

# Palynological dating of coal-bearing sediments from the Bottapagudem area, Chintalputi sub-basin, Andhra Pradesh

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## ABSTRACT

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Palynological studies were carried out in bore core MAB-I from the Bottapagudem area of the Beddadanur Block in Chintalputi Sub-Basin in order to date and correlate the coal bearing sediments. Three palynological assemblages have been recognised in 220 m thick sedimentary sequence of this bore hole MAB- I. Assemblage I is characterised by dominance of striate disaccates, chiefly *Striatopodocarpites* and *Faunipollenites*, along with some stratigraphically significant taxa, viz., *Falcisporites*, *Guttulapollenites*, *Chordasporites*, *Osmundacidites*, *Playfordiaspora*, *Klausipollenites*, *Strotersporites* and *Vitreisporites*. Assemblage II is also dominated by striate disaccates, together with *Densipollenites* and rare occurrences of palynotaxa like *Falcisporites*, *Klausipollenites*, *Playfordiaspora*, *Lundbladispota*, *Chordasporites*, *Strotersporites*, *Densosporites* and *Lunatisporites*. Palynoassemblage III is likewise dominated by striate disaccates, with common occurrence of *Crescentipollenites* and less frequent *Falcisporites*, *Chordasporites*, *Klausipollenites* and *Strotersporites*. All three assemblages belong to the Raniganj palynosequence and are of Late Permian age. Raniganj palynoflora has been recorded in lithologically designated Barren Measures sequence between 176-220 m.

**Key-words**—Palynology, Dating, Coal, Gondwana, Late Permian, Raniganj, Godavari Graben.

आंध्र प्रदेश प्रान्त में चिंतलपुड़ी उपद्रोणी के बोट्टापागुडेम क्षेत्र से प्राप्त कोयलाधारी अवसादों का परागाणविक कालनिर्धारण

नीरजा झा

सारांश

चिंतलपुड़ी उपद्रोणी में बेड्डाडानूर खण्ड के बोट्टापागुडेम क्षेत्र से प्राप्त कोयलाधारी अवसादों का कालनिर्धारण तथा सहसंबंधित करने के क्रम में वेध छिद्र एम.ए.बी.1 में परागाणविक अध्ययन पूर्ण किया गया। तीन परागाणविक समुच्चयों को वेध छिद्र एम.ए.बी.1 के 220 मी. मोटी अवसादी अनुक्रम में अभिज्ञात किया गया है। परागाणु समुच्चय प्रथम रेखित द्विसकोषी, मुख्यतः *स्ट्रिएटोपोडोकार्पाइटीज* एवं *फॉनीपोलेनाइटीज* के साथ कुछ स्तरिकी सार्थक वर्गकों, अर्थात् *फॉल्सीस्योराइटीज*, *गुट्टुलापोलेनाइटीज*, *कॉर्डस्योराइटीज*, *ओसमुण्डेसीडाइटीज*, *प्लेफोर्डियास्योरा*, *क्लोसीपोलेनाइटीज*, *स्ट्रोटरस्योराइटीज* एवं *विट्रीस्योराइटीज* की प्रमुखता लक्षणित करता है। परागाणु समुच्चय द्वितीय में *डेन्सीपोलेनाइटीज* के साथ परागाणु वर्गकों जैसे *फॉल्सीस्योराइटीज*, *क्लोसीपोलेनाइटीज*, *प्लेफोर्डियास्योरा*, *लुण्डब्लेडीस्योरा*, *कॉर्डस्योराइटीज*, *स्ट्रोटरस्योराइटीज*, *डेन्सोईस्योराइटीज* एवं *लुनोटीस्योराइटीज* की दुर्लभ प्राप्तियाँ रेखित द्विसकोषी द्वारा भी अभिभावी होता है। परागाणु

समुच्चय तृतीय क्रीसेन्टीपोलेनाइटीज़ की सामान्य प्राप्तियों के साथ तथा फॉल्सीपोलेनाइटीज़, कॉर्डोस्पोराइटीज़, क्लॉसीस्पोराइटीज़ एवं स्ट्रोटरस्पोराइटीज़ का कम बहुल होना, रेखित द्विसकोषी इसी तरह अभिभावी होता है। सभी तीनों परागाणु समुच्चय रानीगंज परागाणु अनुक्रम से संबंधित है तथा इनकी आयु पश्च परमियन है। रानीगंज परागाणु वनस्पतिजात 176-220 मी. के मध्य आशिमकी नामित बैरन मेज़र शैल-संस्तर अनुक्रम में अभिलेख किया गया है।

