

# Palynological dating of sub-surface Gondwana sediments in Sattupalli area, Godavari Graben, Telangana

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*Manuscript received: 29 October 2015*

*Accepted for publication: 18 April 2016*

## ABSTRACT

Mishra S., Jha N, Joshi H. & Gahalain S. S. 2016. Palynological dating of sub-surface Gondwana sediments in Sattupalli area, Godavari Graben, Telangana. *Geophytology* 46(1): 33-41.

In the present communication, palynological investigation for the dating of Gondwana sediments in a 350 m deep bore core MSP-21 from Sattupalli area, Chintalapudi sub-basin, Godavari Graben has been done. The studies revealed the presence of two distinct palynoassemblages, both belonging to Raniganj Formation of Late Permian age. Palynoassemblage I and II show a marked dominance of striate bisaccate pollen, chiefly *Striatopodocarpites*, *Faunipollenites* and *Crescentipollenites* along with some stratigraphically significant taxa, viz., *Falcisporites*, *Klausipollenites*, *Chordasporites*, *Striasulcites*, *Densipollenites* and *Strotersporites*. Palynoassemblage I differs from Palynoassemblage II in having the significant presence of *Striasulcites* along with *Faunipollenites* whereas Palynoassemblage II can be distinguished from the later by the presence of enveloping monosaccate pollen *Densipollenites* spp. in significant percentage. The present palynological investigation revealed the presence of Raniganj (=Late Permian) equivalent sediments in Chintalapudi sub-basin.

**Key-words:** Raniganj, Chintalapudi sub-basin, Telangana, Late Permian, palynology.

## INTRODUCTION

Godavari basin preserves a complete sedimentation record of Gondwana period ranging from Early Permian to Early Cretaceous. The Lower Gondwana strata in Godavari graben is represented by Talchir, Barakar, Barren Measures and Raniganj formations, while the Upper Gondwana strata is represented by the Panchet, Maleri, Kota and Chikiala formations (Ramanamurthy & Rao 1996, Jha & Srivastava 1996). The basin displays a good record of terrestrial and paralic sediments, deposited in a successively developed block faulted trough. The Pranhita - Godavari basin has been divided into four sub-basins on the basis of structure and tectonics, viz., Godavari, Kothagudem,

Chintalapudi and coastal tract of Krishna-Godavari. The present palynological investigation has been done in the Sattupalli area of Chintalapudi sub-basin, Godavari Graben.

Chintalapudi sub-basin represents the south-easterly continuation of Kothagudem sub-basin. It covers an area of 2500 sq. km. Gondwana rocks unconformably overlie the Archaean gneisses. Stratigraphy of this sub-basin is not well defined due to the presence of many small faults and the absence of or reduction in thickness of an intervening strata i.e. Barren Measures. The thickness of Barren Measures Formation in Ramagundam area of Godavari sub-basin is  $\pm 500$ m (Raja Rao 1982), which is gradually reduced towards

south, and in Chinatalapudi sub-basin it is almost non-existing. Hence, the dating of coal bearing and associated sediments is difficult in Chintalapudi sub-basin. Earlier, the rocks above the Talchir Formation were referred as Kamthi sandstone (Blandford 1872) and Kamthi Formation (Raja Rao 1982). Barakar and Barren Measures were not identified in this sub-basin. However, Lakshminarayana and Murthy (1990), Lakshminarayana (1996) revised the stratigraphy of the Chintalapudi sub-basin in which the Barakar Formation is overlain by the Kamthi Formation. The stratigraphic succession of the Chintalapudi sub-basin is given in Table 1.

Palynological studies have been done in different parts of the sub-basin, viz., Ayyanapalli-Gompana (Srivastava & Jha 1993), Sattupalli (Srivastava & Jha 1994; Jha 2008) and Chintalapudi (Jha et al. 2012) areas from the north-western margin of the sub-basin, Bottapagudem (Jha 2004), Amavaram (Srivastava & Jha 1991) and Gauridevipet (Jha et al. 2014) from north-eastern margin of the sub-basin, and Gattugudem (Jha 2002) area from central part of the sub-basin. The present work has been carried out in Sattupalli area in order to date and correlate the strata and to understand the stratigraphy of Chintalapudi basin. Location of the area and studied bore hole has been shown in Text

