PERMIAN PALYNOSTRATIGRAPHY IN RAMAKRISHNAPURAM AREA, GODAVARI GRABEN, ANDHRA PRADESH, INDIA

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Abstract

Palynological investigations of the subsurface Lower Gondwana (Permian) sediments from Ramakrishnapuram Area of Godavari Graben reveal nine distinct palynozones relating to Talchir-Kamthi formations in succession. The present evidences indicate that the Talchir sediments were deposited under fluvio-glacial regime periodically influenced by marine transgressions at the beginning of the sequence. Presence of Karharbari palynoflora has been reported in lower part of Barakar Formation. Recurrence of *Parasaccites* in association with striate disaccate pollen preceding *Corisaccites* and *Guttulapollenites* assemblages at the base of Middle Member of the Kamthi Formation indicates a cooling phase in the upper part of Late Permian in Godavari Graben.

Introduction

The Ramakrishnapuram Area constitutes the major proportion of the Somagudem to Indaram belt in Godavari Graben. It lies north of the Godavari River and south of the Golet-Belampalli belt. There are very few exposures of the Lower Gondwana sediments as the entire sequence is preserved in the subsurface. There are ten coal seams recognised in Somagudem-Indaram belt out of which four coal seams are being worked out in Ramakrishnapuram Area.

The stratigraphical sequence described by Raja Rao (1982) has been followed being the most logical and widely accepted scheme of classification.

The stratigraphical succession described by Raiverman *et al.* (1985) holds good for a part of the Godavari Graben as various formations proposed by them do not correlate to other parts of the graben.

Recently Kutty *et al.* (1988) have redefined the stratigraphical succession of the Kamthi Formation according to which the Lower and Middle Members relate to Infra-Kamthi Formation while the Upper Member have been restricted to the Kamthi Formation.

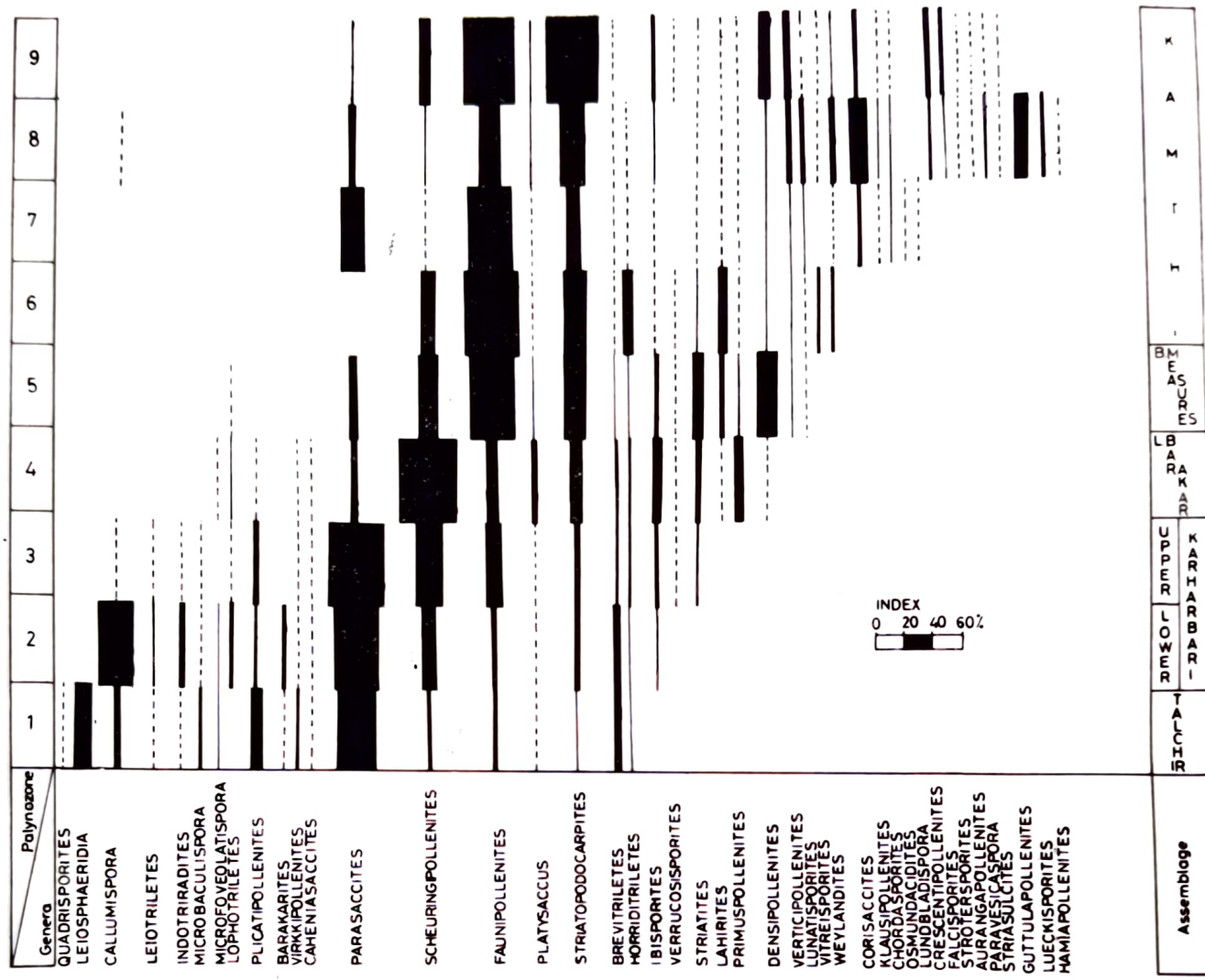
Three bore holes (GRK—1, 24 & 25) from the Ramakrishnapuram Area and one bore hole (GJP—1) from the adjoining Jaipuram Area in the south have been investigated. The results of bore-hole GRK—1 from north of Godavari River have already been published by us (Srivastava & Jha 1989). Bore holes GRK—24 and 25 are located northeast of bore-hole GRK—1. These repesent the entire sequence from Talchir to Kamthi Formation whereas only a part of the Middle Member of the Kamthi Formation has been drilled in bore hole GJP-1. Nine palynozones have been demarcated in these sediments (Histogram 1).