संकेत-शब्द—परागाणु विज्ञान, कालनिर्धारण, कोयला, गोण्डवाना, पश्च परमियन, रानीगंज, गोदावरी द्रोणिका।

## INTRODUCTION

**T**HE Chintalpudi sub-basin, extending from Zangareddygudem in the east to Chintalpudi in the west, represents the south-easterly continuation of the Kothagudem sub-basin. The Lower Gondwana sediments representing Talchir, Barakar, Barren Measures and Raniganj formations are well developed in the Godavari and Kothagudem sub-basins but the stratigraphic sequence of the Chintalpudi sub-basin remains debatable as the thickness of Barren Measures is much reduced in this area. This renders identification of the Barakar and Raniganj coal measures a difficult task. The Chintalpudi sub-basin is supposed to consist mainly of the Kamthi Formation (Raja Rao, 1982) except the localised occurrences of the Talchir Formation in the Chintalpudi area and the Barakar Formation in the Beddadanur and Ayanapalli areas. Lakshminarayana and Murty (1990) have described the stratigraphy of the Gondwana Sequence in the Chintalpudi sub-basin and considered that the Barakar Formation is unconformably overlain by Upper Member of Kamthi

Formation (*sensu* Raja Rao, 1982). Thus, a considerable gap in stratigraphic sequence is evident.

Palynological studies have been carried out in many bore cores from this sub-basin viz., GAG-1 from Ayanapalli area (Srivastava & Jha, 1993), GCH-4 from Chintalpudi area (Srivastava & Jha, 1994), GSS-1, GS-1, GS-2, GS-3 and GS-4 from Sattupalli area (Srivastava & Jha, 1994), GC-17 from Krishnavaram area (Srivastava *et al.*, 1997) and SGG-1 from Gattugudem area (Jha, 2002). All these bore cores are from the western margin of the sub-basin except SGG-1 which is from the central part. The present bore core MAB-1 drilled by Mineral Exploration Corporation of India is located on the eastern margin of Chintalpudi sub-basin (Fig. 1, after G.S.I.) at Bottapagudem. Palynological investigation has been undertaken on these sediments in order to date and correlate them since no such data exists from this area.

In bore core MAB-1 all the Lower Gondwana sequences, viz., Talchir, Barakar, Barren Measures and Kamthi, are recognised lithologically. The bore core was closed at 429.60 m within the Talchir Formation. The sedimentary sequence in the upper part of the bore core MAB-1 consists of fine to

