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Early and Late Permian palynoflora from Lower Gondwana sediments of Gundala area, Godavari Graben, Andhra Pradesh, India

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ABSTRACT

Jha N & Aggarwal N 2010. Early and Late Permian palynoflora from Lower Gondwana sediments of Gundala area, Godavari Graben, Andhra Pradesh, India. The Palaeobotanist 59(1-3) : 71-80.

Palynological investigations in 377 m deep subsurface sediments of Bore core MLG-28 from Gundala area of Lingala-Koyagudem coal belt, Godavari Graben, Andhra Pradesh have revealed three distinctly identifiable palynoassemblages related to Early Permian (Karharbari and Barakar formations) and Late Permian (Raniganj Formation). Palynoassemblage-I showing dominance of *Parasaccites* alongwith high percentage of *Scheuringipollenites* and *Callumispora* belongs to Upper Karharbari. Palynoassemblage-II having dominance of nonstriate disaccates chiefly *Scheuringipollenites* indicates Lower Barakar affinity while Palynoassemblages-III characterised by dominance of striate disaccates along with the occurrence of some stratigraphically significant taxa, *viz. Kamthisaccites, Lunatisporites, Falcisporites, Hamiapollenites*, *Guttulapollenites, Lundbladispora* and *Weylandites* indicates the Late Permian (Raniganj) age. Raniganj palynoflora has been demarcated in lithologically designated Barren Measures Formation. This is the first report of Late Permian (Raniganj) palynoflora from Gundala area.

Key-words—Permian, Lower Gondwana, Karharbari, Barakar, Raniganj, Gundala, Godavari Graben.

भारत में आंध्र प्रदेश की गोदावरी द्रोणिका के गुण्डाला क्षेत्र के निम्न गोंडवाना अवसादों से प्राप्त प्रारंभिक एवं अंतिम पर्मियन परागाणु वनस्पतिजात

नीरजा झा एवं नेहा अग्रवाल

सारांश

आंध्र प्रदेश में गोदावरी द्रोणिका के लिंगला-कोयागुडेम कोयलाबेल्ट के गुण्डाला क्षेत्र से प्राप्त वेध-क्रोड एम.एल.जी.-28 के 377 मी. गहरे उपपृष्ठीय अवसादों में परागाणविक अन्वेषण से प्रारंभिक पर्मियन (करहरबारी एवं बराकार शैलसमूह) एवं अंतिम पर्मियन (रानीगंज शैलसमूह) से संबंधित तीन सुस्पष्ट रूप से परागाणु समुच्चय पाए गए हैं। परागाणु समुच्चय-I उपरि करहरबारी से संबंधित *पैरासेक्साइटीज* के साथ-साथ *श्यूरिंगीपोलेनाइटीज* एवं *केलुमीस्पोरा* की प्रतिशतता की प्रमुखता प्रदर्शित हो रही है। परागाणु समुच्चय-II में अरेखित द्विसपुटी मुख्य रूप से *श्यूरिंगीपोलेनाइटीज* की प्रमुखता होने से निम्न बराकार की सहसंबंधता का संकेत मिलता है जबकि परागाणु समुच्चय-III में कुछ रेखित सपुटियों के साथ-साथ कुछ स्तरिकी रूप से मुख्य वर्गकों अर्थात् *कामथीसेक्साइटीज, लुनाटीस्पोराइटीज, फॉल्सीस्पोराइटीज, हेमियापोलेनाइटीज, गुट्टुलापोलेनाइटीज, लुंडब्लेडीस्पोरा,* एवं *वेलेंडाइटीज*

की उपस्थिति प्रमुखता से लक्षणित होने से अंतिम पर्मियन (रानीगंज) आयु का संकेत मिलता है। रानीगंज परागाणुवनस्पतिजात को अश्मविज्ञान संबंधी रूप से नामित अनुत्पादक शैल-संस्तर शैलसमूह में सीमांकन किया गया है। गुण्डाला क्षेत्र से अंतिम पर्मियन (रानीगंज) परागाणुवनस्पतिजात की यह प्रथम रिपोर्ट है।

संकेत-शब्द—पर्मियन, निम्न गोंडवाना, करहरबारी, बराकार, रानीगंज, गुण्डाला, गोदावरी द्रोणिका।

INTRODUCTION

GODAVARI Graben, only coal producing area in south India is one of the biggest Gondwana basins in India. In this Graben the Lower Gondwana sediments are exposed along the eastern and the western margins of the basin while the upper Gondwana sediments cover only the central/axial portion. About 15 coal belts have been identified in this Graben, out of these Lingala-Koyagudem coal belt has been undertaken for the present study. Long unbroken stretch of Lower Gondwana sediments, formed between Lingala in the north west to Koyagudem in the southeast over a length of 50 km on the western margin of Godavari sub-basin, is known as Lingala-Koyagudem coal belt. Structurally, the Lingala-Koyagudem coal belt is traversed by a number of strike and transverse faults as a result of which the successive formations are repeated or omitted. Palynological investigation of the sediments from Gundala area has been undertaken for the present work for dating and correlation of coal bearing horizons.