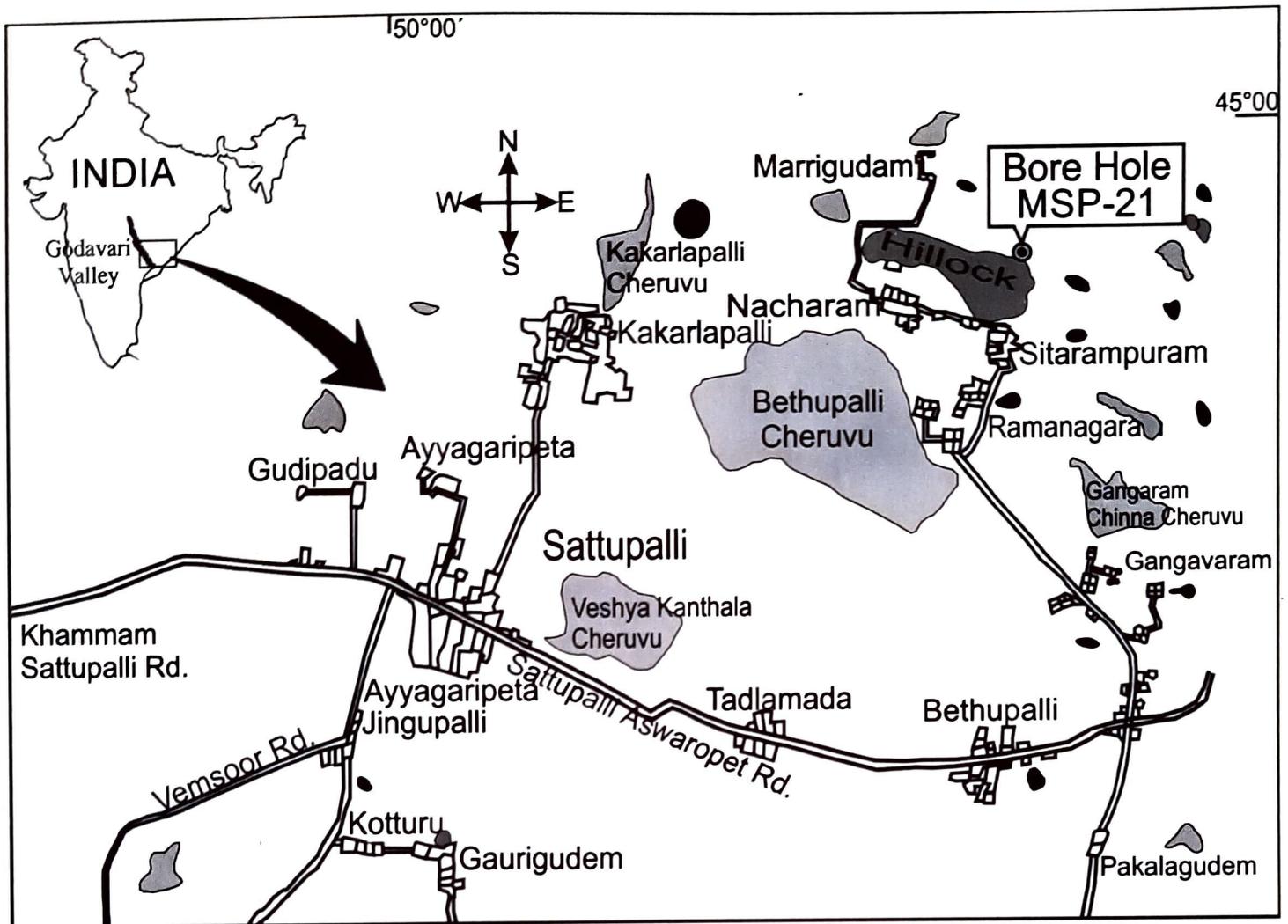
figure 1 and lithological details of bore core MSP-21 is illustrated in Text figure 2.

