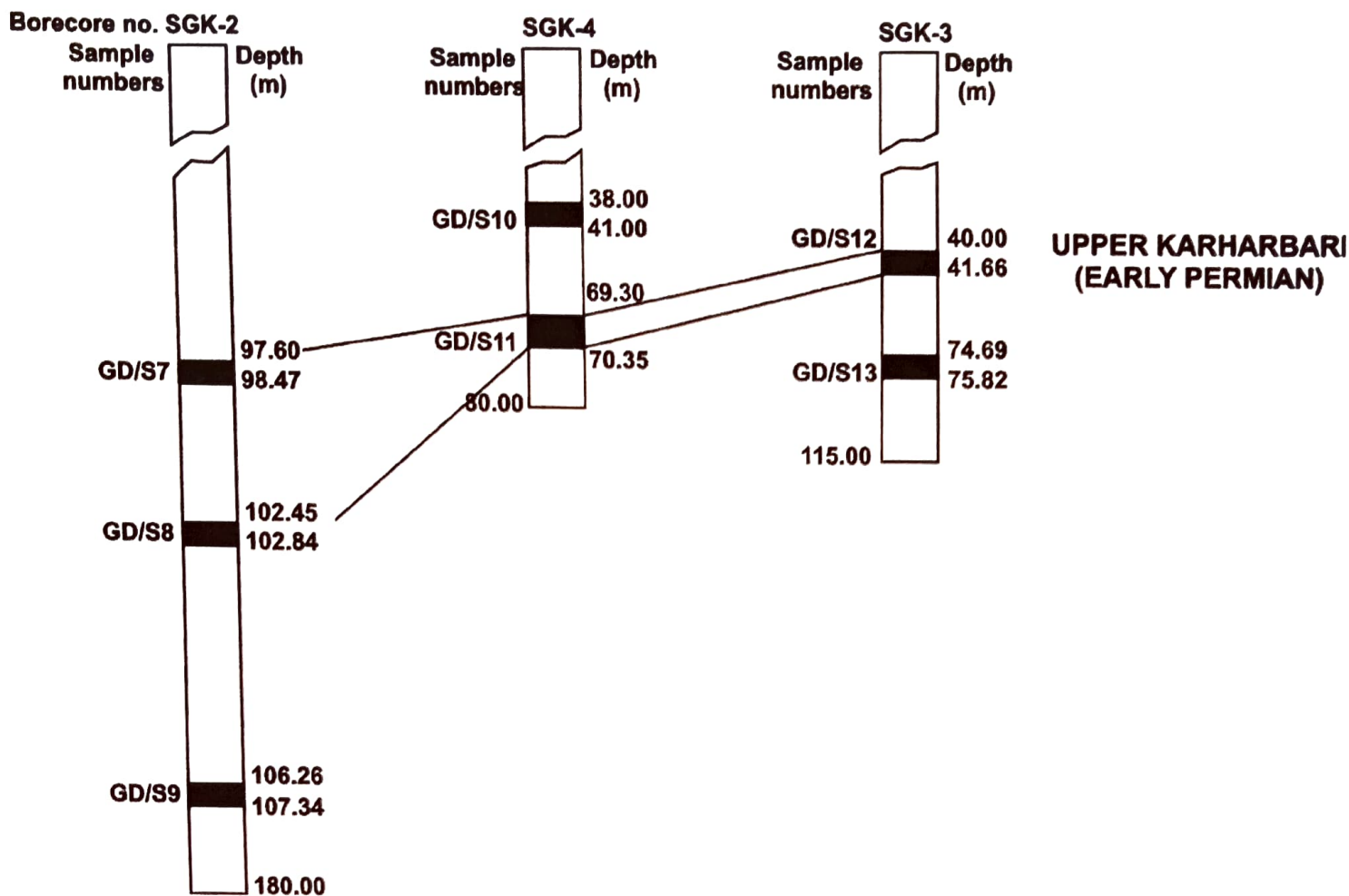
Others: *Balmella* sp., *Leiosphaeridia* sp., *Tiwariasporis gondwanensis* (Tiwari) Maheshwari & Kar, *T. simplex* (Tiwari) Maheshwari & Kar.

Earlier, a megaspore assemblage was recorded from borecore SGK-2 by Jha et al. (2006).



Text-figure 2. Histogram showing percentage frequency of palynofossils in borecores SGK-2, SGK-3 and SGK-4 of Gundala area

GUNDALA BLOCK



Text-figure 3. Diagrammatic representation of palynological correlation of borecores SGK-2, SGK-4 and SGK-3 from Gundala area of Lingala-Koyagudem coalbelt

QUANTITATIVE ANALYSIS

The present palynoassemblage is characterized by dominance of radial monosaccates chiefly *Parasaccites* (23-32%) and subdominance of non-striate disaccates chiefly *Scheuringipollenites* (17-22%). The other taxa are: triletes: *Horriditriletes* (0.2-1.5%), *Callumispora* (0.5-1.7%), *Microbaculispora* (0.5%), *Leiotriletes* (0.5%), *Brevitriletes* (1.5-4.3%), *Lophotriletes* (0.5%), *Microfoveolatispora* (0.5%); monosaccates: *Virkkipollenites* (2.7-7.2%), *Plicatipollenites* (1.7-7.2%), *Potonieisporites* (0.6-4.1%), *Crucisaccites* (3-12.3%), *Divarisaccus* (2.6-4%); non-striate disaccates: *Ibisporites* (2.8-3.6%), *Platysaccus* (0.4-0.8%); striate disaccates: *Faunipollenites* (3.4-8.1%), *Striatopodocarpites* (1.5-3.7%), *Striatites* (1.5-4%) and *Verticipollenites*