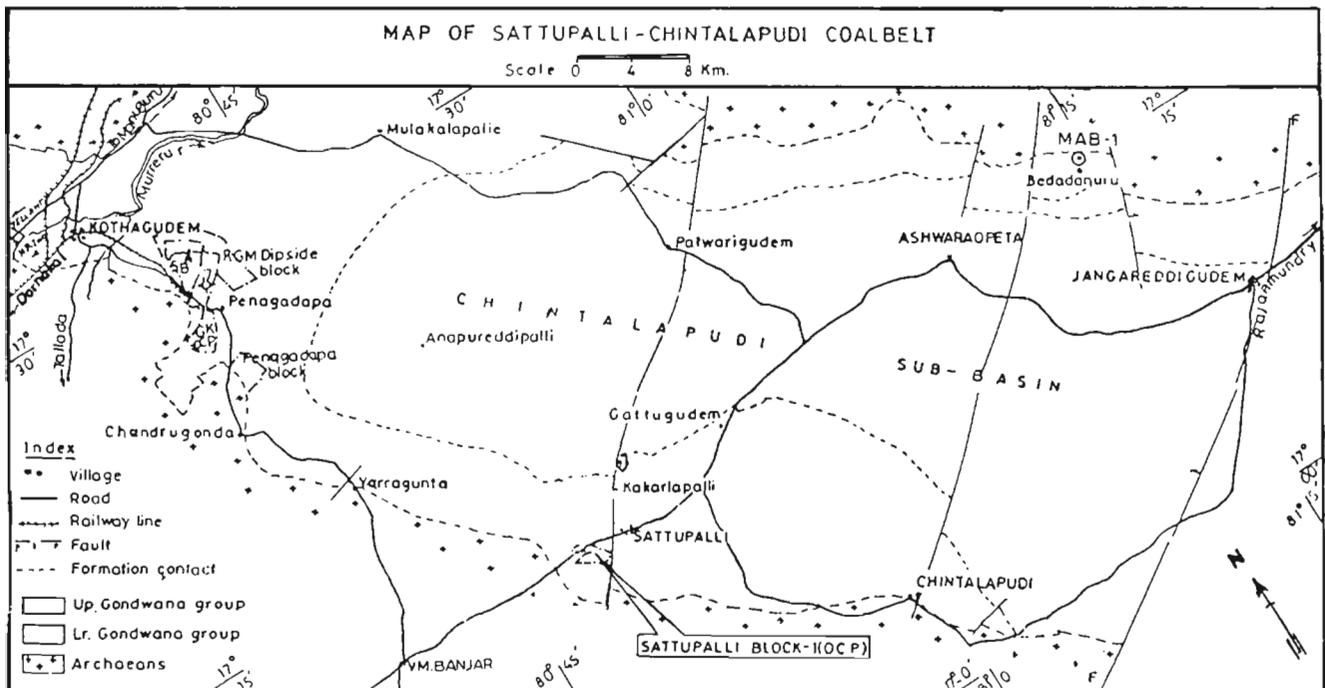


Fig. 1—Map showing location of bore core MAB-1 from Bottapagudem area of Chintalpudi sub-basin.

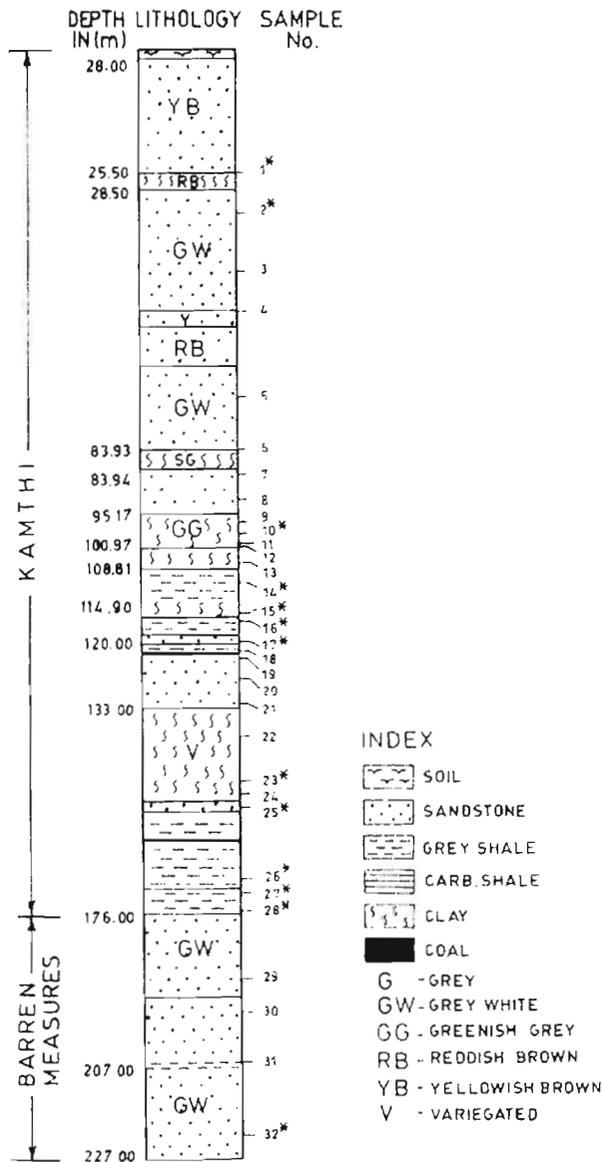


Fig. 2—Litholog of bore core MAB-1 Asterisk denotes productive sample.

medium grained yellowish brown to reddish brown sandstone and clay from 2.50 to 34.50 m. The sequence from 34.50 to 97.50 m is represented by grey white sandstone with some coal lenses. Sandstone at various levels is also yellowish brown. Greenish grey clay is present from 97.50 to 100.82 m. The sequence between 100.82 to 176.0 m consists of coal seams, carbonaceous shale, grey sandstone/shale, greenish grey/variegated clays. This sequence from 2.50 to 176.00 m has been lithologically designated as Kamthi Formation (*sensu* Raja Rao, 1982). The sediments from 176.00 to 344.00 m are mainly represented by grey white sandstone, greenish at places, few grey shales are also recorded. This sequence has been designated as Barren Measures (Kulti) Formation. Barakar