GEOLOGY

The Gundala Block lies in central part of Lingala-Koyagudem coal belt on the south western margin of Godavari sub basin, with a strike length of 12 km and average width of 6 km. It is bounded by latitudes 17°52'33" N to 17°58'56" N and longitudes 80°17'35" E to 80°22'36" E and covers an area about 60 sq km (Fig. 1). Mainly Barakar and Kamthi (*sensu* Raja Rao, 1982) formations are exposed in the central

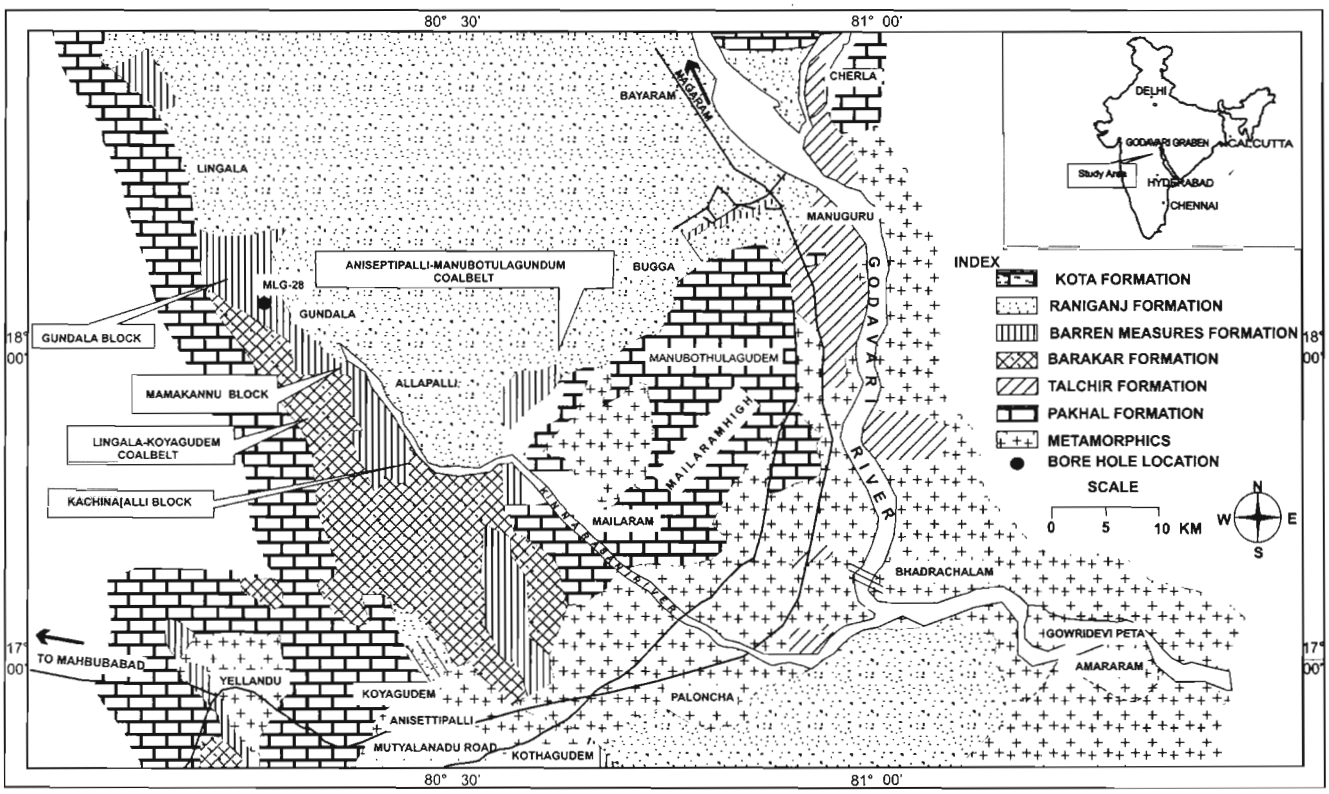

Fig. 1—Map of Gundala area, Godavari Graben showing location of Bore core MLG-28 (after MECL).

