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

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ABSTRACT


Palynological studies were carried out in bore core MAB-I from the Bottapagudem area of the Beddadanur Block in Chintalpudi 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, Guttulapollellites, Chordasporites, Osmundacities, Playfordiaspora, Klausipollenites, Strotersporites and Vaireispores. Assemblage II is also dominated by striate disaccates, together with Densipollenites and rare occurrences of palynotaxa like Falcisporites, Klausipollenites, Playfordiaspora, Lundbladispora, Chordasporites, Strotersporites, Densoisporites 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.

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INTRODUCTION

THE 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-I 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-I from Gattugudem area (Jha, 2002). All these bore cores are from the western margin of the sub-basin except SGG-I 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.J.) 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
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 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-I 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-I from the Bottapagudem area, on the basis of quantitative dominance and qualitative occurrence of various miospore genera (Figs 4, 5).
<table>
<thead>
<tr>
<th>Sample nos.</th>
<th>Depth (m)</th>
<th>Palynocomposition</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, 2, 10</td>
<td>25.50, 33.98</td>
<td>Poor in spore-pollen</td>
<td>Raniganj (Late Permian)</td>
</tr>
<tr>
<td>14</td>
<td>108.30-109.30</td>
<td>Dominance of striate disaccates chiefly <em>Striatopodocarpites</em> and <em>Faunipollenites</em>, sub-dominance of <em>Scheuringipollenites</em> and <em>Crescentipollenites</em>. Other significant genera present in low amounts are <em>Verticipollenites</em>, <em>Weylandites</em>, <em>Strotersporites</em>, <em>Falciisporites</em>, <em>Klausipollenites</em>, <em>Chordasporites</em>.</td>
<td></td>
</tr>
<tr>
<td>15, 16, 17</td>
<td>114, 115.5, 119-120</td>
<td>Dominance of striate disaccates, sub-dominance of <em>Densipollenites</em>. Qualitatively significant taxa present in the assemblage are <em>Falciisporites</em>, <em>Lunatisporites</em>, <em>Klausipollenites</em>, <em>Guttulapollenites</em>, <em>Playfordiaspora</em>, <em>Vitreisporites</em>, <em>Strotersporites</em>, <em>Hamiapollenites</em>, <em>Corisaccites</em>.</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>168</td>
<td>Poor in spore-pollen. Presence of <em>Striatapodocarpites</em> and <em>Faunipollenites</em>.</td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>171</td>
<td>Dominance of striate disaccates chiefly <em>Striatapodocarpites</em> and <em>Faunipollenites</em>. Presence of stratigraphically significant taxa viz., <em>Falciisporites</em>, <em>Guttulapollenites</em>, <em>Corisaccites</em>, <em>Klausipollenites</em>, <em>Chordasporites</em>, <em>Osmundacides</em>, <em>Strotersporites</em>, <em>Sriasulcites</em>, <em>Vitreisporites</em>, <em>Weylandites</em>, <em>Playfordiaspora</em>, <em>Leiosphaerids</em> common</td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>173</td>
<td>Very very poor in spore-pollen. Presence of <em>Striatapodocarpites</em> and <em>Faunipollenites</em>.</td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>205</td>
<td>Poor in organic matter. No spore seen.</td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>220</td>
<td>Spore frequency low. Presence of striate disaccates, Qualitatively significant taxa <em>Falciisporites</em>, <em>Chordasporites</em>, <em>Crescentipollenites</em>, <em>Klausipollenites</em>, <em>Leiosphaerids</em> common</td>
<td></td>
</tr>
</tbody>
</table>

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

**Palynoassemblage I**

The sediments between 171-220 m are dominated by striate disaccates viz., *Striatapodocarpites* and *Faunipollenites*. *Sriasulcites* is common up to 11%. Stratigraphically significant taxa are *Falciisporites*, *Guttulapollenites*, *Chordasporites*. *Osmundacides*, *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 *Striatapodocarpites* and *Faunipollenites*, but sub dominated by of *Densipollenites*. Qualitatively significant taxa include *Falciisporites*, *Lunatisporites*, *Klausipollenites*, *Guttulapollenites*, *Playfordiaspora*, *Vitreisporites*, *Strotersporites*, *Lundbiadiaspores*, *Chordasporites*, *Densoisporites*, *Corisaccites* and *Sriasulcites*.

**Palynoassemblage III**

This assemblage occurs between 108.30-109.30 m in the grey clay sequence. The assemblage is dominated by striate disaccates chiefly *Striatapodocarpites* and *Faunipollenites*, and sub dominated by *Scheuringipollenites* and *Crescentipollenites*. Other rare, but stratigraphically significant taxa identified in palynoassemblage III include: *Falciisporites*, *Klausipollenites*, *Strotersporites*, *Chordasporites* 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 *Sriasulcites* rich assemblage from Koel River Section in Hutar Coalfield (Shukla, 1983) which also has *Potoneisporites*, *Scheuringipollenites* and *Faunipollenites*. In Palynoassemblage I of BotttaPagudem area *Sriasulcites* is associated with dominance of striate disaccates. In addition, the genera *Falciisporites*, *Guttulapollenites*, *Chordasporites*, *Osmundacides*, *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, Chintalpudi 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 magnicorpus 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. magnicorpus 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 lose 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 magnicorpus 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 Chintalpudi 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
Lophotrilites rectus
Calamospora exila
Horriditriletes ramosus
Osmundacitites sp.
Densoisporites sp.
Laevigatosporites collinensis
Parasaccites obscurus
Scheuringipollenites maximus
S. tentulus
Ibisporites diplosaccus
Densipollenites invisus
D. indicus
D. invisus
D. densus
D. magnicorpus
D. kamthiensis
Alisporites landianus
A. indairensis
Vesicaspora sp.
Vitreisporites sp.
Klausipollenites sp.
Playjordiaspora cancellosa
Falcisporites sp.
Chordasporites sp.
Guttulapollenites hannonicus
Corisaccites alatus
Hamapollenites insolitus
Lanatisporites ovari
Strotersporites communis
S. wilsonii.
Lueckisporites virkii
Verticipollenites debiles
Crescentipollenites globosus
C. barakarensis
C. gondwanensis
C. brevis
Faunipollenites varius
F. parvus
F. bharadwaji
Striatopodocarpites diffuses
S. decorus
S. brevis
S. multisritatus
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, Densipollenites and Playjordiaspora, which become more prominent in the Early Triassic, make their early appearance in Late Permian of Boltapagudem as in other areas of the Godavari Graben. The palynocomposition of all three assemblages clearly indicates Raniganj affinity. The presence of Densipollenites magnicorpus 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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