



TRIASSIC PALYNOFLORA FROM THE MAHULI-MAHERSOP AREA, SINGRAULI COALFIELD (SOUTHERN EXTENSION), SARGUJA DISTRICT, CHHATTISGARH, INDIA

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ABSTRACT

This is the first spore-pollen study of the subsurface strata (Raniganj and Parsora formations) in two boreholes, SSM-1 and SSM-2, from the Mahuli-Mahersop area, Singrauli Coalfield, Chhattisgarh. In all, the five palynoassemblages identified suggest the deposits of latest Permian (Assemblage I in SSM-2), earliest Triassic (Assemblage II in SSM-2), and Late Triassic (Assemblage A in SSM-1; Assemblage III in SSM-2 and Assemblage B in SSM-1) ages. The palynological data indicates the Permo-Triassic boundary between 542.00 and 537.00m in Borehole SSM-2, whereas the occurrence of the marker paleosol horizon at 509.50m in the same borehole determines the lithological break between the top of the Raniganj Formation and the basal Parsora Formation. Absence of the major part of Early and Middle Triassic deposits is also proved by the present study.

Key words: Palynology, Raniganj Formation, Parsora Formation, Permian, Triassic, Singrauli Coalfield

INTRODUCTION

The Singrauli Coalfield of the South Rewa Gondwana Basin occupies a central position in the Permian coal basins of India (Fig. 1a). The thickest coal seam, the Jhingurdah Seam, of this coalfield had been palynologically detailed (Bharadwaj and Sinha, 1969a, b; Sinha 1969, 1972; Tiwari and Srivastava, 1984). The Geological Survey of India has recently explored a new area in the southern extension of the Singrauli Coalfield in the Sarguja District for its coal reserves. The sedimentary facies encountered in two cores of boreholes SSM-1 and SSM-2, Mahuli-Mahersop area (Fig. 1) are devoid of coal. The palynofloras encountered in these boreholes are reported herein and their chronological significance is discussed.

GEOLOGY OF THE AREA

Reconnaissance traverses have suggested a generalised stratigraphic succession of sedimentary units, that overlie the Sarguja Crystalline. These are represented by the following: Talchir Formation (70–450 m); Barakar Formation (250–300 m); Barren Measures Formation (200–300 m); and Raniganj Formation (550 m+) in Pali-Parsora (700 m+) covered country (Mukhopadhyay and Mukhopadhyay, 1999). Rocks akin to older formations are seen along the river and tributary, affected by subparallel faults. In and around Mahuli, the Parsora Formation is represented mainly by medium- to coarse-grained quartzo-feldspathic sandstone rich in micaceous and ferruginous constituents. Associated coarse feldspathic sandstone interbedded with ferruginous and argillaceous horizons are often cross bedded. Subarkosic sandstone with gritty and chocolate coloured siltstone with clay galls are found to the west of Mahuli village. Regional dip of the strata is 7° southeast.

The subcropping Parsora Formation can be broadly differentiated into two parts (Fig. 2). The upper part is represented mainly by medium-to coarse-grained grey, friable massive arkose to wacke with mica and ferruginous matter randomly present. Very coarse-grained horizons occur locally as thin lenses, mostly along erosional contacts. In the lower part, fine-grained sandstone, chocolate coloured shale and siltstone, variegated siltstone and very fine-grained sandstone are predominant.

A significant lithological change is noticed below 537.00m depth in Borehole SSM-2, where a palaeosol is identified. Downwards, this is followed by dirty white feldspathic sandstone, occasionally micaceous with subordinate grey siltstone, carbonaceous shale and stringers and thin lenses of coal, similar to those as found in Raniganj Formation of Singrauli main Basin.

MATERIAL

The present study is based on cores from the two boreholes SSM-1 and SSM-2 (Tables 1, 2; Fig. 2). Due to the mainly arenaceous nature of the sediments in the core material, the palynomorphs have been recovered only at varied depths in the sequence, and are listed in Table 3.

PALYNOFLORAL SEQUENCE AND AGE

On the basis of quantitative and qualitative analysis of spores-pollen recovered (Plates 1-4, Fig. 3; Table 3) in the productive samples from Raniganj and Parsora formations of boreholes SSM-1 and SSM-2, five assemblages have been identified. These are: Assemblages A and B in Borehole SSM-1, and Assemblages I, II and III in Borehole SSM-2. Compositionally each assemblage is different, being characterised by a group