Palynozones

Palynozone 1—The oldest palynozone has been demarcated in bore hole GRK—24 (Table-1). *Leiosphaeridia* (30%) dominates the assemblage between 853.55 to 847.55 m but attains a second place between 830.90—826.65 m. *Parasaccites* (19%), *Plicatipollenites* (13%) and *Vestigisporites* (10%) together form the subdominance at this level but in the overlying sediments *Parasaccites* (62%) rises to its maximum. The overall dominance is marked by radial monosaccate pollen grains (60%). Trilete spores constitute 14 per cent.

The *Parasaccites* dominant zone in bore hole GRK—1 (825-807.45 m) is correlatable to 802.00 m strata in bore hole GRK—24 and shows the decline of *Leiosphaeridia* dominant phase.

The radial monosaccate dominant asso-



Histogram 1—Showing succession of palynozones in Ramakrishnapuram Area, Godavari Graben, Andhra Pradesh.

ciation with *Leiosphaeridia* has been reported by Rawat and Jain (1985) from Pranhita-Godavari Graben having *Botryococcus* and foraminifera, though in the rare amounts. The palynoflora of the Talchir Formation described by Lele (1984) from Penganga Valley also bears resemblance in having similar association. However, the Penganga assemblage shows the dominance of *Potonieisporites* and perhaps represents the oldest palynoassemblage known among the Talchir palynofloras Except *Leiosphaeridia*, there are few acritarch taxa, viz., *Kildinella*, *Origmatosphaeridium*, *Lophosphaeridium*, and *Tasmanites*, which are not present in Palynozone 1 of Ramakrishnapuram Area.

The palynoassemblage from Chingleput Area in Palar Basin (Venkatachala & Rawat, 1973) also shows *Leiosphaeridia* (80%) in association with *Potonieisporites* (6%), *Plicatipollenites* (6%) and *Parasaccites* (4%). The percentage of monosaccate pollen in Chingleput is less but the trend of dominance is similar to that of Penganga Valley assemblage. Palynozone 1 of Ramakrishnapuram Area resembles in respect of *Leiosphaeridia*. Bharadwaj *et al.* (1978a) have described *Leiosphaeridia* (80%) assemblage in association with *Foveofusa* and very few monosaccate pollen from Anjan-Pathapani area in Satpura Basin. In Umaria Marine Bed (Lele & Chandra, 1972) *Foveofusa* is abundant with few *Leiosphaeridia* and monosaccate pollen. The *Parasaccites* dominant assemblage with *Leiosphaeridia* from Manendragarh (Bharadwaj *et al*, 1979; Palynozone 3) is comparable with the present assemblage and shows the decline of leiosphaerids. However,