Sample nos.	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**
Genera/depth	377	374	317.5	283	275.5	204	185.5	144	128.6	18
Brevitriletes		2.4%	0.8%							
Microfoveolatispora	1.5%	1.6%								
Microbaculispora	0.5%									
Indotriradites	1%	0.8%								
Callumispora	20.5%	1.6%								1%
Striomonosaccites										0.5%
Divarisaccus		1.6%								
Parasaccites	6%	52%	1.6%		4.5%		1	1%	2%	1%
Kamthisaccites				B			1			0.5%
Plicatipollenites		2.4%			1.5%					0.5%
Potonieisporites			1.6%	A						
Caheniasaccites			0.8%	R	0.5%					
Crucisaccites	0.5%	0.8%								
Sahnites		0.8%		R	1.5%				3%	5%
Vestigisporites			1.6%		0.5%					
Scheuringipollenites	37.5%	12%	47.2%	E	47.5%	1	21	7%	32%	15%
Ibisporites	6%				2.5%		1	1.5%	2%	
Platysaccus	1%	0.8%	11.2%	N	8.5%		1		4%	
Falcisporites									1%	3.5%
Primuspollenites			1.6%		2.5%					0.5%
Crescentipollenites		0.8%			2%		3	0.5%	3%	4%
Strotersporites		2.4%					1	2%		5.5%
Striatopodocarpites	4%	3.2%	5.6%		15%		23	47%	38%	36.5%
Faunipollenites	18.5%	10.4%	4.8%		10.5%	1	15	35%	13%	15.5%
Striasulcites								0.5%		0.5%
Striatites	0.5%				0.5%		1	3%	1%	0.5%
Lunatisporites								1.5%		7%
Hamiapollenites							1			1%
Guttulapollenites										1.5%
Latosporites			1.6%							
Tiwariasporis	0.5%	5.6%	0.8%							0.5%
Weylandites								1%		
Quadrisporites	0.5%									
Inaperturopollenites	1.5%	0.8%			2%					

Fig. 2—Table showing the percentage frequencies of various palynotaxa in different samples of Bore core MLG-28.

part of Lingala-Koyagudem coal belt. Talchir Formation is exposed in the northwestern part of the Gundala Block while, Barakar is in the central part of the block. Kamthi Formation forming hillocks in the dip side is exposed in the southwestern part. Lithologically, Talchir Formation is represented by fine-grained sandstone, shales and tillites, Barakar Formation consists of grey and light brown medium to coarse grained sandstone, shales and coal seams while Kamthi Formation (*sensu* Raja Rao, 1982) is represented by medium to coarse grained ferruginous sandstones with few inter bedded thin coal seams (after SCCL). This coal bearing member of Kamthi Formation is designated as Raniganj Formation (Jha & Srivastava, 1996; Srivastava & Jha 1997). Barakar beds having a thickness of 17-150 m considered by the Geological Survey of India as Barren Measures Formation may be of the Lower Kamthi (Saleem, 2004).

MATERIAL AND METHODS

Palynofossils were recovered from the sediments by usual maceration technique. About 5-7 gm of the material from each sample was first treated with conc. hydrofluoric acid for 2-3 days and then with commercial nitric acid for 3-4 days followed by treatment with 10% potassium hydroxide after thorough washing with water. The macerates were then mounted in canada balsam and slides were prepared. Palynomorphs were identified and counted from each sample at generic level. Counting of the pollen and spores was done under BX61 Olympus microscope. All nicely preserved stratigraphically significant palynomorphs were photographed with the help of DP25 Camera.

PALYNOLOGICAL ANALYSIS

Out of the ten samples analyzed from Bore core MLG-28 for palynological studies, seven samples have yielded sufficient palynomorphs for quantitative analysis, in one sample, i.e. sample no. 4 (depth 185.50 m) the yield is poor while in sample no. 5 (depth 204 m) miospores were very rare and sample no. 7 (depth 283 m) was devoid of palynofossils (Fig. 2). Nicely preserved stratigraphically significant taxa have been shown in Pl. 1 & 2.

Details of samples, depth range and composition of assemblages in Bore core MLG-28 have been depicted in Fig. 3. The palynoassemblages present in this bore core of Gundala Block comprises diversified forms of trilete, monosaccate, disaccate, and alete genera. These palynoassemblages have been assigned to thirty five genera representing dominant, subdominant and rare elements. On the basis of qualitative and quantitative distribution of various genera three palynoassemblages have been distinguished. Vertical distribution of various palynotaxa recovered in samples of Bore core MLG-28 have been shown in Fig. 4.