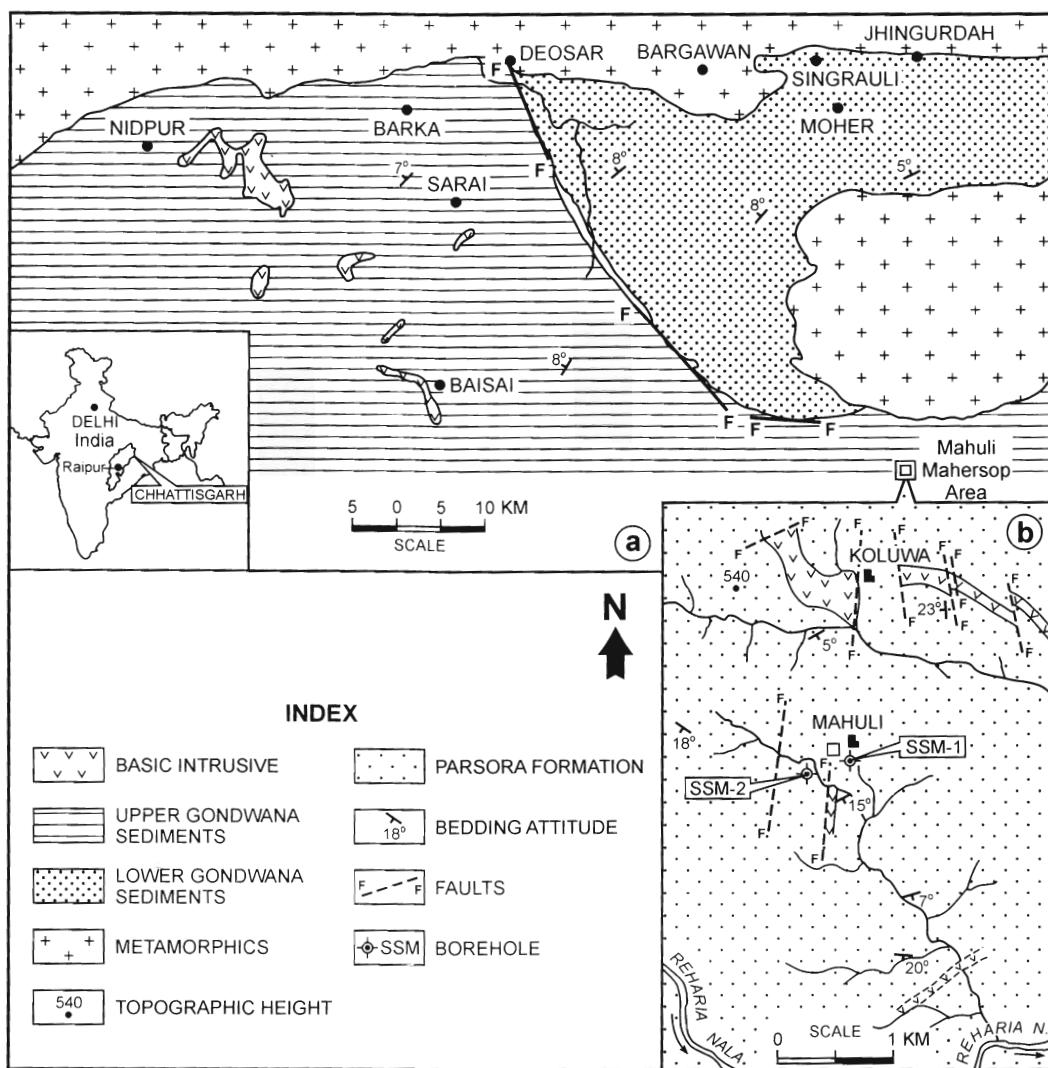


Fig. 1. Map showing geographical location and geology of Singrauli Basin in India. 1a. Geological map of Singrauli Basin, Madhya Pradesh, Uttar Pradesh and Chhattisgarh. 1b. Geological map around Mahuli-Surguja District, Chhattisgarh showing the location of boreholes SSM-1 and SSM-2.

EXPLANATION OF PLATE I

(Scale bar 10 µm, scale in figure 27 stands for all except figures 11, 22)

(Scale bar 10 µm, scale in figure 22 stands for figure 11)

1. *Annulispora folliculosa*, SSM-2/261.75, BSIP Slide No.13010.
2. *Simeonospora kholonae*, SSM-2/261.75, BSIP Slide No 13010.
3. *Lundbladispora reticulata*, SSM-2/261.75, BSIP Slide No 13010.
4. *Lundbladispora warti*, SSM-2/261.75, BSIP Slide No 13010.
5. *Enzonalsporites vigens*, SSM-2/261.75, BSIP Slide No 13010.
6. *Tethysispora unica*, SSM-2/261.75, BSIP Slide No 13010.
7. *Krempipollenites indicus*, SSM-2/261.75, BSIP Slide No 13010.
8. *Tethysispora playfordii*, SSM-2/476.85, BSIP Slide No 13015.
9. *Lundbladispora brevicula*, SSM-2/261.75, BSIP Slide No 13010.
10. *Lundbladispora baculata*, SSM-2/261.75, BSIP Slide No 13010.
11. *Conaletes tetrad*, SSM- 26/152.56, BSIP Slide No 13009.
12. *Densoisporites playfordii*, SSM-2/261.75, BSIP Slide No 13010.
13. *Callumispora barakarensis*, SSM-2/446.85, BSIP Slide No 13013.
14. *Lundbladispora willmotti*, SSM-2/261.75, BSIP Slide No 13010.
15. *Lunatisporites rhaeticus*, SSM-2/261.75, BSIP Slide No 13010.
16. *Ovalipollis rarus*, SSM-1/39, BSIP Slide No 13008.
17. *Verrucosisporites varius*, SSM-2/487.50, BSIP Slide No 13016.
18. *Verrucosisporites narmianus*, SSM-2/261.75, BSIP Slide No 13010.
19. *Playfordiaspora cancellosa*, SSM-2/261.75, BSIP Slide No 13010.
20. *Arcuatipollenites tethysensis*, SSM-2/508.50, BSIP Slide No 13018.
21. *Nidipollenites monoletes*, SSM-2/542.00, BSIP Slide No 13021.
22. *Alisporites damudicus*, SSM-2/261.75, BSIP Slide No 13010.
23. *Arcuatipollenites damudicus*, SSM-2/504.50, BSIP Slide No 13017.
24. *Arcuatipollenites ovatus*, SSM-2/261.75, BSIP Slide No 13010.
25. *Densipollenites annulatus*, SSM-2/537.00, BSIP Slide No 13020.
26. *Arcuatipollenites pellucidus*, SSM-2/261.75, BSIP Slide No 13010.
27. *Praecolpatites sinuosus*, SSM-2/542.00, BSIP Slide No 13021.