(1.5-4.6%). *Crucisaccites* (3-12.3%) and *Tiwariasporis* (1.5-7.6%) have been recorded in all the samples. Besides, aletes have also been marked in low amount (2-3%). Diagrammatic representation of palynological correlation of borecores SGK-2, SGK-4 and SGK-3 from Gundala area of Lingala-Koyagudem coalbelt is shown in Text-figure 3.

COMPARISON AND DISCUSSION

The present palynoassemblage compares well with Upper Karharbari palynoassemblages of different Gondwana basins of India, viz. Damodar (Korba Coalfield-Bharadwaj & Srivastava 1973, Raniganj Coalfield-Tiwari 1973), Wardha (Bharadwaj & Anand-Prakash 1974, Sarate 1985, Bhattacharyya 1997, Katol area-Kumar & Jha 2000), Satpura (Trivedi &

Ambwani 1984, Sarate 1986) and Godavari (Srivastava 1987, Srivastava & Jha 1989, 1992a, b, 1993, 1995a, b, 1996). It closely resembles with the palynoassemblage of type area of Karharbari Formation, i.e. Giridih Coalfield (Maithy 1965, Srivastava 1973) in dominance of radial monosaccates and subdominance of non-striate disaccates. Bharadwaj and Anand-Prakash (1974) recorded a rich palynoflora in coal deposits of Umrer Coalfield and established 3 biozones. The present assemblage compares with biozone III in having dominance of *Parasaccites* and subdominance of *Scheuringipollenites*.

The dominance of monosaccates during Early Permian has also been recorded from all other Gondwana continents, i.e. Africa (Dwyka Tillite - Anderson 1970, Falcon 1975, Utting 1978), Australia (Baccus Marsh Tillite - Truswell 1980), Antarctica (Darwin Tillite - Barrett & Kyle 1975, Victoria Group - Roaring Formation - Kyle & Schopf 1982, Mackellar Formation - Masood et al. 1994), South America (Lower Itararé Formation of Brazil - Bharadwaj et al. 1976) and Salt Range (Tobra Formation - Masood et al. 1992).

The dominance of *Parasaccites* has been recorded from Early Permian sediments of India (Talchir and Karharbari) but the association of *Scheuringipollenites* and few striate disaccates distinguish the present assemblage from palynoflora of Talchir Formation. Palynoflora of Barakar Formation of India is characterized by dominance of *Scheuringipollenites* and subdominance of striate disaccates, viz. *Faunipollenites*, *Striatopodocarpites*. High frequency of monosaccate, viz. *Parasaccites* and very low percentage of striate disaccates in the present palynoassemblage indicate that this is older than palynoflora of Barakar Formation. Moreover, presence of triletes in good amount and occurrence of *Crucisaccites* also indicate Karharbari affinity.

On the basis of lithological attributes, the coal seams have so far been considered to be of Barakar Formation but present palynological analysis provides evidence for the presence of Upper Karharbari sediments (Late Sakmarian-Early Artinskian) in Gundala area. However, the coal seam has not attained workable

thickness in this borecore but it opens up new possibility for search of Karharbari coals in Gundala area. The megafloora, too, exemplifies floristic differences in both the formations, i.e. Karharbari and Barakar formations (Maheshwari 1992). On the basis of present palynological investigation, it can be established that rich Karharbari flora existed during Early Permian in Godavari Valley.

Spore/pollen from various coalfields of India have been extensively worked out and many biozones have been proposed (Tiwari 1995). Stratigraphic significance of spore-pollen, in resolving time boundaries, has been consistently emphasized (Tiwari & Kumar 2002). The distinction between Karharbari and Barakar formations is primarily based on megafloreal (Maithy 1966, 1969, Banerjee 1988, Maheshwari 1992) and spore/pollen (Maithy 1965, Srivastava 1973, Bharadwaj 1974, 1975) studies. Unlike other basins, Wardha-Godavari Basin is deprived of well established megaflorestic zones distinguishing Karharbari and Barakar sequences. It is also noteworthy that lithological characters did not help their categorization. But the Karharbari palynoflora has been recorded in many areas in Godavari Graben (Jha 2006, Jha & Aggarwal 2010a, b). This necessitates a thorough search for plant fossil evidences in Godavari Graben in order to understand floristic differentiation, if any.

CONCLUSION

The palynoassemblage encountered in borecores of Gundala block of Lingala-Koyagudem coalbelt compares with palynoassemblage of Karharbari Formation described from Giridih Coalfield, Bihar (Maithy 1965). It shows that diversified vegetation was growing in Gundala area comprising 23 genera and 38 species of palynofossils. It is concluded that the assemblage encountered in the carbonaceous horizons of Gundala block belongs to Karharbari and is Early Permian in age.

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