Palynoassemblage-I

This palynoassemblage marked at the depth of 377-374 m (sample nos. 10, 9) shows the dominance of *Parasaccites* (6-52%) alongwith *Scheuringipollenites* (12-37.5%) and *Callumispora* (1.6-20.5%). Other taxa present in this assemblage are trilete *Brevitriletes* (2.4%), *Microfoveolatispora* (1.5-1.6%), *Indotriradites* (0.8-1%), *Microbaculispora* (0.5%); monosaccates *Plicatipollenites* (2.4%),

PLATE 1

Early Permian palynotaxa in Bore core MLG-28, Gundala area, Godavari Graben.

1. *Callumispora*, B.S.I.P. Slide No. 13939, N63.
2. *Microbaculispora*, B.S.I.P. Slide No. 13939, N70.
3. *Crucisaccites*, B.S.I.P. Slide No. 13940, H55.
4. *Faunipollenites*, B.S.I.P. Slide No. 13940, O42.
5. *Indotriradites*, B.S.I.P. Slide No. 13940, S35-3.
6. *Plicatipollenites*, B.S.I.P. Slide No. 13941, L49-3.
7. *Tiwariasporis*, B.S.I.P. Slide No. 13942, O56-2.
8. *Scheuringipollenites*, B.S.I.P. Slide No. 13943, F46-2.
9. *Striatites*, B.S.I.P. Slide No. 13945, J64-1.
10. *Vestigisporites*, B.S.I.P. Slide No. 13944, T32-1.
11. *Caheniasaccites*, B.S.I.P. Slide No. 13946, Q58-4.
12. *Lophotriletes*, B.S.I.P. Slide No. 13947, H49-2.
13. *Striatopodocarpites*, B.S.I.P. Slide No. 13947, G66-3.
14. *Quadrisporites*, B.S.I.P. Slide No. 13939, G50-3.
15. *Parasaccites*, B.S.I.P. Slide No. 13949, P36-2.