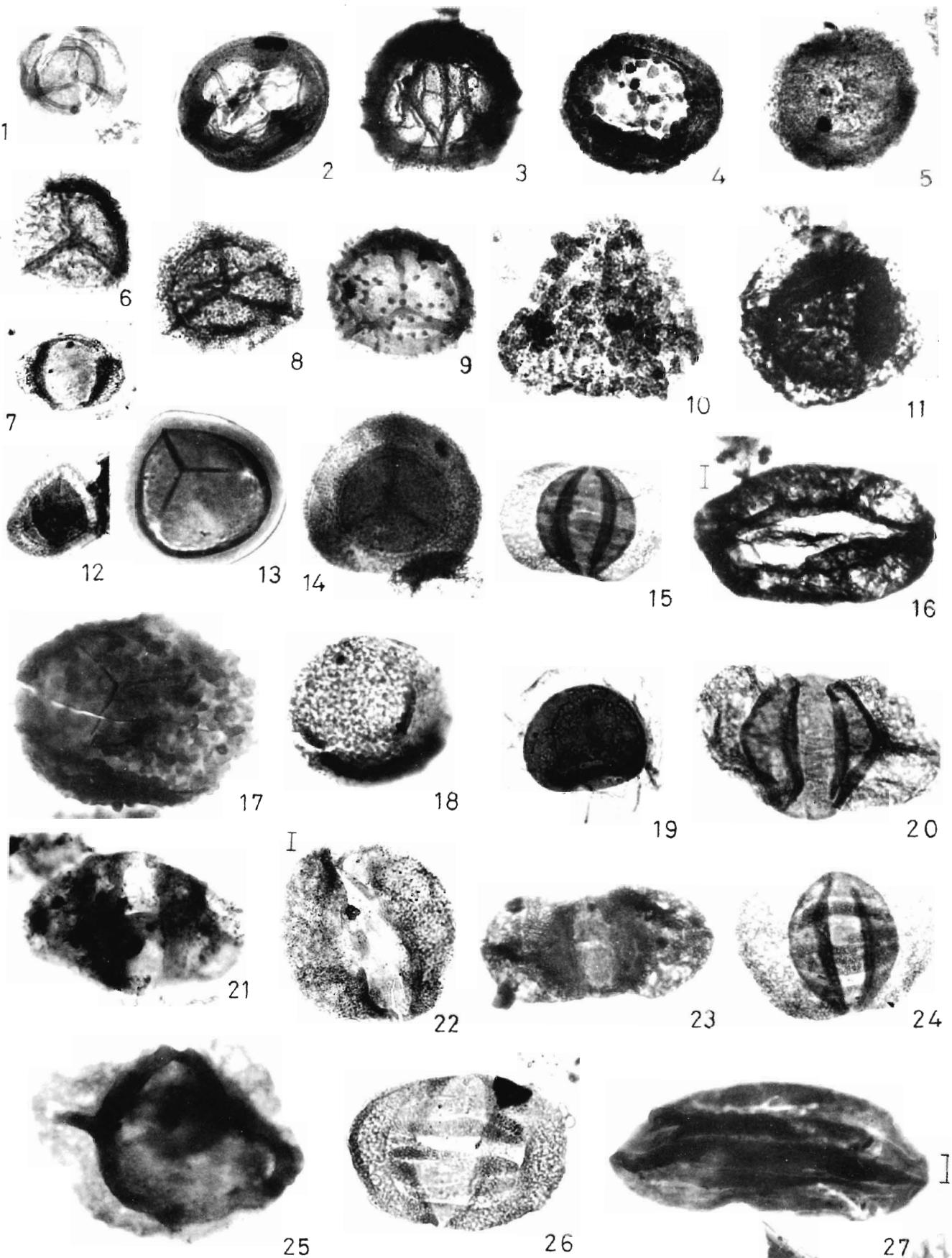


Table 1 : List of samples studied from Borehole SSM-1, Mahuli-Mahersop area, Singrauli Coalfield (southern Extension), Sarguja district, Chattisgarh, India.

S.No	Depth	Lithology	Remarks
1	19.70	Dark grey micaceous sandy shale	All material is black or blackish brown, unidentifiable, palynomorph rare
2	19.27	Grey Shale	Palynomorph rare, full of black wood
3	28.52	Black streaks in sst	Palynomorph rare, full of black wood
4	37.70	Intercalation of sst + sh	Palynomorph rare, full of black wood
5	70.40	Intercalation of sst + sh	Palynomorph very rare, full of black wood
6	80.70	Intercalation of sst + sh	Palynomorph rich, blackish brown
7	152.40	Grey Shale	Palynomorph rich
8	152.56	Dark grey sandy shale	Palynomorph rare, full of black wood
9	161.70	Intercalation of sst + sh	Palynomorph very rare, full of black wood
10	162.10	Grey with greenish tint micaceous sandy shale	Organic matter poor, black, palynomorph rare, preservation bad
11	175.00	Grey mudstone	Palynomorph absent
12	188.80	Intercalation of sst + sh	Palynomorph very rare, full of black wood
13	204.90	Intercalation of sst.+ sh	Palynomorph rare
14	228.40	Intercalation of sst + sh	Poor yield, spore-pollen very rare, black wood
15	238.50	Intercalation of sst + sh	Palynomorph very rare
16	262.50	Intercalation of sst + sh	Poor yield, wood black, palynomorph rare
17	268.50	Grey micaceous sandy shale	Organic matter not much, black, palynomorph rare, preservation bad
18	296.70	Intercalation of coarse-grained sst + sh	Poor yield, palynomorph absent, wood black
19	301.35	Grey micaceous sst	Organic matter rich, black, palynomorph rare, preservation bad
20	306.80	Intercalation of sst + sh	Palynomorph very rare, wood black
21	341.80	Intercalation of greenish sst + sh	Palynomorph rich, black particles impregnated
22	354.60	Dark grey hard shale	All material black, palynomorph very rare, black and golden yellow both, preservation poor.
23	363.85	Intercalation of buff coloured sst + sh	Palynomorph rich, black particles impregnated
24	372.50	Grey sst	All material black, palynomorph rare, pyrite present, yellowish palynomorphs, badly preserved
25	377.25	Intercalation of buff coloured sst + sh	Palynomorph rare, full of black wood
26	383.05	Buff coloured sh	Palynomorph rare, full of black wood
27	391.80	Dark grey compact sandy claystone	All material balck, light yellow, unidentifiable material also present, palynomorph very rare
28	397.10	Green fine grained sst	Palynomorph rare, full of black wood
29	532.70	Hard dark grey massive claystone	Palynomorph rare, preservation bad
30	535.25	Carb? Shale	Palynomorph very rare, organic matter rich
31	557.15	Shaly sst	Palynomorph rare, preservation bad
32	588.20	Grey shale	Palynomorph absent, rich in amorphous matter
33	612.10	Grey micaceous sst	Rich in woody matter, palynomorph very rare
34	631.10	Grey micaceous sst	Rich in woody matter, palynomorph very rare
35	669.35	Grey shaly sst	Rich in palynomorph and woody matter
36	688.70	Grey siltstone	Rich in palynomorph and woody matter, preservation good, dark brown
37	696.90	Micaceous shaly sst	Rich in palynomorph and woody matter, preservation good, dark brown
38	702.00	Dark grey shaly sst	Palynomorph common, organic matter rich
39	704.05	Sandy shale	Organic matter rare, black, palynomorph very rare
40	716.15	Fine-grained sandstone with grey shale clasts	Organic matter rich, dark brown, palynomorph common, preservation good

Table 2 : List of samples studied from Borehole SSM-2, Mahuli-Mahersop area, Singrauli Coalfield (Southern Extension), Sarguja District, Chhattisgarh, India.