Table 1—Showing details of samples, limits and characters of assemblages and palynozones in bore core GRK-24

Sample No.	Depth	Lithology	Dominant	Subdominant	Significant Forms	Palynozone	
1	2	3	4	5	6	7	
1.	34.00	Cg. ferruginous Sandstone	Non yielding sample				K
2.	35.95-40.00	Carb. Shale	Striate disaccates *Striatopodocarpites*, *Faunipollenites*	*Scheuringipollenites* *Densipollenites*	*Falcisporites*, *Vitreisporites*, *Chordasporites*, *Klausipollenites*	9	A
3.	54.35	Grey Shale	—	—	—		
4.	72-75.00	Carb. Shale	—	—	—		
4A.	75.40-81.40	Carb. Shale	—	—	—		
5.	85.40-90.40	Green Sst.	Non yielding sample				M
6.	103.65	Cg. Sst. mic.	Non yielding sample				
7.	111-116.00	Carb. Shale	—	—	—		
8.	116-121.40	Sandy Shale	Non yielding sample				
9.	121.40-127.40	Grey Shale	Striate disaccates chiefly *Striatopodocarpites*, *Faunipollenites*	*Corisaccites* *Guttulapollenites*	*Falcisporites*, *Lunatisporites*	8	T
10.	154.40-148.40	Greenish Sandy Shale mic.	Non yielding sample				
11.	160.40-178-40	Green Sandstone	Non yeilding sample				H
12.	210.80	Grey Shale	Striate disaccates chiefly *Faunipollenites*, *Striatopodocarpites*	*Verticipollenites*	*Vitreisporites*, *Weylandites*, *Marsupipollenites*	6	
13-19.	235.40-363.40	Green Sandy Shale+ green Sandstone	Very rare spores and pollen				I

Table 1—(*Contd.*)

1	2	3	4	5	6		7
20.	363.70	Carb. Shale	Striate disccates chiefly *Faunipollenites* and *Striatopodocarpites*	*Densipollenites*			K
21.	385-385.40	Sandy Shale					U
22.	391.40-397.40	Carb. Sandy Shale	—	—	—	5	
23.	442.00-442.63	,,	—	—	—		L
24.	446.40-475.00	Grey Clay	—	—	—		
25-26.	475-505.40	Green Sandstone	Non yielding sample				T
27.	514.75-515.75	Sandy Shale	—	—	—		
28.	516.75-517.19	Green mic. sandstone	Non yielding sample				I
29A.	535.40	Grey Shale	Non yielding sample				
29.	535.40-542.40	Coal+Carb.Shale	*Scheuringipollenites*	*Faunipollenites*, *Striatopodocarpites*, *Parasaccites*	*Indotriradites*		B A
30-31.	558.40-569.40	Carb. Shale+Sst	—	*Horriditriletes*, *Brevitriletes* better represented in sample No. 32	—	4	R
32.	569.40-571.40	Shaly Sandstone	—				A
32A.	594.90-598.40	Coal-Shale	—	—	—		K
33.	607.40	Sandstone	Non yielding sample				A
34.	613.40-622.00	Sandstone	—	—	—		R
35-36.	629-645	Sandstone	Non yielding sample				U P
37.	645.20-649.50	Sandstone	*Parasaccites*	*Scheuringipollenites*	*Faunipollenites*, *Striatopodocarpites*	3	P E R
38-41.	661.30-725.05	Clay+Carb.Shale	Very rare spores and pollen				K A R
42.	743-749	Coal+Shale	—	—	—		H A
43.	749-749.75	Coal	—	—	—		R B

44.	752.75	Coal + Shale	—	—	—		A
45.	755.75	Shale	—	—	—		R
							I
46.	765.15-767.75	Coal	*Callumispora*	*Parasaccites*	*Scheuringipollenites* and few striate disaccates chiefly *Faunipollenites* and *Striatopodocarpites*	LOWER	K
47.	768.15	Fg.Sandstone Laminated	—	—			A
							R
						2	H
							A
48.	771.32	Fg. Sandstone	Non yielding sample	—	—		R
							B
49.	775.5	Coal	—	—	—		A
							R
50-52	775.60-681.55	Sandstone	Non yielding sample				I
53.	802.55	Silty Shale	Radial monosaccates chiefly. *Parasaccites* and *Plicatipollenites*	*Leiosphaeridia* in older sediments (Sample No. 55) *Vestigisporites*	*Virkipollenites*, *Divarisaccus*, *Caheniassacites*, *Callumispora*	1	T
							A
							L
54.	820.65-826.65	Banded Siltstone	—	—	—		C
55.	826.65-830.90	Shale	—	—	—		H
56.	835.55-842.55		Siltstone	—	—		I
57.	847.55-853.55	Banded Shale	*Leiosphaeridia*	*Parasaccites* and *Plicatipollenites*	*Virkkipollenites*, *Caheniasaccites*		R