## MATERIAL AND METHODS

Samples of varied lithology viz., grey shale, carbonaceous shale, sandstone, siltstone and shaly coal were collected from bore hole MSP-21, Sattupalli area near Nacharam Hillock. The samples were processed following the standard maceration technique. 15-30 gm of each sample, depending on the lithology was used for the extraction of palynomorphs. Firstly, samples were washed and then crushed to 2-5 mm size and then transferred to 30 ml plastic beakers for the chemical treatment. Samples were then treated with 40% hydrofluoric acid (HF) for 2-3 days with periodic stirring after an interval of 2-3 hours each. Samples were then treated with concentrated nitric acid (HNO<sub>3</sub>) for 3-4 days after washing with water. Samples were observed after each step of acid treatment to analyse its effect on the recovery of palynomorphs. After washing with water, samples were subjected to KOH (10%) treatment for obtaining clear palynomorphs. Permanent slides were made using polyvinyl alcohol and Canada Balsam as mounting medium. Slides have been deposited in the museum of the Birbal Sahni Institute of Palaeobotany, Lucknow.

**Table 1.** Lithostratigraphic succession of Chintalapudi sub-basin (after Lakshminarayana 1996).

Age	Group	Formation	Lithology
Early Cretaceous	UPPER GONDWANA	Gangapur	White sandstone, buff siltstone and claystone
Jurassic		Kota	<b>Upper:</b> Sandstone and conglomeratic sandstone
Middle-Late Triassic		Maleri	<b>Middle:</b> Limestone and marl <b>Lower:</b> Conglomeratic sandstone and trough cross stratified sandstone. (?) Red clay and lime pellet rock
Unconformity			
Late Permian-Early Triassic	LOWER GONDWANA	Kamthi	Conglomerate, conglomeratic sandstone, siltstone and grey shales
Early Permian		Unconformity	
		Barakar	<b>Upper:</b> White felspathic sandstone, siltstone, shale, carbonaceous shale and coal seams <b>Lower:</b> Very coarse grained, pebbly, feldspathic sandstone
		Talchir	Diamictite, rhythmite, fine grained light green sandstone and siltstone
Unconformity			
Proterozoic Archaean			



Text figure 1. Map of Sattupalli block showing location of bore core MSP-21 [after Mineral Exploration Corporation Limited (MECL)].