1.	25.50 m*	Clay.
2.	33.00 m*	Grey white sandstone
3.	45 m	Grey sandstone
4.	50.54 m	Fine grained micaceous sandstone
5.	70.80 m	Fine grained sandstone
6.	83.50 m	Grey sandstone
7.	84.50 m	Sandstone
8.	90.80 m	Coarse grained sandstone
9.	95.50 m	Grey clay
10.	98.00 m*	Grey clay
11.	100.50 m	Clay
12.	100.97-101.81 m	Shaly coal
13.	103.34 m	Grey clay
14.	108.30-109.30 m*	Grey shale
15.	114.00 m*	Grey clay
16.	115.50 m*	Grey shale
17.	119-120 m*	Shale
18.	121.83 m	Grey shale
19.	122 m	Carbonaceous shale
20.	127 m	Micaceous sandstone
21.	133 m	Ferruginous sandstone
22.	139 m	Grey clay
23.	148.50 m*	Greenish grey clay
24.	151.50 m	Grey clay
25.	154.50 m*	Sandstone
26.	168.00 m*	Grey shale
27.	171.00 m*	Dark grey shale
28.	173.00 m*	Grey shale
29.	189.50 m	Micaceous sandstone
30.	196.00-197.50 m	Coarse grained sandstone
31.	205 m	Arenaceous shale
32.	220.60 m*	Sandstone

(Asterisk shows productive sample)

Fig. 3—List of samples of Bore core MAB 1, Bottapagudem Area Chintalputi sub-basin, Andhra Pradesh

Formation, recognised from 344.00 to 410.00 m consists of coal, carbonaceous shale, grey shale and grey white sandstone. The sandstone is gritty in the lower part of the Barakar Formation. Talchir sandstone, greenish in colour, has been recognised at 410.00–420.00 m. Litholog of bore core MAB-1 and list of samples are given in Figs 2, 3.

### PALYNOASSEMBLAGES

Three palyno-assemblages have been recognised in the 220 m thick sedimentary sequence of bore core MAB-1 from the Bottapagudem area, on the basis of quantitative dominance and qualitative occurrence of various miospore genera (Figs 4, 5).

Sample nos.	Depth(m)	Palynocomposition	Remarks
1, 2, 10	25.50, 33, 98	Poor in spore-pollen	
14	108.30-109.30	Dominance of striate disaccates chiefly <i>Striatopodocarpites</i> and <i>Faunipollenites</i> , sub-dominance of <i>Scheuringipollenites</i> and <i>Crescentipollenites</i> . Other significant genera present in low amounts are <i>Verticypollenites</i> , <i>Weylandites</i> , <i>Strotersporites</i> , <i>Falcisporites</i> , <i>Klausipollenites</i> , <i>Chordasporites</i> .	Raniganj (Late Permian)
15, 16, 17	114, 115.5, 119-120	Dominance of striate disaccates, sub-dominance of <i>Densipollenites</i> . Qualitatively significant taxa present in the assemblage are <i>Falcisporites</i> , <i>Lunatisporites</i> , <i>Klausipollenites</i> , <i>Guttulapollenites</i> , <i>Playfordiaspora</i> , <i>Vitreisporites</i> , <i>Strotersporites</i> , <i>Hamiapollenites</i> , <i>Corisaccites</i> .	Raniganj (Late Permian)
23	148	Very very poor in spore-pollen	
25	154.50	Abundance of trachieds, poor in spore-pollen. Presence of striate disaccates viz., <i>Striatopodocarpites</i> , <i>Faunipollenites</i> , <i>Striatites</i> and non-striate disaccates viz., <i>Chordasporites</i> , <i>Falcisporites</i> .	
26	168	Poor in spore-pollen. Presence of <i>Striatopodocarpites</i> and <i>Faunipollenites</i> .	
27	171	Dominance of striate disaccates chiefly <i>Striatopodocarpites</i> and <i>Faunipollenites</i> . Presence of stratigraphically significant taxa viz., <i>Falcisporites</i> , <i>Guttulapollenites</i> , <i>Corisaccites</i> , <i>Klausipollenites</i> , <i>Chordasporites</i> , <i>Osmundacidites</i> , <i>Strotersporites</i> , <i>Striasulcites</i> , <i>Vitreisporites</i> , <i>Weylandites</i> , <i>Playfordiaspora</i> , <i>Leiosphaerids</i> common	Raniganj (Late Permian)
28	173	Very very poor in spore-pollen. Presence of <i>Striatopodocarpites</i> and <i>Faunipollenites</i> .	
31	205	Poor in organic matter. No spore seen.	
32	220	Spore frequency low. Presence of striate disaccates, Qualitatively significant taxa <i>Falcisporites</i> , <i>Chordasporites</i> , <i>Crescentipollenites</i> , <i>Klausipollenites</i> , <i>Leiosphaerids</i> common	Raniganj (Late Permian)