presence of spinose acritarchs in Manendragarh differentiates it from Ramakrishnapuram Area *Leiosphaeridia* dominant assemblage in association with *Parasaccites* in Barpathar Well No. 1 (Sharma *et al.*, 1986) bears close resemblance with present palynozone.

Palynozone 2—This palynozone has been demarcated in bore hole GRK—24 (775.55-765.15 m) and is characterised by the dominance of *Callumispora* and subdominance of *Parasaccites* *Scheuringipollenites* (10-12%) follows in the order of subdominance while *Faunipollenites* and *Striatopodocarpites* appear in low percentages. Trilete spores are represented by *Brevitriletes* (1-7%), *Horriditriletes* (1%), *Indotriradites* (1-7%) and *Microfoveolatispora* (1-4%). The overall dominance is maintained by trilete spores (36%) followed by monosaccate pollen (30%).

The assemblage shows resemblance with Palynozone—1 from Giridih Coalfield (Srivastava, 1973), Zone-II in North Karanpura Coalfield (Kar, 1973), Zone-I from Pusai Nala in Raniganj Coalfield (Tiwari, 1973) and younger part of Zone 1 in Korba Coalfield (Bharadwaj & Srivastava, 1973). This palynozone represents Lower Karharbari palynoflora.

In bore hole GRK—1 this palynozone occurs between 798.90—795.66 m in a shale underlying the first coal bed above Talchir Formation. This assemblage is also present in coal beds below the King Seam in Kothagudam Area.

Palynozone 3—Parasaccites attains overall dominance once again (29.50%). At this stage *Scheuringipollenites* (18-33%) rises to subdominance differentiating it from Palynozone 1. This assemblage is present between 755.75—645.2 m in bore hole GRK—24 and 676.5 m in bore hole GRK—25 (Text-fig. 1). Palynozone 3 also occurs in bore hole GGK—20 (854—827.25 m) in Ramagundam Area (Srivastava & Jha, 1989). This palynozone represents Upper Karharbari palynoflora. The Assemblage E marked by the association of *Parasaccites* and *Scheuringipollenites* (Srivastava, 1987; King Seam, Yellandu Area) is comparable to Palynozone-3.

Palynozone 3 compares with the Upper Karharbari palynoassemblages of Korba Coalfield (Bharadwaj & Srivastava, 1973; Zone 2), Raniganj Coalfield (Tiwari, 1973; Zone 2) and Pathakhera Coalfield (Sarate, 1986, Zone 1).

Palynozone 4—Scheuringipollenites attains overall dominance in Palynozone 4 in association with *Faunipollenites* and *Striatopodocarpites* representing the Lower Barakar palynoflora. The dominance is maintained by nonstriate disaccate (59%) associated with striate disaccate (20%) pollen grains.