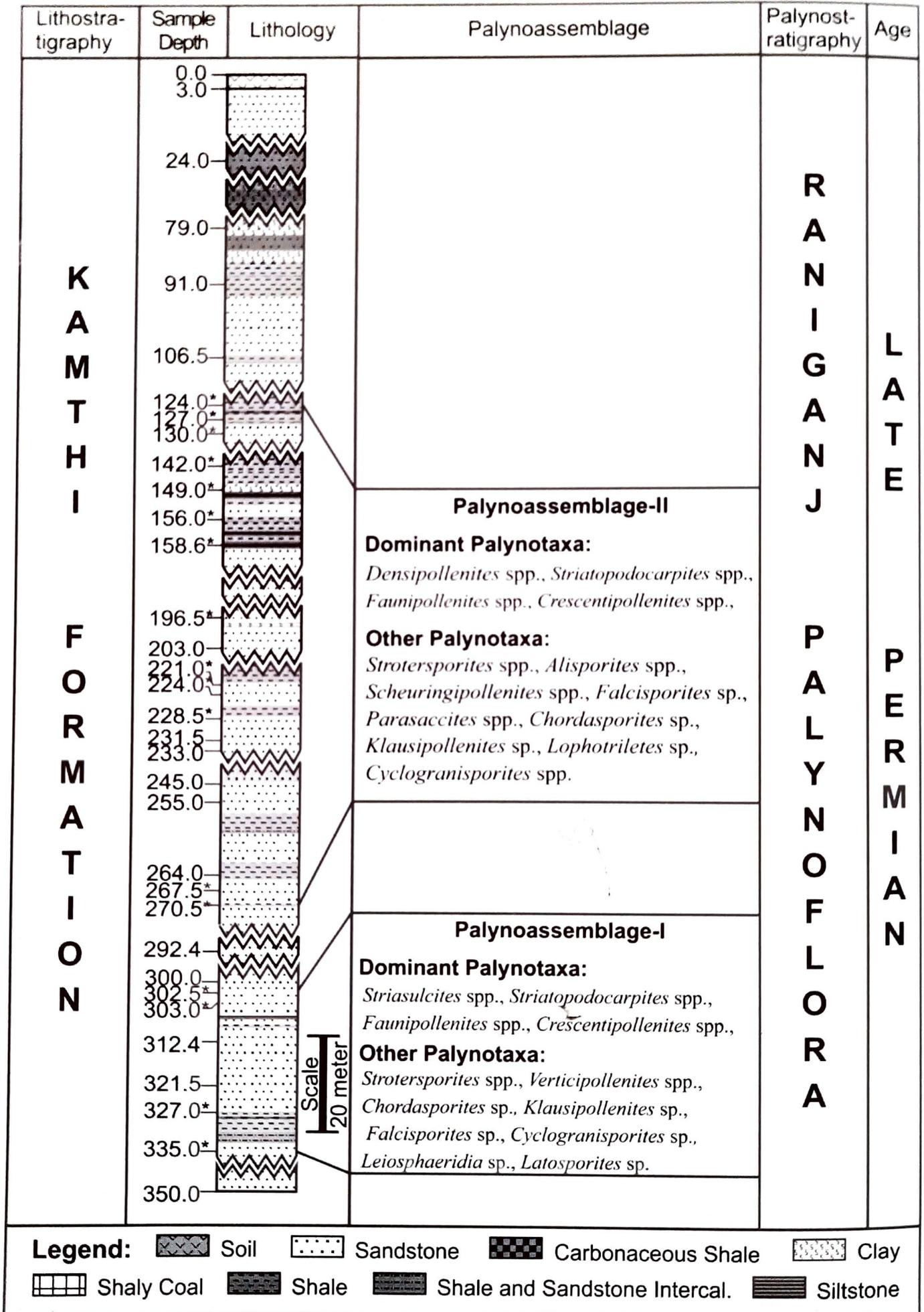
## PALYNOLOGICAL ANALYSIS

Thirty-one samples were collected from the 350m deep bore core MSP-21 from Sattupalli area, Telangana. However, only seventeen samples yielded rich and diverse palynoflora, while others were either barren or have very low pollen and spores. Two palynoassemblages were identified on the basis of quantitative as well as qualitative distribution of various palynotaxa. Vertical distribution of palynomorphs is depicted in Text figure 3 and some stratigraphically significant palynotaxa are shown in Plate 1.

**Palynoassemblage - I:** This palynoassemblage is identified from a depth of 302.5m to 335.0m. Palynoassemblage-I is characterised by the dominance of striate bisaccates viz., *Striatopodocarpites* spp. (21.5%), *Faunipollenites* spp. (17.0%), *Crescentipollenites* spp. (5.7%), *Strotersporites* spp. (2.5%), *Verticopollenites* spp. (2.5%) and *Striasulcites*

spp. (17.8%). The other rare but stratigraphically important palynotaxa include *Chordasporites* sp., *Klausipollenites* sp. and *Falcisporites* sp. Spores account to an average value of 6.5% of the total palynoassemblage and are chiefly represented by *Cyclogranisporites* sp., *Leiosphaeridia* sp. and *Latosporites* sp.

**Palynoassemblage - II:** This palynoassemblage is recorded at 124.0m to 270.5m depth and is marked by the high incidence of enveloping monosaccate pollen *Densipollenites* spp. (11.5%) along with the dominance of striate bisaccates chiefly, *Striatopodocarpites* spp. (20.0%), *Faunipollenites* spp. (16.5%), *Crescentipollenites* spp. (1.5%) and *Strotersporites* spp. (3.0%). Non-striate bisaccates include *Scheuringipollenites* spp. (24.19%) and *Alisporites* spp. (3.6%). Other rare but important palynotaxa include *Falcisporites* sp. (1.02%), *Parasaccites* spp.



Text figure 2. Litholog and palynoassemblage of bore core MSP-21, Sattupalli area, Telangana (\* yielding samples).

(2.68%), *Chordasporites* sp. (2.3%) and *Klausipollenites* sp. Spores like *Cyclogranisporites* sp. (3.0%) and *Lophotriletes* sp. (1.5%) are rare in occurrence.