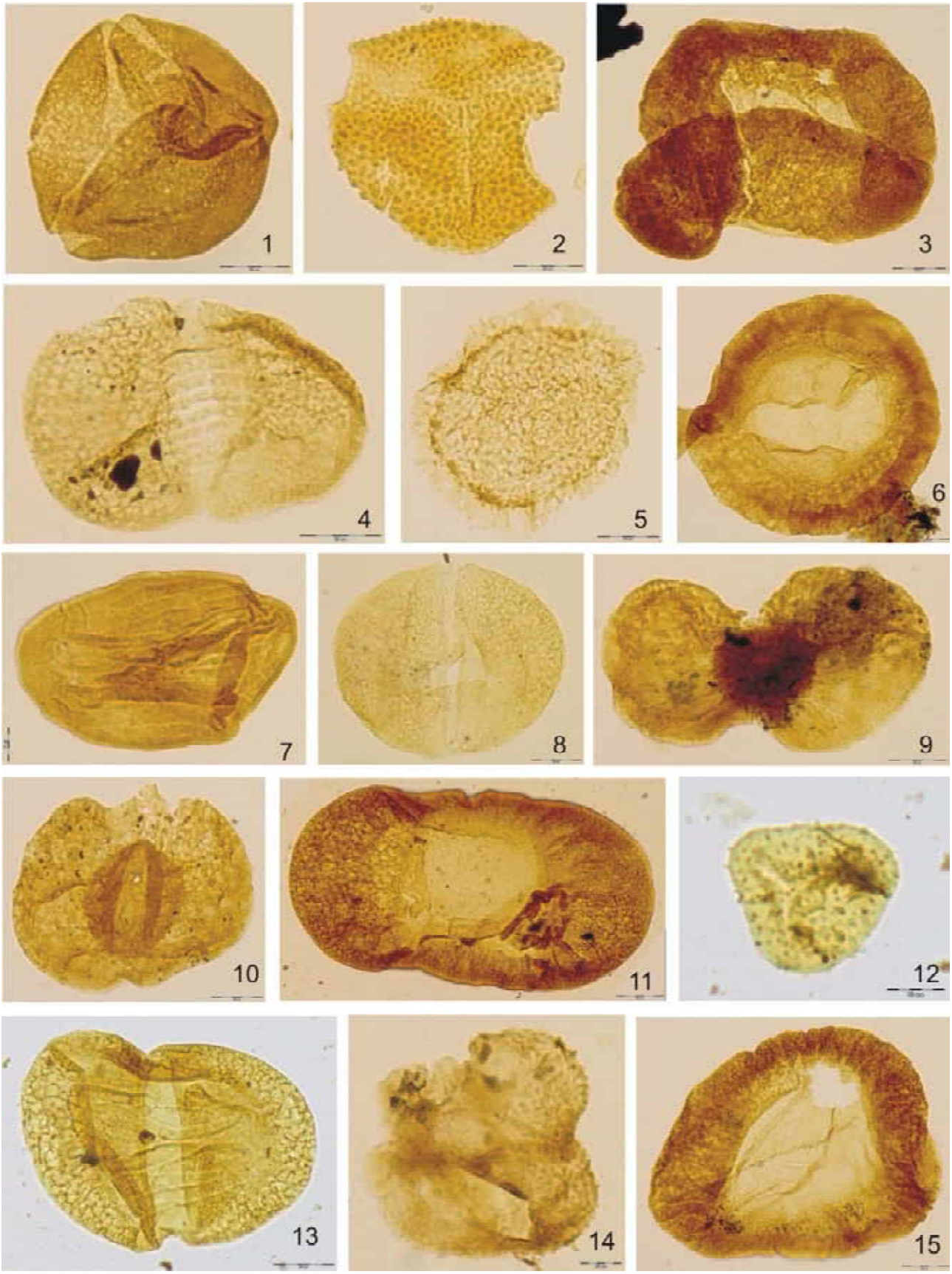

PLATE 1

S.N.	Depth (m)	Lithology	Dominant	Subdominant	Significant forms	Palynoflora	Age
1	18	Carbonaceous streak in sandstone	*Striatopodocarpites, Faunipollenites*	*Scheuringipollenites*	*Kamthisaccites, Lunatisporites, Falcisporites, Hamiapollenites, Guttulapollenites, Lundbladispora*	Raniganj	LATE PERMIAN
2	128.50	Coal streak in greenish sandstone	*Striatopodocarpites, Faunipollenites*	*Scheuringipollenites*	*Falcisporites*		
3	144	Coal streak in greenish sandstone	*Striatopodocarpites, Faunipollenites*	--------	*Lunatisporites, Striasulcites, Weylandites*		
4	185	Coal streak in greenish sandstone	Yield is poor but *Striatopodocarpites* and *Faunipollenites* are dominating palynomorphs	*Scheuringipollenites*	*Hamiapollenites, Kamthisaccites*		
5	204	Greenish grey shale	Very rare spore and pollen	--------	--------		
6	275.70	Greenish grey shale	*Scheuringipollenites*	*Striatopodocarpites, Faunipollenites*	*Ibisporites*	Barakar	EARLY PERMIAN
7	283	Greenish grey shale	Non yielding sample	--------	--------		
8	317.50	Carbonaceous shale	*Scheuringipollenites*	*Platysaccus*			
9	374	Carbonaceous shale	*Parasaccites*	*Scheuringipollenites*	*Striatopodocarpites, Faunipollenites, Crescentipollenites, Strotersporites*	Upper Karharbari	
10	377	Carbonaceous shale	*Scheuringipollenites, Callumispora*	*Faunipollenites*	*Striatopodocarpites, Striatites, Crucisaccites,*		

Fig. 3—Table showing details of samples, limits and characters of palynoassemblages in Bore core MLG-28.