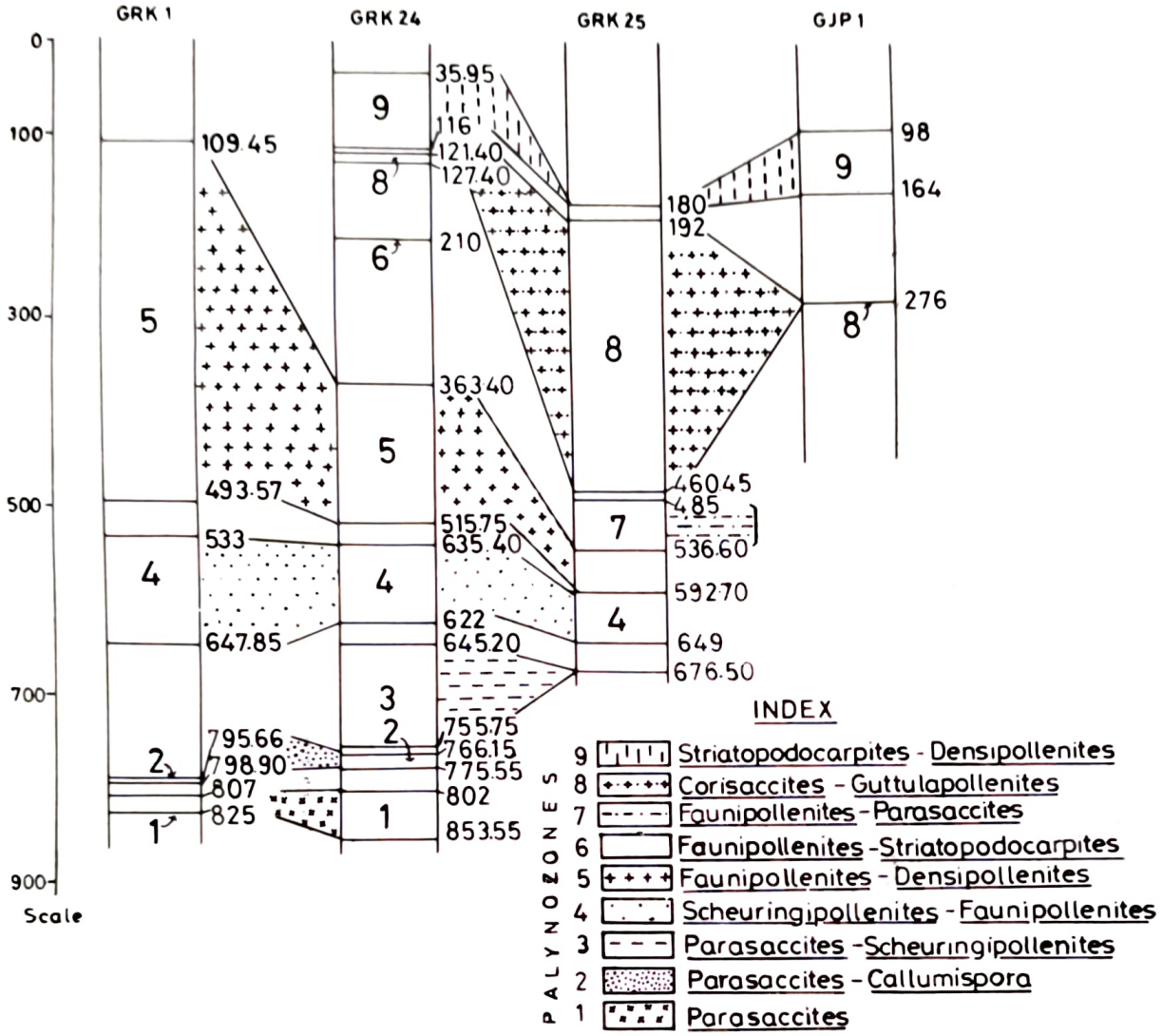
In bore hole GRK—1 this assemblage occurs between 647.85—533.00 m while further northwards in bore hole GRK—24 it occurs between 622-535.40 m and GRK—25 between 649-592.70 m (Table 2). Working coal seams 2-4 in Mandamari area compare palynozone 4. However, they contain *Brevitriletes* in higher percentage in association with *Scheuringipollenites* (Srivastava 1987; Assemblage D) and shows an older aspect. Coal seams 1 and 2 in Ramagundam Area, Top 1 seam in Kothagudam Area also compare favourably. The younger coal seams of Ramakrishnapuram (Coal seam 1) and Mandamari (Coal seams 1 & 2) may possibly correlate to this palynozone.

Palynozone 4 is widely distributed in many other coalfields of peninsular India and is correlatable to Middle Barakar assemblage of Pusai-Shampur Area of Raniganj Coalfield (Tiwari, 1973).

Palynozone 5 - This is present between 493.57-109.45 m in bore-hole GRK—1 and is characterised by the dominance of striate disaccate pollen grains associated with *Densipollenites*. A complete epibole of this genus is present in this bore hole having its maximum (19%) between 150.38—136.66 m (Srivastava & Jha, 1989). The percentage of *Densipollenites* rises further to 39 per cent in GRK—24 (515.75-363.70 m). In bore hole GRK—25 this zone is not well differentiated as the samples have not yielded sufficient spores between 592-536.60 m yet their lithological resemblance with that in bore hole GRK—24 is reasonable. In Ramagundam Area it is present in bore hole GGK—20 between 628.44-215 m.