S. No.	Depth	Lithology	Remarks
1.	261.75	Medium-grained grey sandstone	Palynomorph rich, preservation good
2.	265.00	Fine-grained greyish white laminated sandstone	Palynomorph rare, preservation poor
3.	358.45	Grey siltstone	Palynomorph rare, preservation fair
4.	424.45	Fine- to medium-grained sandstone with sandy carb. shale partings	Palynomorph rare, preservation fair
5.	462.60	Medium-grained sandstone with carb. shale stringers	Palynomorph very rare, preservation poor
6.	476.85	Dark chocolate shale	Palynomorph rare to common, preservation poor to fair
7.	487.50	Greyish brown shale with carb. shale stringers	Palynomorph common to rich, preservation fair to good
8.	504.50	Grey mudstone	Palynomorph rare, preservation poor to fair
9.	505.00	Grey friable mudstone	Palynomorph rare to common, preservation good
10.	506.80	Grey shale	Palynomorph rare, preservation poor to fair
11.	508.50	Grey to greenish grey mudstone	Palynomorph rare to common, preservation fair
12.	514.00	Medium-grained sandstone with carb. sandstone	Palynomorph rich, preservation good
13.	537.00	Dark grey shaly sandstone	Palynomorph rare to common, preservation fair
14.	542.00	Grey sandy carb. shale	Palynomorph common, preservation fair

Table-3: Checklist of spore-pollen.

MONOLETE	<i>Cyclotriletes oligogramifer</i> Mädler, 1964
<i>Aratrisporites coryliseminis</i> Klaus, 1960	<i>Cyclotriletes</i> sp.
<i>A. flexibilis</i> Playford & Dettmann, 1965	<i>Denoisporites playfordii</i> (Balme) Dettmann, 1963
<i>A. minimus</i> Schultz, 1967	<i>D. contactus</i> Bharadwaj & Tiwari, 1977
<i>A. paenulatus</i> Playford & Dettmann, 1965	<i>Densosporites raceviewensis</i> de Jersey, 1971
<i>A. parvispinosus</i> Leschik, 1955	<i>Dictyophyllidites surangei</i> Bharadwaj & Singh, 1964
<i>Laevigatosporites colliensis</i> (Balme & Henn.) Venkatachala & Kar, 1968	<i>Dictyotosporites complex</i> Cookson & Dettmann, 1958
<i>Polypodiisporites ipsviciensis</i> (de Jersey) Playford & Dettmann, 1965	<i>D. filosus</i> Dettmann, 1963
TRILETE	<i>Dubrajisporites isolatus</i> Tripathi et al., 1990
<i>Alsophyllidites</i> sp.	<i>Foveosporites moratonensis</i> de Jersey, 1964
<i>Anapiculatisporites telephorus</i> Pautsch, 1958	<i>F. triassicus</i> Kumaran & Maheshwari, 1980
<i>Annulispora folliculosa</i> (Rogal.) de Jersey, 1959	<i>Guttatisporites ambiguus</i> Tiwari & Rana, 1980
<i>Apiculatisporis globosus</i> (Lesch.) Playford & Dettmann, 1965	<i>G.guttatus</i> Visscher, 1966
<i>Aulisporites astigmosus</i> (Lesch.) Klaus, 1960	<i>G. microechinatus</i> Visscher, 1966
<i>Biretisporites potoniaei</i> Delcourt & Sprumont, 1955	<i>G. visscheri</i> de Jersey, 1968
<i>Brevitriletes communis</i> Tiwari & Singh, 1981	<i>Grandispora spinosa</i> Hoffmeister, Staplin & Malloy, 1955
<i>Cadargasporites baculatus</i> de Jersey & Paten, 1964	<i>Horriditriletes rampurensis</i> Tiwari, 1968
<i>C. granulatus</i> de Jersey & Paten, 1964	<i>Indotriradites mammilatus</i> Bharadwaj & Tiwari, 1977
<i>C. reticulatus</i> de Jersey & Paten, 1964	<i>Klukisporites variegatus</i> Couper, 1958
<i>C. verrucosus</i> Reiser & Williams, 1969	<i>Kraeuselisporites cuspidus</i> Balme, 1963
<i>Callumispora gretensis</i> (Balme & Henn.) Bharadwaj & Srivastava, 1969	<i>K. saeptatus</i> Balme, 1957
<i>C. barakarensis</i> Bharadwaj & Srivastava, 1969	<i>K. verrucifer</i> de Jersey & Hamilton, 1967
<i>Camerosporites secatus</i> Leschik, 1955	<i>Lapposisporites armatus</i> Visscher, 1966
<i>C. verrucosus</i> de Jersey, 1971	<i>Leptolepidites argenteiformis</i> (Bolkh.) Morbey, 1975
<i>Camerozonosporites clivosus</i> McKellar, 1974	<i>Lundbladispora baculata</i> Bharadwaj & Tiwari, 1977
<i>C. rudis</i> (Lesch.) Klaus, 1960	<i>L. brevicula</i> Balme, 1970
<i>Carnisporites hercynicus</i> Mädler, 1964	<i>L. densispinosa</i> Bharadwaj & Tiwari, 1977
<i>C. mesozoicus</i> (Klaus) Mädler, 1964	<i>L. microconata</i> Bharadwaj & Tiwari, 1977
<i>C. raniganjensis</i> Tiwari & Rana, 1980	<i>L. reticulata</i> Tiwari & Rana, 1980
<i>Ceratosporites helidonensis</i> de Jersey, 1971	<i>L. warti</i> Tiwari & Rana, 1981
<i>Chasmatosporites apertus</i> (Rogal.) Nilsson, 1958	<i>L. willmotti</i> Balme, 1963
<i>C. hians</i> Nilson, 1958	<i>Lycopodiacytidites rugulatus</i> (Couper) Schultz, 1967
<i>Cingutriletes</i> sp. cf. <i>clavus</i> (Balme) Dettmann, 1963	<i>Lycospora</i> sp.
<i>Cingutriletes</i> sp.	<i>Nevesisporites limatulus</i> Playford, 1965
<i>Cingulizonates indicus</i> Kumaran & Maheshwari, 1980	<i>N. vallatus</i> de Jersey & Paten, 1964
<i>C. rhaeticus</i> (Reinh.) Schultz, 1967	<i>Osmundacidites senectus</i> Balme, 1963
<i>C. verrucosus</i> Kumaran & Maheshwari, 1980	<i>Polycingulatisporites crenulatus</i> Playford & Dettmann, 1965
<i>Clavatisporites hammenii</i> (Herbst) de Jersey, 1971	<i>P. densatus</i> (de Jersey) Playford & Dettmann, 1965
<i>Conbaculatisporites mesozoicus</i> Klaus, 1960	<i>Pyramidosporites racemosus</i> Balme, 1970
<i>Conbaculatisporites</i> sp.	<i>Retitriletes huttonensis</i> McKellar, 1974
<i>Concavissimisporites penolaensis</i> Dettmann, 1963	<i>Ringosporites fossulatus</i> (Balme) Tiwari & Rana, 1981
<i>C. subverrucosus</i> Venkatachala, 1969	<i>R. ringus</i> Tiwari & Rana, 1981
<i>Converrucosporites cameronii</i> (de Jersey) Playford & Dettmann, 1965	<i>Rugulatisporites trisinus</i> de Jersey & Hamilton, 1967
<i>Converrucosporites</i> sp.	<i>Simeonospora khlonovae</i> Balme, 1970
<i>Convertubisporites variabilis</i> Kumaran & Maheshwari, 1980	<i>Spinotriletes echinoides</i> Mädler, 1964
<i>Convolutispora</i> sp.	<i>S. senecioides</i> Mädler, 1964
<i>Cyathidites asper</i> (Bolkh.) Dettmann, 1963	<i>Taurocuspores verrucatus</i> Schultz, 1967
<i>Cyclogranisporites gondwanensis</i> Bharadwaj & Salujha, 1964	<i>Tikisporites balmei</i> Kumaran in Kumaran & Maheshwari, 1980
	<i>Tethysispora playfordii</i> Vijaya & Tiwari in Vijaya et al., 1988
	<i>T. unica</i> Vijaya & Tiwari, 1988
	<i>Tigrisporites halleinis</i> Klaus, 1960
	<i>Todisporites minor</i> Couper, 1958