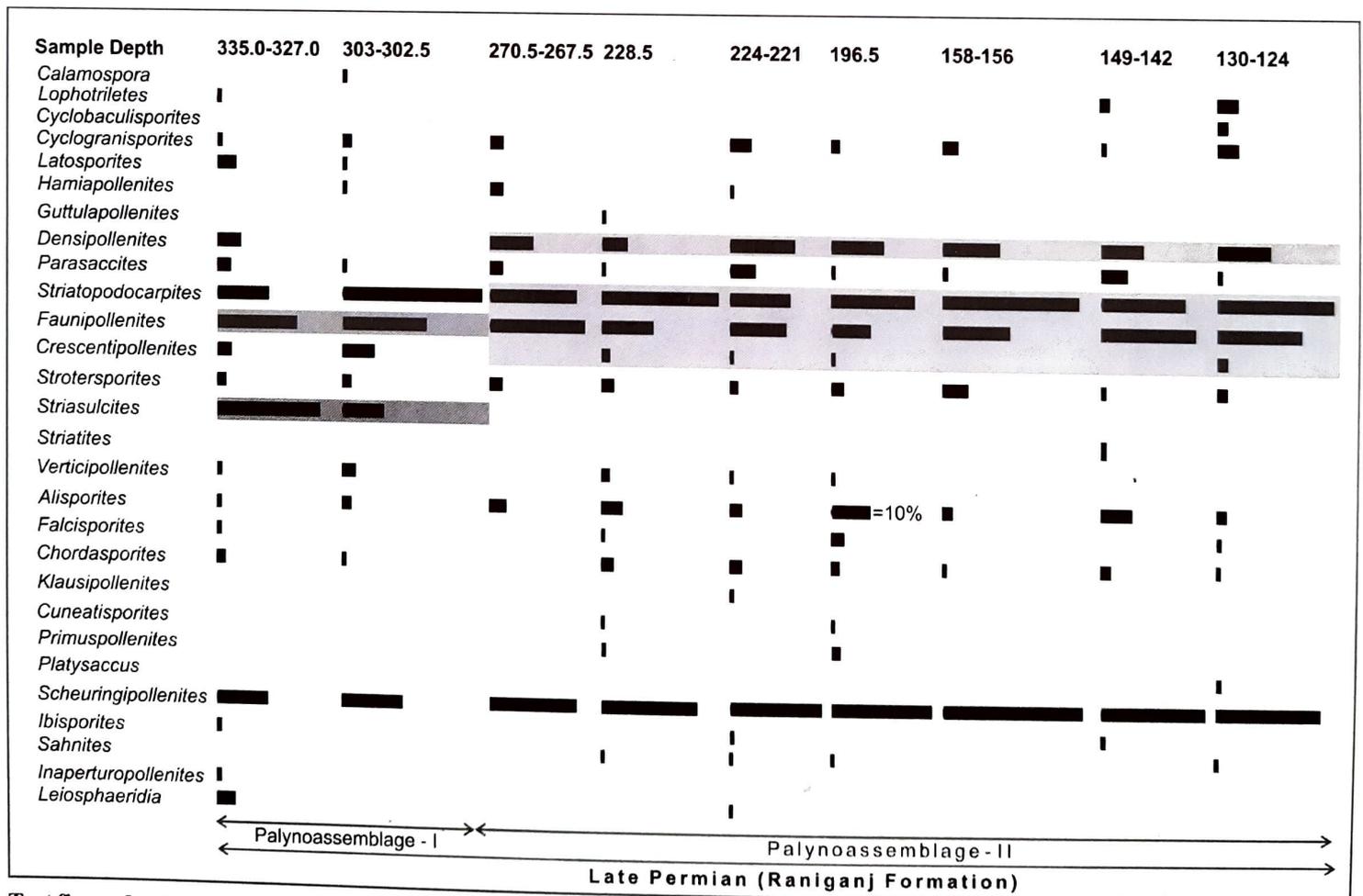
### PALYNOFLORAL CORRELATION AND DISCUSSION

The Gondwana sequence of peninsular India was deposited in fault-bounded basins that developed along Precambrian lineaments. Gondwana sedimentation is affected by intrabasinal faults indicating fault-controlled synsedimentary subsidence (Chakraborty et al. 2003). The presence of these faults makes the stratigraphy and correlation of the strata difficult. To overcome this problem palynological succession of Lower Gondwana sequences have been studied in different basins of India by several authors (Bharadwaj 1962, 1975, Lele & Karim 1971, Lele & Srivastava 1980, Tiwari & Ram-Awatar 1989, Tiwari et al. 1991, Tiwari & Tripathi 1992, Srivastava & Jha 1989, 1990, 1992a, 1992b,