Palynozone 5 represents the Kulti (Barren Measures) palynoflora in Ramakrishnapuram Area of Godavari Graben and is comparable to the Kulti Formation palynoflora from Jharia Coalfield (Bharadwaj *et al.*, 1965). However, the percentage of *Parasaccites* in Ramakrishnapuram Area is significantly high as compared to several other Gondwana basins in India.

Palynozone 6—The overall dominace of striate disaccate pollen continue in this palynozone but several other forms appear in



Text-fig. 1—Showing correlation of coal-bearing strata in Ramakrishnapuram Area, Godavari Graben, Andhra Pradesh.

low percentages, viz., *Weylandites* (2%), *Marsupipollenites* (1%) and *Vitreisporites* (3%). Palynozone 6 is distributed in bore hole GRK—24 (210.8 m) and resembles Lower Kamthi palynoflora (Srivastava & Jha 1988, Assemblage 1) in Ramagundam Area (bore hole GGK—27), Mailaram Area (Srivastava & Jha, 1990, bore hole GAM—7) and Chelpur Area (Srivastava & Jha, 1987; bore hole GJ—3) of Godavari Graben.

Palynozone 6 resembles Raniganj palynoflora in Damodar Valley coalfields (Bharadwaj *et al.*, 1979; Bharadwaj & Tiwari, 1977) in having dominance of striate disaccate pollen. However, *Indospora* and *Spinosporites* present in Raniganj sediments are absent in Lower Kamthi of Godavari Graben. The palynoflora of Jhingurdah seam, Singrauli Coalfield (Tiwari & Srivastava, 1984) shows closer resemblance in the presence of *Falcisporites*, *Gondisporites*, *Lunatisporites* and *Corisaccites*. The Raniganj palynoflora of Auranga Coalfield (Lele & Srivastava, 1979) contains *Mahudapollenites* and *Mammialetes* which are absent in the bore holes studied here.

Palynozone 7—This palynozone is demarcated in bore hole GRK—25 between 536.60-485 m and is characterised by the dominance of striate disaccate pollen and higher percentage of *Parasaccites*. In addition to these, *Falcisporites* continue to occur in low percentages. *Chordasporites*, *Klausipollenites*, *Osmundacidites*, *Lundbladispora* and *Guttu-*

TABLE 2—Showing details of samples, limits and characters of assemblages and palynozones in bore core GRK-25

Sample No.	Depth	Lithology	Dominant	Sub-dominant	Significant Forms	Palynozone	
1	2	3	4	5	6		7
1-9.	43.10-169.55	Green clay and clayey Shale	Non yielding samples	—	—	9	K
10.	180.55	Grey Clay	*Striatopodocarpites*, *Faunipollenites*	*Scheuringipollenites*	*Densipollenites*, *Lunatisporites*		
11.	187.03-192.05	Clay	Non yielding sample				A
12.	192.00	Carb. Shale	Striate disaccates chiefly *Faunipollenites*, *Striatopodocarpites*	*Corisaccites*, *Guttulapollenites*, *Scheuringipollenites*	*Lunatisporites*, *Densipollenites*, *Hamiapollenites*, *Verticipollenites*, *Crescentipollenites*, *Falcisporites*, *Klausipollenite*, *Chordasporites*, *Vireisporites*, *Kalusipollenites*, *Weylandites*, *Aurangapollenites*, *Striasulcites*	8	
13.201.05-204.05		Grey Shale	Non yeilding sample				M
14.	204.5-207-05	Carb. Shale	—	—			
15.-20	219.05-308.55	Green Shale	Non yielding samples				T
21.	336.05	Grey Shale	—	—	—		
22.	362.50	Carb. Shale	—	—	—		H
23.	386.05	Grey Shale	Non yielding sample				
24.	435.15	Grey Green Shale	Non yielding sample				I
25.	438.50	,,	—	—	—		
26.	439.45-456.95	,,	Non yielding sample				
27.	460.95	,,	—	—	—		
28.	462.95	,,	Non yielding sample				
29-31.	482-496	Grey-Green shale	Striate disaccates chiefly *Faunipollenites*, anb *Striatopodocarpites*	*Parasaccites*, *Scheuringipollenites*	*Chordasporites*, *Corisaccites*, *Lunatisporites*, *Guttulapollenites*, *Klausipollenites*, *Osmundacidites*, *Lundbladispora*	7	K A M T