- Triletes tuberculiformis* Cookson, 1947
Undulatisporites dilucidus Kraeusel & Leschik, 1955
Uvaesporites verrucosus Helby in de Jersey, 1971
Verrucosisporites carnarvonensis de Jersey & Hamilton, 1967
V. densus Bharadwaj & Tiwari, 1977
V. morulae Klaus, 1960
V. narmianus Balme, 1970
V. triassicus Bharadwaj & Tiwari, 1977
V. varians Volkheimer, 1972

STRIATE BISACCATE

- Distriatites bilateris* Bharadwaj, 1962
Faunipollenites varius Bharadwaj, 1962 emend. Tiwari *et al.*, 1989
F. peregrinus Bharadwaj & Salujha, 1965
Guttulapollenites hannonicus Goubin, 1965
Rhizomaspora triassica Tiwari & Rana, 1981
Striatopodocarpites auriculatus Vijaya & Tiwari in Vijaya *et al.*, 1988
Striatopodocarpites diffusus Bharadwaj, 1962
S. dubrajpurensis Tripathi *et al.*, 1990
S. magnificus Bharadwaj & Salujha, 1964
Schizopollis distinctus Sinha, 1972
Striasulcites ovatus Venkatachala & Kar, 1968
Tumori pollenites baculosus Bharadwaj, 1962
Verticipollenites gibbosus Bharadwaj, 1962
Verticipollenites finitimus Bharadwaj & Salujha, 1964

NON-STRIATE BISACCATE

- Accinctisporites ligatus* Leschik, 1955
Alisporites asansoliensis Maheshwari & Banerji, 1975
A. damudicus Tiwari & Rana, 1980
Cristatisaccus cristatus Mädler, 1964
Falcisporites minutosaccus Kumaran & Maheshwari, 1980
F. nuthallensis Blame, 1970
F. stabilis Blame, 1970
Krempipollenites indicus Tiwari & Vijaya, 1995
Minutosaccus crenulatus Dolby, 1976
M. maedleri Kumaran & Maheshwari, 1980
Nidipollenites monoletes Bharadwaj & Srivastava, 1969
Ovalipollis varus Klaus, 1960
Plicatisaccus badius Pautsch, 1971
Rimaesporites aquilonalis Goubin, 1965
Satsangisaccites nidpurensis Bharadwaj & Srivastava, 1969
S. triassicus Bharadwaj & Srivastava, 1969
Samaropollenites speciosus Goubin, 1965
Sahnites panchetensis Tiwari & Singh, 1984

TAENIATE BISACCATE

- Arcuatipollenites damudicus* Tiwari & Rana, 1980
A. pellucidus Tiwari & Vijaya, 1995
A. ovatus Tiwari & Vijaya, 1995
A. tethysensis (Vijaya & Tiwari) Tiwari & Vijaya, 1995
Infernopolllenites claustratus Dolby & Balme, 1976

- I. sulcatus* Litwin & Ash, 1995
I. simplex Kumaran & Maheshwari, 1980
Lunatisporites noviaulensis Leschik, 1955
L. rhaeticus (Schultz) Warrington, 1974

MONOSACCATE

- Barakarites indicus* Bharadwaj & Tiwari, 1964
B. triquetrus Tiwari, 1965
Callialasporites dampieri (Balme) Dev, 1961
C. turbatus (Balme) Schultz, 1967
Densipollenites annulatus Jha, 1995
D. densus Bharadwaj & Srivastava, 1969
D. indicus Bharadwaj, 1962
D. invius Bharadwaj & Salujha, 1964
D. magnicorpus Tiwari & Rana, 1981
Enzonalsporites vigens Leschik, 1955
Enzonalsporites sp.
Goubinispora indica Tiwari & Rana, 1981
G. morondavensis (Goubin) Tiwari & Rana, 1981
G. triassica n. sp.
Kamthisaccites kamthiensis Srivastava & Jha, 1986
K. ringus n. sp.
Playfordiaspora cancellosa (Maheshwari & Banerji) Vijaya, 1995
Playfordiaspora hexagonalis (Klaus) Vijaya, 1995
Plicatisaccus badius Pautsch, 1971
Staurosaccites minutus Kumaran & Maheshwari, 1980
S. marginalis Kumaran & Maheshwari, 1980
S. tharipatharensis Kumaran in Maheshwari & Kumaran, 1979
S. quadrifidus Dolby in Dolby & Balme, 1976

TRISACCATE

- Dacrycarpites europaeus* Mädler, 1964
Trisaccites variabilis (Dev) Haskell, 1968

SULcate

- Araucariacites australis* (Cooks.) Couper, 1953
*Classopollis anasillo*s Filatoff, 1975
C. harrisii Muir & Konij. – Cittert, 1970
C. meyeriana (Klaus) de Jersey, 1974
C. simplex Reiser & Williams, 1969
Labiipollis granulatus Mädler, 1964
Monosulcites perforatus Mädler, 1964
Praecolpatites sinuosus Bharadwaj & Srivastava, 1969
Pretricolpipedites bharadwajii Balme, 1970
Weylandites lucifer (Bharad. & Sal.) Bharadwaj & Srivastava, 1969

ALETE

- Bartenia communis* Helby, 1987
Brazillea punctata Tiwari & Navale, 1967
Cerebropollenites sp.
Chytroeisphaeridia variabilis Pocock, 1962
Circulisporites parvus de Jersey, 1962

- Conaletes gondwanensis* Kumaran & Maheshwari, 1980
Cymatiosphaera sp.
Grebospora concentrica Jansonius, 1962
Hemisphaeridium sp.
Lecaniella foveolatus Filatoff, 1975
Leiosphaeridia sp.
Peltacystia sp.
Pilasporites crateriformis Jain, 1968
Schizosporis sp.
Tasmanites suevicus (Eisen.) Wall, 1965
Type A
Type B
Type C
Quadrисporites horridus Potonie & Lele, 1961

MEGASPORE

Porcellispora sp cf. *P. longdonensis* (Clarke) Scheuring, 1970

of stratigraphically significant species (Fig. 3), that facilitate dating and correlation of the studied lithosequence. These assemblages are described below.