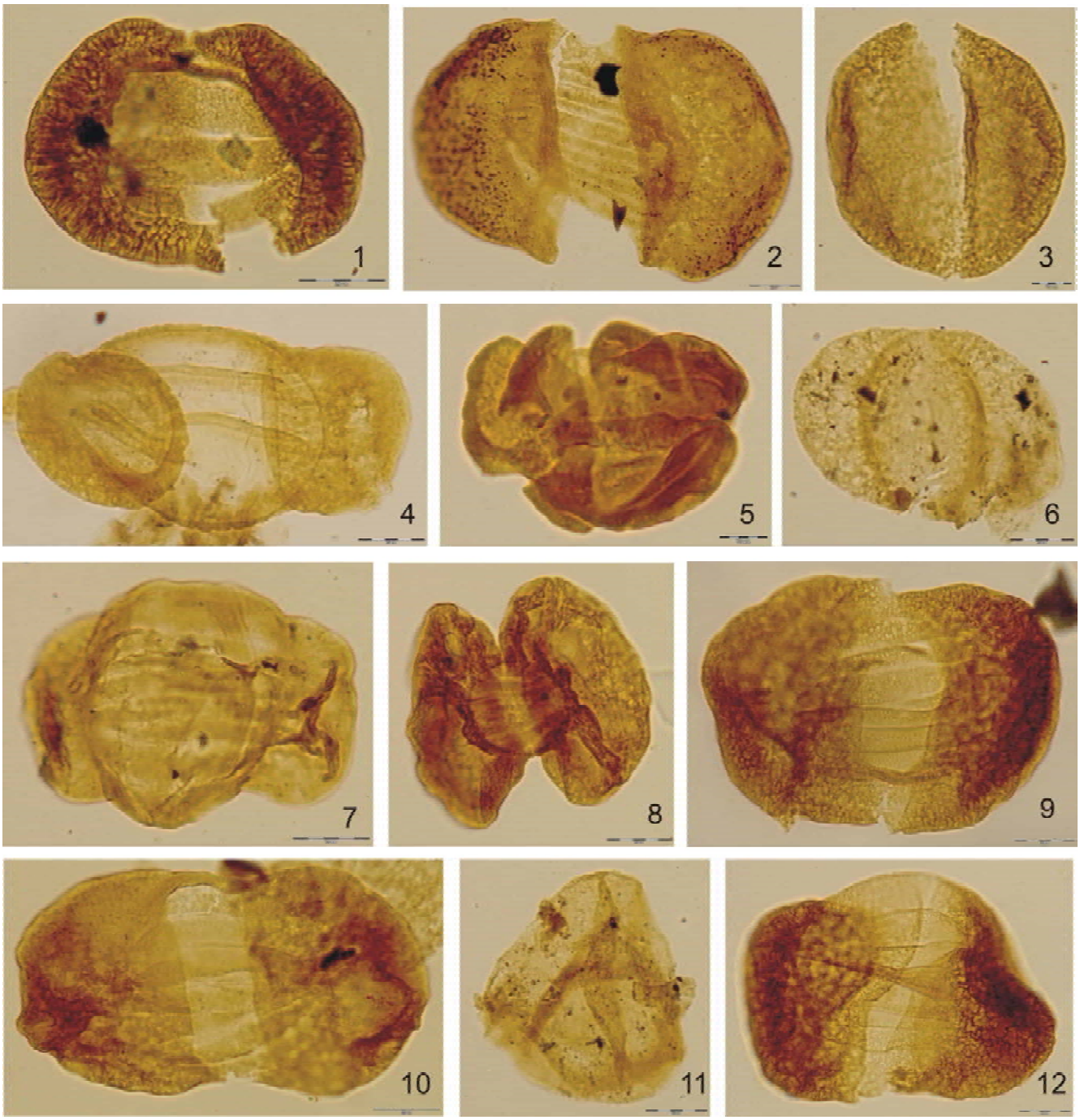

PLATE 2

Late Permian palynotaxa identified in Bore core MLG-28, Gundala area, Godavari Graben.

1. *Kamthisaccites*, B.S.I.P. Slide No. 13950, F63-2.
2. *Crescentipollenites*, B.S.I.P. Slide No. 13950, Q46-4.
3. *Scheuringipollenites*, B.S.I.P. Slide No. 13950, F63-1.
4. *Striatopodocarpites*, B.S.I.P. Slide No. 13951, U51-1.
5. *Guttulapollenites*, B.S.I.P. Slide No. 13951, K35-3.
6. *Falcisporites*, B.S.I.P. Slide No. 13952, P58-2.
7. *Hamiapollenites*, B.S.I.P. Slide No. 13952, Q38-1.
8. *Striatites*, B.S.I.P. Slide No. 13954, J45-4.
9. *Lunatisporites*, B.S.I.P. Slide No. 13953, S60-4.
10. *Striatopodocarpites*, B.S.I.P. Slide No. 13954, J35-1.
11. *Lundbladispora*, B.S.I.P. Slide No. 13955, F43-1.
12. *Strotersporites*, B.S.I.P. Slide No. 13951, J48-4.

Divarisaccus (1.6%), *Crucisaccites* (0.5-0.8%); nonstriate disaccates *Ibisporites* (6%), *Platysaccus* (0.8-1%), *Sahnites* (0.8%); striate disaccates *Faunipollenites* (10.4-18.5%), *Striatopodocarpites* (3.2-4%), *Strotersporites* (2.4%), *Crescentipollenites* (0.8%), *Striatites* (0.5%); aletes *Tiwariasporis* (0.5-5.6%), *Inaperturopollenites* (0.8-1.5%) and *Quadrisporites* (0.5%).

Palynoassemblage-II

This palynoassemblage marked at the depth of 317.50 and 275.50 m (sample nos. 8, 6) is characterised by the dominance of *Scheuringipollenites* (47.2-47.5%) alongwith other nonstriate disaccates, *viz. Platysaccus* (8.5-11.2%) and *Ibisporites* (2.5%). Associated monosaccate taxa, *viz. Parasaccites* (1.6-4.5%), *Potonieisporites* (1.6%), *Plicatipollenites* (1.5%), *Caheniasaccites* (0.5-0.8%); striate disaccates, *viz. Striatopodocarpites* (5.6-15%), *Faunipollenites* (4.8-10.5%), *Crescentipollenites* (2%) and *Striatites* (0.5%) are present in this palynoassemblage. Other associated taxa include *Inaperturopollenites* (2%), *Latosporites* (1.6%), *Tiwariasporis* (0.8%), *Brevitriletes* (0.8%), *Vestigisporites* (0.5-1.6%), *Sahnites* (1.5%) and *Primuspollenites* (1.6-2.5%).