Fig. 4—Table showing palynocomposition of samples from bore core MAB-1, Bottapagudem area, Chintalpudi sub-basin.

### Palynoassemblage I

The sediments between 171-220 m are dominated by striate disaccates viz., *Striatopodocarpites* and *Faunipollenites*. *Striasulcites* is common up to 11%. Stratigraphically significant taxa are *Falcisporites*, *Guttulapollenites*, *Chordasporites*, *Osmundacidites*, *Playfordiaspora*, *Corisaccites*, *Klausipollenites*, *Vitreisporites*, *Weylandites* and *Strotersporites*. *Leiosphaerids* are common (8-12%) at 171 m and 220 m.

### Palynoassemblage II

Palynoassemblage II, demarcated between 114.00 to 120.00 m is also dominated by striate disaccates, chiefly *Striatopodocarpites* and *Faunipollenites*, but sub dominated by of *Densipollenites*. Qualitatively significant taxa include *Falcisporites*, *Lunatisporites*, *Klausipollenites*, *Guttulapollenites*, *Playfordiaspora*, *Vitreisporites*, *Strotersporites*, *Lundbladisporea*, *Chordasporites*, *Densoisporites*, *Corisaccites* and *Striasulcites*.

### Palynoassemblage III

This assemblage occurs between 108.30-109.30 m in the grey clay sequence. The assemblage is dominated by striate

disaccates chiefly *Striatopodocarpites* and *Faunipollenites*, and sub dominated by *Scheuringipollenites* and *Crescentipollenites*. Other rare, but stratigraphically significant taxa identified in palynoassemblage III include: *Falcisporites*, *Klausipollenites*, *Strotersporites*, *Chordasporites*, *Weylandites* and *Vitreisporites*.

## COMPARISON

Palynoassemblage I compares well with the Palynoassemblage 4 of Sattupalli area of the Chintalpudi sub-basin (Srivastava & Jha, 1994), Assemblage II of the Ramagundam, Khammampalli and Manuguru areas of Godavari sub-basin (Srivastava & Jha, 1988). An assemblage comparable to Palynoassemblage I is not known from any other basin except for *Striasulcites* rich assemblage from Koel River Section in Hutar Coalfield (Shukla, 1983) which also has *Potoneisporites*, *Scheuringipollenites* and *Faunipollenites*. In Palynoassemblage I of Bottapagudem area *Striasulcites* is associated with dominance of striate disaccates. In addition, the genera *Falcisporites*, *Guttulapollenites*, *Chordasporites*, *Osmundacidites*, *Playfordiaspora*, *Corisaccites*, *Klausipollenites*, *Vitreisporites*, *Weylandites* and *Strotersporites* that occur regularly in Palynoassemblage I are absent in Hutar assemblage.