32.	499.50	,,	Non yielding sample			
33.	529.50-536.50	,,	—	—	—	
34.	582 70	Grey Sandstone	*Striatopodocarpites* and *Faunipollenites*	*Densipollenites*		5 KULTI
35.	592	Carb. Shale	*Scheuringipollenites*	*Faunipollenites* *Striatopodoca. pites*	*Indotriradites*	4 BARAKAR
36.	649.00	Carb. Shale	—	—	—	
37.	670.10	Grey mic. Sst.	Non yielding sample			
38.	676.50	Carb. Shale mic.	*Parasaccites*	*Scheuringipollenites*	*Faunipollenites*, *Striatapodocarpites*	3 UPPER KARHARBARI
39-40.	709.20-754.80	Carb. Shale+ Coal	Non yielding samples			

lapollenites though in rare amount make their appearance at this level.

The occurrence of higher percentage of *Parasaccites* in association with striate disaccate pollen is not known from any other basin in India. In Raniganj Coalfield, *Parasaccites* is persistently present in low percentage in RAD—5 (Tiwari & Singh, 1983) and RNM—2 (Tiwari & Rana, 1984). In Rajmahal Basin similar occurrence is recorded in RJNE—9 (Tripathi, 1986). Srivastava and Jha (1988) recorded *Striatopodocarpites - Parasaccites* Assemblage in bore hole GJ—6 (210.20 m) from Bhopalpalli Area.

Palynozone 8—The striate disaccate pollen continue to occur in dominance while *Corisaccites* and *Guttulapollenites* rise to attain subdominance. *Lueckisporites* (6%), *Lunatisporites* (2%), *Hamiopollenites* (1%) and *Falcisporites* (2%) become persistent.

The Assemblage 4 described by Srivastava and Jha (1988) represents the palynoflora described here in palynozone 8. This palynozone is present in bore hole GRK—24 (121.40-127.00 m) and GRK—25 (460.45-192 m). These two bore holes are located on the same strike continuation, hence, the occurrence of this palynozone in bore hole GRK—25 upto 460.45 m appears doubtful. In Jaipuram Area (bore hole GJP—1) this palynozone is well developed as *Corisaccites* reaches its maximum (33%) at 276 m and is associated with *Guttulapollenites* and *Parasaccites* (Table-3). The latter genus appears to have declined in this palynozone. *Guttulapollenites* and *Corisaccites* also occur in Satpura Basin (Bharadwaj *et al.* 1978b; Bijori Formation). Salujha and Kindra (1984) have further reported a number of trilete spores in Bijori Formation which are not present in Palynozone 8 described here.

Palynozone 9—This is the youngest palynozone (Text-fig. 1) demarcated in bore hole GRK—24 (116.00—35.95 m), GRK—25 (180 m) and GJP—1 (164-98 m). In Palynozone 9, *Densipollenites* rises to subdominance again but the persistent occurrence of *Falcisporites*, *Klausipollenites*, *Vitreisporites*, *Chordasporites* and *Weylandites* differentiates it from Kulti Palynozone 5. Thus the occurrence of *Densipollenites* phase at two different levels is present in the same bore hole, i.e. GRK—24 and GRK—25. Palynozone 9 is also well developed in Ramagundam Area (Bharadwaj *et al.* 1987, GGK—27) where a perfect epibole of *Densipollenites* is recorded. Assemblage 5 described by Srivastava and Jha (1988) shows that this palynozone is widely distributed in Mantheni, Bhopalpalli, Khammampalli, Kamalapur and Manuguru areas of Godavari Graben. In bore hole GJP—1 from Jaipuram Area the presence of *Crescentipollenites* is comparable to that in Damodar Basin (Bharadwaj *et al.*, 1979) and Satpura Basin (Bharadwaj *et al.*, 1978b). In Pali Formation from Son Valley similar occurrence of *Densipollenites* in association with striate disaccate pollen has been described by Tiwari and Ram-Awatar (1986).

Discussion

The Lower Gondwana sedimentation in Ramakrishnapuram area commenced with the deposition of Talchir Formation. The oldest palynozone has been recorded in bore hole GRK-24 between 853.55-826.65 m in which *Leiosphaeridia* dominates (16-30%) the assemblage while the overall dominance of monosaccate pollen in younger sediments at 802.55 m is correlatable with that between 807-825.20 m in bore hole GRK—1. It appears that the sedimentation during Talchir Formation in the early phase was highly influenced by marine incursions.