Palynoassemblage-III

Palynoassemblage-III marked at the depth level of 144-18 m (sample nos. 3-1) in Bore core MLG-28 registers a change in composition, with remarkable dominance of striate disaccates, *viz. Striatopodocarpites* (36.5-47%) and *Faunipollenites* (13-35%), other striate disaccates present in the assemblage include *Crescentipollenites* (0.5-4%), *Striatites* (0.5-3%), *Verticipollenites* (1%), *Strotersporites* (2-5.5%) and *Striasulcites* (0.5%). Nonstriate disaccates present in the assemblage are *Scheuringipollenites* (7-32%), *Ibisporites* (1.5-2%), *Platysaccus* (4%), *Falcisporites* (3.5%) and *Primuspollenites* (0.5%). Monosaccates are represented by *Striomonosaccites* (0.5%), *Parasaccites* (1-2%) and *Plicatipollenites* (0.5%). Taeniate pollen grains, *viz. Lunatisporites* (1.5-7%), *Kamthisaccites* (0.5%), *Guttulapollenites* (1.5%) and *Hamiapollenites* (1%); triletes spores, *viz. Callumispora* (1%), *Lundbladispora* (0.5%) and other taxa, *viz. Weylandites* (1%), *Sahnites* (3-5%) and *Tiwariasporis* (0.5%) have also been recorded.

DISCUSSION

Occurrence of *Parasaccites* in high percentage in association with *Scheuringipollenites* and presence of *Crucisaccites* in Palynoassemblage-I (depth 377-374 m) indicates Upper Karharbari affinity (Early Permian). This palynoassemblage resembles with the Upper Karharbari palynoflora of Godavari as well as other basins in India (Tiwari, 1973; Bharadwaj & Srivastava, 1973; Srivastava & Jha, 1992; Srivastava & Jha, 1993; Srivastava & Jha, 1996; Bhattacharrya, 1997; Jha *et al.*, 2007) in this regard. But occurrence of high percentage of striate disaccates in the present assemblage indicates that this may be Upper Karharbari-Lower Barakar transition zone.

Percentage of monosaccates is reduced in Palynoassemblage-II. Presence of nonstriate disaccates, *viz. Scheuringipollenites* and *Platysaccus* in high percentage alongwith striate disaccates in Palynoassemblage-II (depth 317.50 and 275.50 m) suggests the Lower Barakar affinity (Early Permian). This palynoassemblage compares well with Lower Barakar palynoflora of Godavari as well as other basins in India (Bharadwaj & Srivastava, 1973; Tiwari, 1973; Srivastava, 1973; Bharadwaj *et al.*, 1974; Tiwari *et al.*, 1981; Srivastava & Jha, 1992a, b, 1995, 1996). All these assemblages are accommodated under *Scheuringipollenites barakarensis* assemblage zone (Tiwari & Tripathi, 1992).

In Lower Gondwana palynofloral succession striate disaccates show fairly good representation in Lower Barakar, attain dominance in Upper Barakar and remain dominant component of palynoflora up to the Raniganj Formation. Thus, the striate disaccates loose the stratigraphic significance and the associated taxa become important while identifying the assemblages.