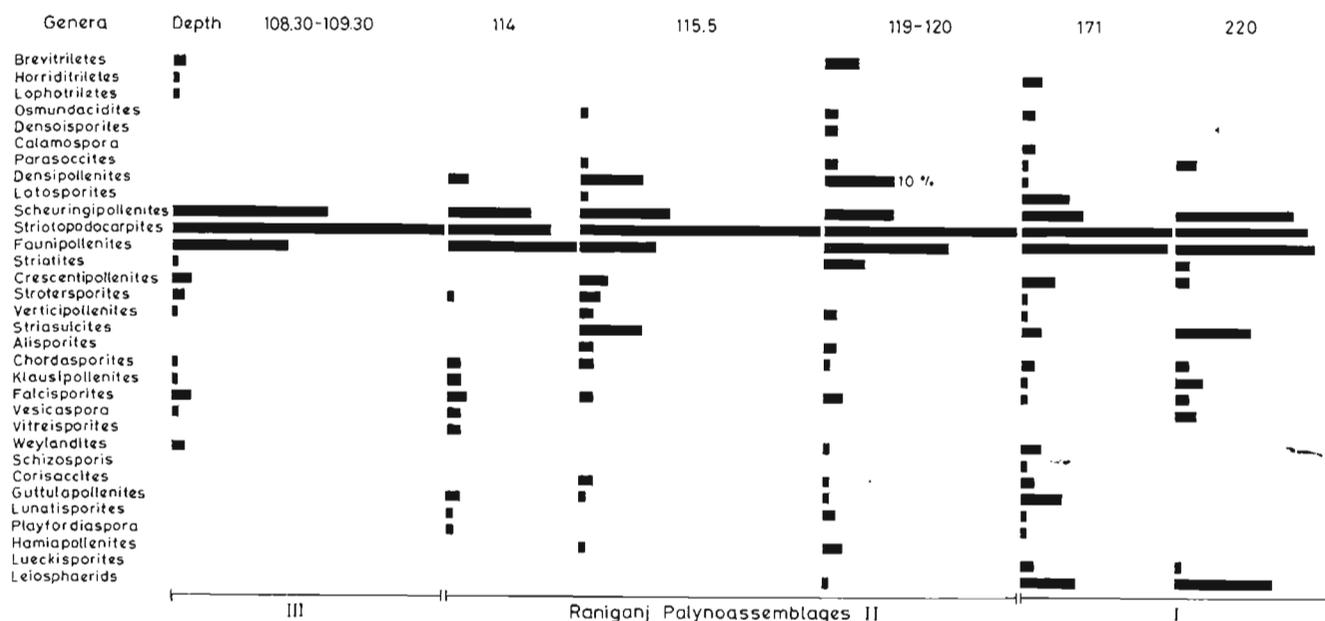


Fig. 5—Histogram showing frequency of various palynotaxa in bore core MAB-I, Bottapagudem area, Chintalputi sub-basin.

Palynoassemblage II compares well with the Assemblage 5 of Sattupalli area (Srivastava & Jha, 1994), Palynozone 8 of Buddharam area (Srivastava & Jha, 1995), Assemblage 5 of Ramagundam, Ramkrishnapuram, Khammampalli and Manuguru areas (Srivastava & Jha, 1988). This assemblage compares with the *Densipollenites magnicarpus* Assemblage Zone described by Tiwari and Tripathi (1992) in having acme of *Densipollenites* in Late Permian. *Densipollenites* assemblage during Late Permian is well known from Damodar Basin (Bharadwaj *et al.*, 1979; Tiwari & Singh, 1983), 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), Kamptee Coalfield (Srivastava & Bhattacharyya, 1996).

Palynoassemblage III compares with the Palynozone 9 of Buddharam area (Srivastava & Jha, 1995). This palynoassemblage is accommodated in *D. magnicarpus* assemblage zone by Tiwari and Tripathi (1992). Similar palynoassemblages have been recognised in Damodar Basin (Bharadwaj *et al.*, 1979; Tiwari & Singh, 1983), Son Valley (Tiwari & Ram-Awatar, 1989), Kamptee Coalfield (Srivastava & Bhattacharyya, 1996), Talchir Coalfield, Mahanadi Basin (Tiwari *et al.*, 1991; Tripathi, 1997) and Satpura Basin (Bharadwaj *et al.*, 1978).

Spore pollen species identified in Late Permian sediments of Bottapagudem area have been listed in Fig. 6.

## PALYNODATING

In Lower Gondwana palynosequence striate disaccates show fairly good representation in Lower Barakar, become dominant component of palynoflora in Upper Barakar and remain dominant up to Raniganj Formation. Hence, at this level

striate disaccates loose stratigraphic significance and the associated taxa become more important while identifying the palynoassemblage. All the three assemblages of Bottapagudem area show dominance of striate disaccates along with rare occurrence of stratigraphically significant genera viz., *Falcisporites*, *Lunatisporites*, *Chordasporites*, *Klausipollenites*, *Vitreisporites*, *Densoisporites* and *Playfordiaspora*, which suggest Late Permian age for this palynoflora. *Densipollenites* along with dominance of striate disaccates is also characteristic of Barren Measures but the presence of above taxa in Palynoassemblages I, II and III distinguishes this palynoflora from Barakar and Barren Measures palynoflora. Moreover, presence of *Densipollenites magnicarpus* and *D. kamthiensis* in Palynoassemblage III also indicates Late Permian (Raniganj) age.