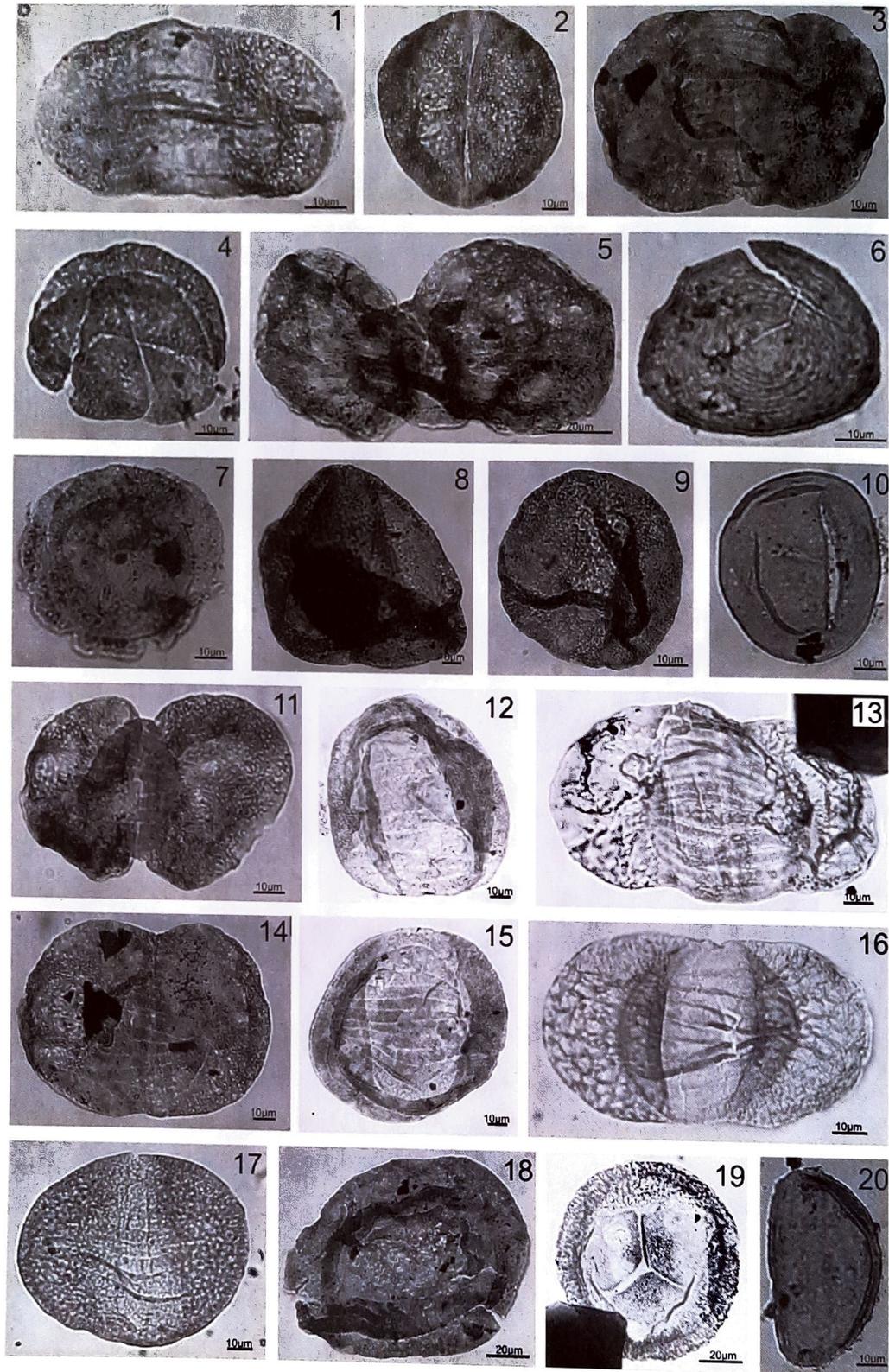
Jha & Srivastava 1996, Jha et al. 2014).