The Karharbari palynoflora has been demarcated in lithologically undifferentiated Lower Barakar sediments. The Lower Karharbari palynoassemblage is present in bore hole GRK—24(775.60—765.15 m) which contains one coal seam and one coal band. This palynoflora is also present in bore hole GRK—1 (798.90-795.66 m). In both the cases this assemblage occurs in sediments lying above the Talchir Formation. The Upper Karharbari palynoflora is present in bore hole GRK—24 (755 75-645.2 m) and GRK—25 (676.5 m). The sediments between 795.66-647. 85 m in bore hole GRK-1 have not yielded spores which could possibly represent Upper Karharbari sediments. Thus it may be inferred here that the Lower Member of the Barakar Formation in Godavari Graben palynologically represents the Karharbari sediments.

The Lower Barakar palynoflora has been demarcated in all the three bore holes, viz., GRK—1, 24 and 25. These sediments represent the Upper Member of the Barakar Formation designated on lithological characters. The Lower Barakar palynoflora in these bore holes occur in succession above

TABLE 3—Showing details of samples, limits and characters of assemblages and plynozones in bore core GJP-1

Sample No.	Depth	Lithology	Dominant	Sub-dominant	Significant Forms	Palynozones	
1.	98	Sandstone	Striate disaccates chiefly *Faunipollenites* and *Striatopodocarpites*	*Densipollenites*, *Crescentipollenites*	*Vitreisporites*, *Corisaccites*, *Falcisporites*, *Osmundacidites*, *Lunatisporites*, *Verticipollenites*, *Weylandites*, *Klausipollenites*, *Playfordiaspora*	9	K A M T H I
2-3.	140-141	Carbonaceous Shale	Non-yielding samples				
4.	164	Sandstone	—	—	—		
5.	276	Sandstone	*Corisaccites*, *Guttulapollenites*	*Parasaccites* Striate, disaccates chiefly *Faunipollenites*, *Striatopodocarpites*	*Falcisporites*, *Verticipollenites*	8	

the Karharbari palynoflora and these conform the order of palynological as well as lithological succession. The workable Barakar coal seams in Ramakrishnapuram area are accommodated in palynozone 4 of the present investigation.

The Kulti palynozone has been demarcated in bore hole GRK-1 (493.57-109.45 m), GRK—24 (515.75-363.70 m) and GRK—25 (592-536.60 m). This assemblage occurs in regular succession above the Lower Barakar palynozone Thus the absence of Upper Barakar palynozone in these bore holes is singnificant. The strata between Lower Barakar and Kulti palynozones (533-493.57 m) in bore hole GRK-1 is represented by medium to fine grained sandstone and clay. There is a distinct change in lithology at this level which is more closer to the overlying Kulti sediments. This level also shows the end of the coal forming phase in bore hole GRK—1. Similar succession is also present in other two bore holes mentioned above indicating a possible absence of Upper Barakar palynozone in Ramakrishnapuram Area. However, there are no lithological evidence of the absence of Upper Barakar sediments. The Kulti sediments are most developed in bore hole GRK- 1 and their thickness has reduced northwards in bore holes GRK—24 and GRK— 25.

Four palynozones (Palynozones 6 9) have been demarcated in the Kamthi Formation of Ramakrishnapuram Area Palynozone 6 is present in bore hole GRK—24 (210.8 m) and contains coal seam. Its equivalent in bore hole GRK—25 and GRK- 1 (109.45-62.28 m) have not yielded spores. This is the coal-bearing phase of the Kamthi Formation in Godavari Graben and correlates to the Lower Kamthi palynoflora of Ramagundam Area (Bhardwaj *et al.*, 1987) where a thick workable coal seam known as 'Sondila Seam' is developed.

The recurrence of *Parasaccites* in higher percentage in Palynozone-7 at the base of the Middle Member of the Kamthi Formation is another significant record in Ramakrishnapuram Area. This palynozone precedes *Corisaccites* and *Guttulapollenites* (Palynozone 8) and occurs at the end of the coal forming phase. The occurrence of *Parasaccites* dominant phase is known in the Talchir Formation and also the Upper Karharbari sediments. The lithology is distinct in the Middle Member of the Kamthi Formation and association of *Parasaccites* with green sandstone, intercalated shale and clay may suggest a similar cooling of the climate in Godavari Graben. Bharadwaj (1975) suggested the possibility of a third glaciation in India during Early Triassic. However, it appears that a cooling phase subtending glaciation might have been initiated much earlier during Late Permian in Godavari Graben.

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