Borehole SSM-1 (total depth 716.15-152.56m): the pattern of species distribution in the productive samples is given in Table 4.

Assemblage A: Table 4, Fig. 3

Sample Depths: 716.15, 696.90, 688.70 m

Lithology: Fine-grained sandstone with grey shale clasts, grey shale, fine-grained sandstone.

Dominant: *Arcuatipollenites*

Subdominant: *Striatopodocarpites*

Age Marker Species: *Apiculatisporites globosus*, *Camerosporites secatus*, *C. verrucatus*, *Verrucosisporites morulae*, *Cadargasporites baculatus*, *C. granulatus*, *C. reticulatus*, *Polycingulatisporites densatus*, *Aratrisporites coryliseminis*, *A. flexibilis*, *Leptolepidites argentiformis*, *Grandispora spinosa*, *Lunatisporites rhaeticus*, *Cerebropollenites* sp., *Porcellispora* sp. cf. *P. longdonensis*, *Clavatisporites hammenii*, *Aulisporites astigmosus*.

Other Species: *Conaletes gondwanensis*, *Carnisporites raniganjensis*, *Densosporites raceviewensis*, *Nevesisporites vallatus*, *Kraeuselisporites cuspidatus*, *Lundbladispora baculata*, *L. willmottii*, *Striatopodocarpites dubrajpurensis*, *S. auriculatus*, *Arcuatipollenites damudicus*, *A. tethysensis*, *Lunatisporites noviaulensis*, *Ovalipollis rarus*.

Remarks: The species which indicate the Early Triassic age are : *Callumispora gretensis*, *Playfordiaspora cancellosa*, *Lundbladispora densispinosa*, *L. brevicula*, *L. microconata*, *Goubinispora indica*, *G. morondavensis*, *Verrucosisporites narmianus*, *V. triassicus*, *V. densus*, *Nevesisporites vallatus*, *Guttatisporites guttatus*, *G. ambiguus*, *G. microechinatus*, *Sahnites panchetensis*, *Alisporites asansoliensis*,

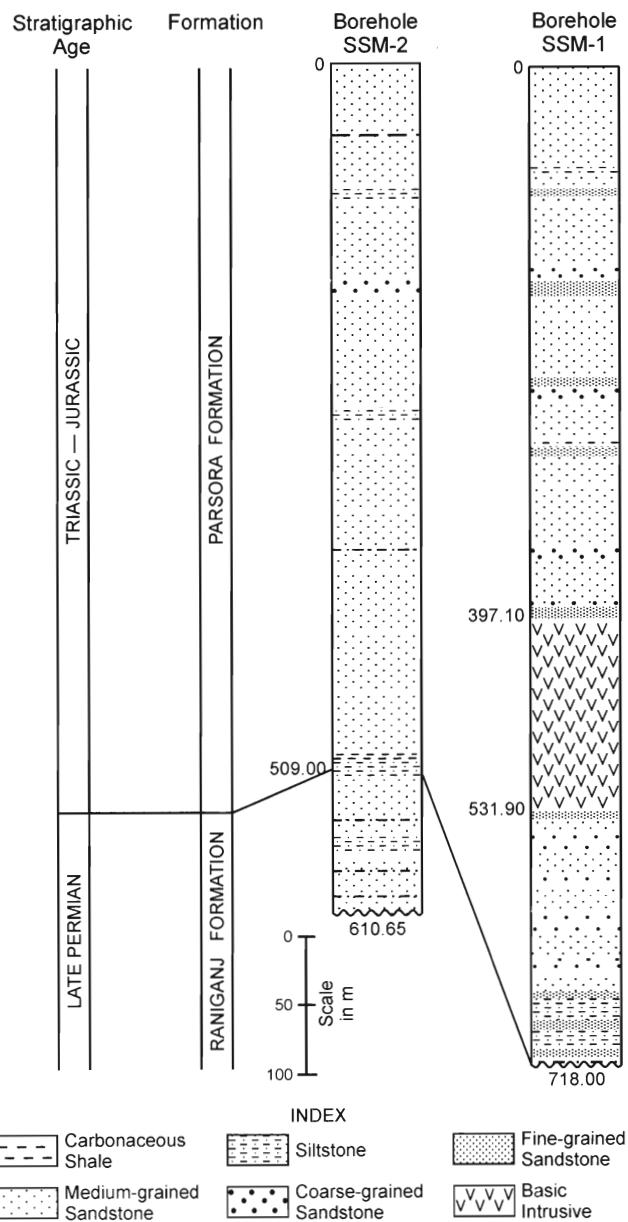


Fig. 2. Lithocolumns of boreholes SSM-1 and SSM-2, illustrating various lithofacies in the Raniganj and Parsora formations.

Satsangisaccites spp., *Falcisporites* spp., *Krempipollenites indicus*, *Arcuatipollenites pellucidus*, *A. ovatus*, *Striatopodocarpites* spp.

A number of species (Table 4) are recorded in the younger strata at 688.70 m depth in the Parsora Formation. The species *Cadargasporites* spp., *Clavatisporites hammenii*, *Camerosporites verrucosus*, *Verrucosisporites morulae*, *Arcuatipollenites tethysensis*, *Chytroeispheridium variabilis* and *Lunatisporites rhaeticus* are present frequently. These species in association with the age marker species mentioned above, suggest that Assemblage A is correlatable with the known palynological assemblages from the Upper Triassic of India and Australia (Figs. 4, 5; Table 6), that are Late Triassic (Norian) in age (Dolby and Balme, 1976; Helby *et al.*, 1987; Prasad, 1997). The marker taxa *Classopollis* is known only

Table 4: Distribution pattern of spore-pollen species recorded in Borehole SSM-1.