Srivastava and Jha (1989, 1997) and Jha (2006) framed the biostratigraphic scheme for the Godavari basin on the basis of dominance, sub-dominance and presence of key taxa. They assigned a total of six palynoassemblages during late Permian through the study of a number of bore cores from different areas of the Godavari basin. In the present study, inter-basinal correlation has been done with some of the selected areas. The correlation shows a gross similarity of late Permian flora among all the five major Gondwana basins of India in having dominance of striate baccates. Yet some regional differences persist viz., the reappearance of *Parasaccites* in Godavari and South Rewa Basin, high incidence of *Guttulapollenites* in Satpura and Godavari basin and *Striasulcites* dominance in Godavari and Mahanadi Basin.

Palynoassemblage - I has been found to be restricted to Godavari and Son -Mahanadi basins and



Text figure 3. Histogram showing vertical distribution and percentage frequency of various palynotaxa in bore core MSP-21, Sattupalli area, Chintalapudi Sub-basin.



### Plate 1

1. *Strotersporites crassiletus* Jha 1995, B.S.I.P. slide no. 40840, J43/2, 2. *Scheuringisporites maximus* Hart emend. Tiwari 1973, B.S.I.P. slide no. 40839, N40, 3. *Striatopodocarpites multistriatatus* Jha 1996, B.S.I.P. slide no. 40832, M21/4, 4. *Guttulapollenites hannonicus* Goubin 1965, B.S.I.P. slide no. 40842, O22/3, 5. *Verticypollenites gibbosus* Bharadwaj 1962, B.S.I.P. slide no. 40835, F19/4, 6. *Circulisporites* sp. B.S.I.P. slide no. 40836, R26/1, 7. *Densipollenites magnicarpus* Tiwari & Rana 1981, B.S.I.P. slide no. 40834, Q-26-4, 8. *Densipollenites densus* Bharadwaj & Srivastava 1969, B.S.I.P. slide no. 40831, N22/2, 9. *Densipollenites invisus* Bharadwaj & Salujha 1964, B.S.I.P. slide no. 40837, Q31/1, 10. *Latosporites colliensis* Balme and Hennelly emend. Venkatachala and Kar 1968, B.S.I.P. slide no. 40840, S45, 11. *Striatites rhombicus* Bharadwaj & Salujha 1964, B.S.I.P. slide no. 40838, T28/4, 12. *Striasulcites ovatus* Venkatachala & Kar 1968, B.S.I.P. slide no. 40836, P29/3, 13. *Hamiapollenites insolitus* Bharadwaj & Salujha 1964, B.S.I.P. slide no. 40845, W39/2, 14. *Faunipollenites varius* Bharadwaj 1962, B.S.I.P. slide no. 40841, K18/3, 15. *Striasulcites tectus* Venkatachala & Kar 1968, B.S.I.P. slide no. 40846, S43/4, 16. *Crescentipollenites fuscus* Bharadwaj emend. Tiwari & Kar 1974, B.S.I.P. slide no. 40843, T31/3, 17. *Faunipollenites varius* Bharadwaj 1962, B.S.I.P. slide no. 40839, S26/1, 18. *Densipollenites marginalis* Jha 1996, B.S.I.P. slide no. 40835, Q30/2, 19. *Parasaccites obscurus* Tiwari 1965, B.S.I.P. slide no. 40844, L42, 20. Unknown spore, B.S.I.P. slide no. 40833, N39/4.

is comparable to Assemblage - 2 of Chelpur area (Srivastava & Jha 1987), Assemblage-II of Mantheni area (Bharadwaj et al. 1987), Palynozone-5 of Mailaram area of Godavari Graben (Jha & Aggarwal 2012), Palynoassemblage - I of bore core MGP-11 from Gauridevipet area of Chintalapudi sub-basin (Jha et al. 2014). This palynoassemblage corresponds with the *Faunipollenites* + *Striasulcites* assemblage of Godavari Graben and belongs to late Permian (Guadalupian) Raniganj Formation (Jha 2006). This assemblage is also present in the Son Valley (Tiwari & Ram-Awatar 1989), although it has been marked by the authors, but the histogram clearly shows a high percentage of *Striasulcites*. This palynoassemblage is equivalent to *Gondisporites raniganjensis* Assemblage zone of Damodar Basin described by Tiwari and Tripathi (1992).