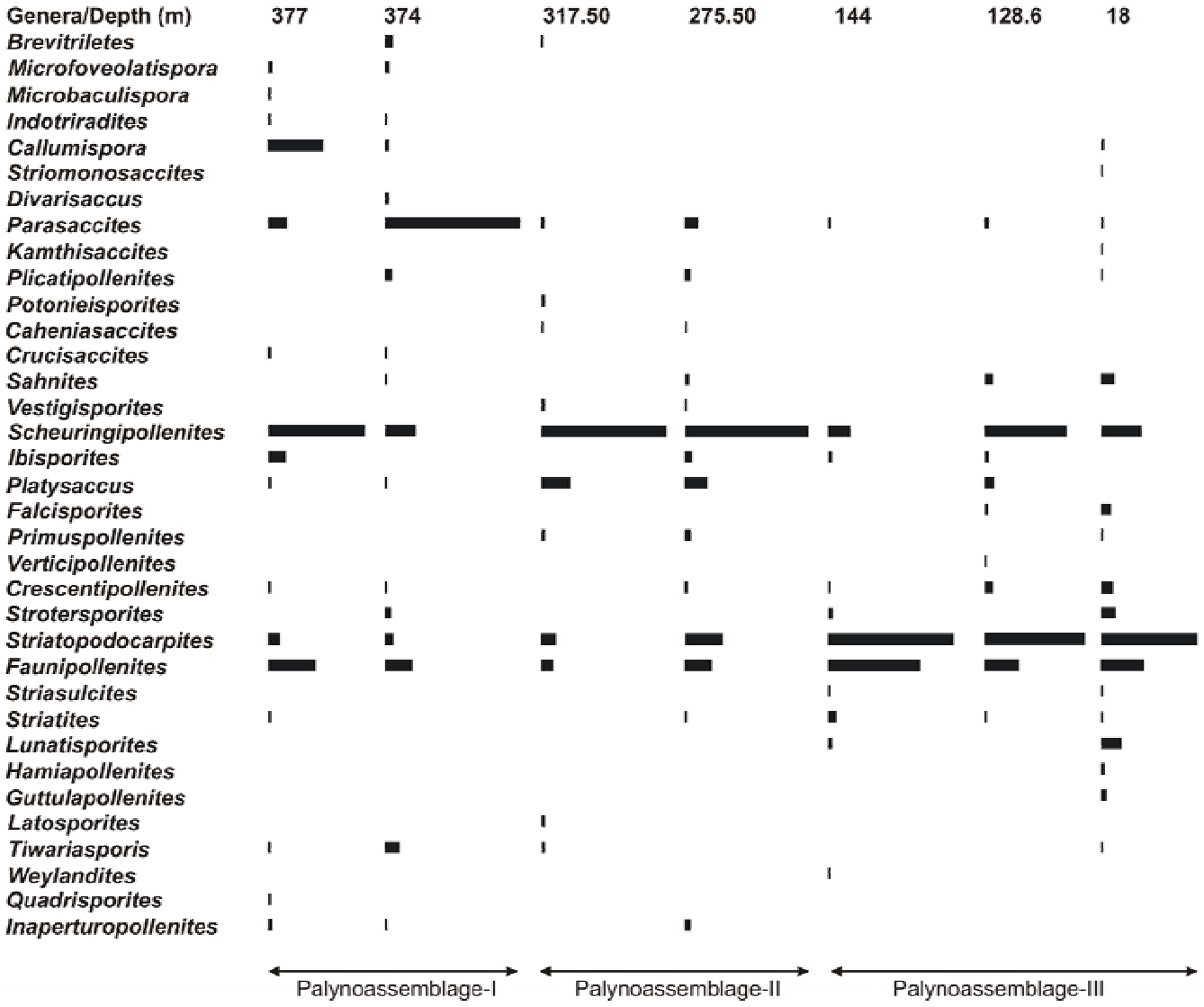

Fig. 4—Histogram showing the vertical distribution of various taxa in Bore core MLG-28, Gundala area.

Dominance of striate disaccates in association with some stratigraphically important taxa, *viz. Lunatisporites* (1.5-7%), *Kamthisaccites* (0.5%), *Falcisporites* (3.5%), *Hamiapollenites* (1%), *Guttulapollenites* (1.5%), *Lundbladispora* (0.5%) and *Weylandites* (1%) is significant in Palynoassemblage-III. Presence of above mentioned younger taxa distinguishes it from Early Permian palynoassemblages. Hence, this palynoassemblage represents Late Permian Raniganj equivalent palynoassemblage in Bore core MLG-28 from Gundala area.

The yield of palynomorphs in sample no. 5 is very poor so nothing can be concluded but spore pollen content in carbonaceous streaks in greenish sandstone at 185.50 m (sample no. 4) is low and whatever spore pollen are present they indicates Raniganj affinity as evidenced by presence of maximum number of striate disaccates alongwith *Crescentipollenites, Strotersporites* and taeniate pollen, *viz. Kamthisaccites* and *Hamiapollenites.* Palynoassemblage-III (depth 18-144 m) of this investigation is akin to the Assemblage-I of Chelpur area (Srivastava & Jha, 1986), Assemblage-I of Ramagundam area (Bharadwaj *et al.*, 1987),

Palynozone-6 of Ramakrishnapuram (Srivastava & Jha, 1992b), Palynoassemblage-V of Manuguru area (Srivastava & Jha, 1992a), Palynoassemblage-I of Bottapagudem area of Chintalpudi sub basin (Jha, 2004), Palynoassemblage-II of Sohagpur Coalfield (Ram Awatar *et al.*, 2004) and is accommodated well within the *Striatopodocarpites-Faunipollenites* Assemblage-zone of Tiwari and Tripathi (1992).

Hence, palynologically Raniganj Formation has been demarcated in lithologically designated Barren Measures Formation and Karharbari palynoflora has been demarcated in lithologically designated Lower Barakar Formation.

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