## DISCUSSION

The bore core MAB-I was drilled in the southern part of the Bottapagudem area of the Beddadanur Block in the Chintalputi sub-basin from where the occurrence of patches of Barakar Formation were reported earlier (Raja Rao, 1982). The upper 2.50 to 176.00 m sequence, consisting of fine to medium - grained yellowish brown and grey white sandstone, clays, grey shales and coal seams has been considered to represent the Kamthi Formation, while the underlying sequence (176.00 to 344.00 m) consisting of coarse-grained grey white sandstone, has been identified as Barren Measures (Kulti) Formation. Of this, the younger 220 m deep sedimentary profile of bore core MAB-I has been studied herein. Striate disaccate pollen, chiefly *Striatopodocarpites* and *Faunipollenites* dominate in all three assemblages. However, the

*Brevitriletes communis*  
*B. unicus*  
*Lophotriletes rectus*  
*Calamospora exila*  
*Horriditriletes ramosus*  
*Osmundacidites sp.*  
*Densoisporites sp.*  
*Laevigatosporites colliensis*  
*Parasaccites obscurus*  
*Scheuringipollenites maximus*  
*S. tentulus*  
*Ibisporites diplosaccus*  
*Densipollenites invisus*  
*D. indicus*  
*D. invisus*  
*D. densus*  
*D. magnicarpus*  
*D. kamthiensis*  
*Alisporites landianus*  
*A. indarrensensis*  
*Vesicaspora sp.*  
*Vitreisporites sp.*  
*Klausipollenites sp.*  
*Playfordiaspora cancellosa*  
*Falcisporites sp.*  
*Chordasporites sp.*  
*Guttulapollenites hannonicus*  
*Corisaccites alutus*  
*Hamiapollenites insolitus*  
*Lunatisporites ovatus*  
*Strotersporites communis*  
*S. wilsonii*  
*Lueckisporites virkii*  
*Verticipollenites debiles*  
*Crescentipollenites globosus*  
*C. barakarensis*  
*C. gondwanensis*  
*C. brevis*  
*Faunipollenites varius*  
*F. parvus*  
*F. bharadwajii*  
*Striatopodocarpites diffuses*  
*S. decorus*  
*S. brevis*  
*S. multisrtiatus*  
*S. subcircularis*  
*Striatites communis*  
*S. parvus*  
*Striasulcites tectus*  
*S. ovatus*  
*Weylandites circularis*  
*Inaperturopollenites*  
*Schizosporis sp.*  
*Leiosphaerids*

stratigraphically important taxa, such as *Falcisporites*, *Lunatisporites*, *Chordasporites*, *Klausipollenites*, *Vitreisporites*, *Densoisporites* and *Playfordiaspora*, which become more prominent in the Early Triassic, make their early appearance in Late Permian of Bottapagudem as in other areas of the Godavari Graben. The palynocomposition of all three assemblages clearly indicates Raniganj affinity. The presence of *Densipollenites magnicarpus* and *D. kamthiensis* along with some stratigraphically significant taxa in Assemblage II distinguishes it from the Barren Measures palynoflora. The sediments from 173.00 to 205 m are very poorly palyniferous. At 220 m spore pollen frequency is low but whatever palynomorphs are present have similar connotation. Qualitatively significant genera at 220 m are: *Falcisporites*, *Chordasporites*, *Crescentipollenites* and *Klausipollenites*. No Barren Measures palynoflora have been recorded in lithologically differentiated Barren Measures sequence between 176.00 to 220 m. Thus, continuation of Raniganj sediments below 176.00 m seems plausible.

It may be interpreted that the sediments between 108.00–220.00 m including coal seams belong to Raniganj Formation (Late Permian). The sediments between 23.8–34.50 m consisting of yellowish brown sandstone represent the Kamthi Formation (Early Triassic) in its revised form (Ramanamurty & Rao, 1996; Jha & Srivastava, 1996). Presence of leiosphaerids in high percentages at 171 m and 220 m indicates shallow marine influence during the deposition of these sediments.

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Fig. 6—List of spore pollen species identified in bore core MAB-1 from Bottapagudem area, Chintalpudiv sub basin.

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