Palynoassemblage - II is comparable to Assemblage -6 of Ramakrishnapuram and Ramagundam area (Srivastava & Jha 1988), Assemblage - III of Mantheni area (Bharadwaj et al. 1987), *Densipollenites* rich phase of Kamthi Formation in Chelpur area (Srivastava & Jha 1987), Assemblage - 5 of Sattupalli area (Srivastava & Jha 1994) and Palynozone - 8 of Budharam Area (Srivastava & Jha 1995) of Godavari Graben. Palynoassemblage -II of Bottapagudem area (Jha 2004), Palynoassemblage - III of Mailaram area in bore core GAM-3 and GAM-7 (Jha & Aggarwal 2012), Palynoassemblage - III of bore core MGK-6 from Kachinapalli area (Aggarwal & Jha 2013) and Palynoassemblage - I of MGP-4 of Gauridevipet area (Jha et al. 2014) also compares well with the present palynoassemblage. Hence, Palynoassemblage - II is comparable to striate bisaccate + *Densipollenites* assemblage of Godavari Graben (Jha 2006) and belongs to Late Permian Raniganj Formation. *Densipollenites* assemblage is well known from other Gondwana basins of India viz., Damodar Basin (Bharadwaj & Tiwari 1977, Bharadwaj et al. 1979, Tiwari & Singh 1983, Tiwari & Tripathi 1992), Rajmahal Basin (Tiwari & Tripathi 1984), Son Valley (Tiwari & Ram-Awatar 1989), Mahanadi Basin (Tiwari et al. 1991, Tripathi 1997), Satpura Basin (Bharadwaj et al. 1978) and Kamptee Coalfield

(Srivastava & Bhattacharya 1996). This palynoassemblage corresponds to *Striatopodocarpites-Densipollenites* Assemblage Zone (Zone Vc) or *Densipollenites magnicarpus* Assemblage Zone described by Tiwari and Tripathi (1992).

In Lower Gondwana palynological succession, striate bisaccates show fairly good representation in lower Barakar, attain dominance in upper Barakar and remain dominant component of palynoflora up to Raniganj Formation. Striate bisaccates chiefly *Striatopodocarpites* spp. and *Faunipollenites* spp. are the chief components of the late Permian palynoassemblages in all the Gondwana basins of India (Jha 2006) and are the long ranging palynotaxa. Thus, these striate bisaccates loose stratigraphic significance and the associated taxa become more important while identifying the assemblages. The dominance of striate bisaccates in association with some stratigraphically significant taxa viz., *Falcisporites*, *Chordasporites*, *Klausipollenites*, *Strotersporites* in both the assemblages, distinguishes it from early Permian palynoassemblages. Hence, Palynoassemblage I and II represent late Raniganj equivalent palynoassemblages and late Permian age has been assigned to the studied sequence in bore core MSP-21 from Sattupalli area.

## CONCLUSION

- Two palynoassemblages belonging to Raniganj Formation have been recorded in the present bore core MSP-21.
- The presence of Raniganj palynoflora has been demarcated in lithologically designated Kamthi Formation. Late Permian age has been assigned to the studied sequence.
- The present palynological study further confirms the presence of Raniganj equivalent sediments in Sattupalli area of Chintalapudi sub-basin.
- It is suggested that stratigraphy of the Chintalapudi sub-basin should be revised on the basis of palynological and lithological evidence.
- Present data further revalidates the findings of Jha and Srivastava (1996) that in Godavari Graben,

Lower Kamthi sequence (*sensu* Raja Rao 1982) represents Raniganj equivalent sediments of late Permian age.

### ACKNOWLEDGEMENTS

Authors are thankful to Prof. Sunil Bajpai, Director, Birbal Sahni Institute of Palaeobotany, Lucknow for providing necessary facilities to carry out the research work and to publish the paper. We are also thankful to Sri. M. Basavachari, Chief General Manager, Singareni Collieries Company Ltd. (SCCL) for permitting to collect the samples, providing necessary details and facilities during the field visit. Thanks are also due to the authorities of Mineral Exploration Corporation Limited (MECL) for providing the bore core samples.

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