Palynotaxa	Depth of sample	Assemblage-A		Assemblage-B	
		716.15 m	688.70 m	152.56 m	
<i>Conaletes gondwanensis</i>		++	+	+	
<i>Densosporites raceviewensis</i>		+	+	+	
<i>Goubinispora indica</i>		+	+	+	
<i>G. morondavensis</i>		+	+	+	
<i>G. triassica</i>		+	+	+	
<i>Apiculatisporis globosus</i>		+	+		
<i>Carnisporites raniganjensis</i>		+	+	+	
<i>Camerosporites secatus</i>		+	+		
<i>Verrucosporites morulae</i>		+	++		
<i>Polycingulatisporites densatus</i>		+	+	++	
<i>Nevesisporites vallatus</i>		+	+	+	
<i>Aratrisporites coryliseminis</i>		+	+		
<i>Cadargasporites reticulatus</i>		+	+		
<i>Striatopodocarpites dubrajpurensis</i>		+	+	+	
<i>S. auriculatus</i>		+	+	+	
<i>Staurosaccites marginalis</i>		+			
<i>Arcuatipollenites damudicus</i>		+	+	+	
<i>A. tethysensis</i>		+	++		
<i>Aratrisporites flexibilis</i>			+		
<i>Chytroeisphaeridia variabilis</i>			++		
<i>Lunatisporites noviaulensis</i>		+	+	+	
<i>Kraeuselisporites cuspidus</i>		+	+	+	
<i>Leptolepidites argentiformis</i>			+		
<i>Lundbladispora baculata</i>		+	+		
<i>Cerebropollenites</i> sp.			+		
<i>Lundbladispora willmotti</i>		+	+		
<i>Lunatisporites rhaeticus</i>		+	+++	+	
<i>Camerospores verrucosus</i>		+	++		
<i>Lecaniella foveolatus</i>		+	+		
<i>Porcellispora longdonensis</i>		+	++		
<i>Grandispora spinosa</i>			+	+	
<i>Cadargasporites baculatus</i>		+	+++	++	
<i>Cadargasporites granulatus</i>			+	+	
<i>Ovalipollis rarus</i>			+		
<i>Cadargasporites verrucosus</i>				+	
<i>Tethysispora indica</i>		+	+	+	
<i>Dubrajisporites isolatus</i>				+	
<i>Carnisporites hercynicus</i>				+	
<i>Clavatisporites hammenii</i>		+	++	+	
<i>Clavatisporites</i> sp.				+	
<i>Cingulizonates indicus</i>				+	
<i>C. verrucosus</i>				++	
<i>C. rhaeticus</i>				++	
<i>Lycopodiacycidites rugulatus</i>				+	
<i>Chasmatosporites apertus</i>				+	
<i>C. hians</i>				+	
<i>Camerozonosporites clivosus</i>				+	
<i>Kraeuselisporites verrucifer</i>				+	
<i>Dictyophyllidites surangei</i>				+	
<i>Retitriletes huttonensis</i>				+	
<i>Lapposisporites armatus</i>				+	
<i>Concavisimmisporites penolaensis</i>				+	
<i>Conbaculatisporites mesozoicus</i>				+	
<i>Spinotriletes echinoides</i>				+	
<i>Plicatisaccus badius</i>				+	
<i>Staurosaccites quadrifidus</i>				+	
<i>Minutosaccus crenulatus</i>				+	
<i>M. maedleri</i>				+	
<i>Dacrycarpites europaeus</i>				+	
<i>Classopollis meyeriana</i>				++	
<i>C. anastiv'os</i>				+	
<i>C. harris'i</i>				+	
<i>Araucariacites australis</i>				+	
<i>Callialasporites turbatus</i>				+	

Table 5: Distribution pattern of spore-pollen species in the Assemblage-I, II, IIIa and IIIb in Borehole SSM-2.

Palynotaxa	Depth	Assemb-I		Assemb-II		Assemb-IIIa		Assemb-IIIb				
		547.00-543.00	542.00	537.00-514.00		508.50-505.00	504.50	487.00	476.85-424.45	358.45	265.00	261.75
Brevitriletes communis		+										
<i>Cyclogranisporites gondwanensis</i>		+										
<i>Horriditriletes rampurensis</i>		+										
<i>Callumispora gretensis</i>		+					+					
<i>Densipollenites</i> spp.		+										
<i>Densipollenites magnicorpus</i>		+		+								
<i>Faunipollenites varius</i>		+		+		+						
<i>Verticipollenites gibbosus</i>		+										
<i>Verticipollenites finitimus</i>		+										
<i>Distriatopollenites bilateris</i>		+										
<i>Striasulcites ovatus</i>		+										
<i>Schizopollis distinctus</i>		+										
<i>Tumoripollenites baculosus</i>		+										
<i>Guttulapollenites hannonicus</i>		+		+								
<i>Striatopodocarpites magnificus</i>		+		+		+						
<i>Striatopodocarpites diffusus</i>		+		+								
<i>Praecolpatites sinuosus</i>		+		+								
<i>Barakarites triquetrus</i>		+										
<i>Rhizomaspores triassica</i>		+		+		+						
<i>Arcuatipollenites diffusus</i>		+		+		+						
<i>Indotriradites mammilatus</i>				+								
<i>Krempipollenites indicus</i>		+		+		+						
<i>Falcisporites stabilis</i>		+		+		+						
<i>Falcisporites nuthallensis</i>		+		+		+						
<i>Nidipollenites monoletes</i>		+				+						
<i>Satsangisaccites nidpurensis</i>		+		+		+						
<i>Verrucosporites densus</i>		+				+						
<i>Verrucosporites triassicus</i>		+				+						
<i>Osmundaciliates senectus</i>		+				+						
<i>Densoisporites contactus</i>		+				+		+				
<i>Polypodiisporites ipsiviciensis</i>		+										
<i>Pretricolipollenites bharadwajii</i>		+										
<i>Densipollenites annulatus</i>		+										
<i>Arcuatipollenites ovatus</i>		+			+		+		+			
<i>Arcuatipollenites pellucidus</i>		+			+		+		+			
<i>Ringosporites fossulatus</i>		+									+	
<i>Foveosporites moretonensis</i>		+										
<i>Playfordiaspora cancellosa</i>		+			+		+		+			
<i>Goubinispora indica</i>		+										
<i>Con verrucosporites cameronii</i>					+							
<i>Verrucosporites carnarvonensis</i>					+							
<i>Verrucosporites narmianus</i>					+							+
<i>Cadrgasporites baculatus</i>					+							
<i>Guttatisporites guttatus</i>					+			+	+			
<i>Guttatisporites ambiguus</i>					+			+	+			
<i>Guttatisporites microechinatus</i>					+			+	+			
<i>Aratrisporites parvispinosus</i>					+							
<i>Concavissimisporites subverrucosus</i>					+				+			
<i>Lundbladispora willmotti</i>					+				+			
<i>Lundbladispora microconata</i>					+							
<i>Cingutriletes clavus</i>					+							
<i>Densosporites raceviewensis</i>					+							+
<i>Tethysporites playfordii</i>					+							+
<i>Tethysporites indica</i>					+							+
<i>Infernopolllenites claustratus</i>					+							+
<i>Arcuatipollenites damudicus</i>					+			+				+

<i>Arcuatipollenites tethysensis</i>	+	+	+
<i>Lunatisporites noviaulensis</i>	+	+	+
<i>Striatopodocarpites dubrajpurensis</i>	+		+
<i>Pilasporites crateriformis</i>	+		
<i>Tasmanites suevicus</i>	+		
<i>Cymatiosphaera</i> sp.	+		
<i>Peltacystia</i> sp.	+		
<i>Kraeuselisporites saeptatus</i>		+	
<i>Camerosporites verrucosus</i>	+	+	
<i>Foveosporites triassicus</i>	+		+
<i>Enzonalasporites vigens</i>	+		+
<i>Staurosaccites minutus</i>		+	
<i>Convertubisporites variabilis</i>		+	
<i>Converrucosporites</i> sp.		+	
<i>Verrucosporites varians</i>		+	
<i>Pyramidosporites racemosus</i>		+	
<i>Carnisporites raniganjensis</i>		+	+
<i>Hamisphaeridium</i> sp.		+	
<i>Grebescora concentrica</i>		+	+
<i>Cristaisaccus cristatus</i>		+	
<i>Playfordiaspora cancellosa</i>		+	
<i>Rimaeasporites aquilonalis</i>		+	
<i>Minutosaccus crenulatus</i>		+	
<i>Aratrisporites paenulatus</i>		+	
<i>Undulatisporites dilucidus</i>		+	
<i>Lundbladispora brevicula</i>		+	+
<i>Kamthisaccites ringus</i>		+	
<i>Uvaesporites verrucosus</i>		+	+
<i>Densoisporites playfordii</i>		+	
<i>Clavatisporites hammenii</i>		+	
<i>Taurocusporites verrucatus</i>		+	
<i>Accintisporites ligatus</i>		+	
<i>Infernopolllenites sulcatus</i>		+	
<i>Bartenia communis</i>		+	+
<i>Callumispora fungosa</i>		+	
<i>Cyclotriletes oligogranifer</i>		+	
<i>Kraeuselisporites verrucifer</i>		+	+
<i>Trilites tuberculiformis</i>		+	
<i>Labiipollis granulatus</i>		+	
<i>Densoisporites mesozoicus</i>			+
<i>Lecaniella foveolatus</i>			+
<i>Nevesisporites vallatus</i>			+
<i>Kraeuselisporites saeptatus</i>			+
<i>Alete</i> (with weak zone)			+
<i>Spinotriletes echinoides</i>			+
<i>Lundbladispora reticulata</i>			+
<i>Camerozonosporites rufus</i>			+
<i>Dictyotosporites filosus</i>			+
<i>Nevesisporites limatulus</i>			+
<i>Circulisporites parvus</i>			+
<i>Cingutriletes</i> sp.			+
<i>Clavatriletes</i> sp.			+
<i>Ceratosporites helidonensis</i>			+
<i>Carnisporites mesozoicus</i>			+
<i>Lycopodiadicidites rugulatus</i>			+
<i>Ischyosporites</i> sp.?			+
<i>Lundbladispora densispinosa</i>			+
<i>Guttatisporites visscheri</i>			+
<i>Convolutispora</i> sp.			+
<i>Ringosporites ringus</i>			+
<i>Verrucosporites morulae</i>			+
<i>Anapiculatisporites telephorus</i>			+
<i>Concavissimisporites penolaensis</i>			+
<i>Callialasporites turbatus</i>			+

Table 6: Pattern of occurrence and distribution of age marker species in the Assemblage-IIIa and IIIb in Borehole SSM-2.

Palynotaxa	IIIa		IIIb		462.60-424.45	358.45	261.75
	Depth						
<i>Converrucosporites cameronii</i>	+	+					
<i>Verrucosporites carnarvoniensis</i>	+	+					
<i>Cadargasporites baculatus</i>	+	+					
<i>Densospores raceviewensis</i>	+	+					
<i>Cingulitrites clavus</i>	+	+					
<i>Arcuatipollenites damudicus</i>	+	+	+	+			
<i>Arcuatipollenites tethysensis</i>	+	+	+	+			
<i>Lunatisporites noviaulensis</i>	+	+	+	+			
<i>Striatopodocarpites dubrajpurensis</i>	+	+		+			
<i>Infernopolenites claustratus</i>	+	+			+		
<i>Tethysispora spp</i>	+	+				+	+
<i>Kraeuselisporites saeptatus</i>			+				
<i>Camerospores verrucosus</i>			+	+			
<i>Enzonatusporites vigens</i>			+	+	+		
<i>Concavissimisporites subverrucosus</i>				+			
<i>Carnisporites raniganjensis</i>				+			
<i>Undulatisporites dilucidus</i>				+			
<i>Grebescora concentrica</i>				+			
<i>Staurosaccites densus</i>				+			
<i>Kamthiaccites ringus</i>					+		
<i>Uvaesporites verrucosus</i>				+			
<i>Clavatisporites hammenii</i>				+			
<i>Tauroctesporites verrucatus</i>				+			
<i>Bartenia communis</i>				+			
<i>Infernopolenites sulcatus</i>					+		
<i>Kraeuselisporites verrucifer</i>					+		
<i>Trilites tuberculiformis</i>					+		
<i>Labiipollis granulatus</i>					+		
<i>Spinotriletes echinoides</i>						+	
<i>Lecaniella sp</i>						+	
<i>Lundbladispora reticulata</i>							+
<i>Comerozonosporites rufus</i>							+
<i>Dictyotosporites filosus</i>							+
<i>Nevesisporites limatulus</i>							+
<i>Clavatisporites hammenii</i>							+
<i>Ceratosporites helidonensis</i>							+
<i>Carnisporites mesozoicus</i>							+
<i>Anapiculatisporites telephorus</i>							+
<i>Lycopodiacaedites rugulatus</i>							+
<i>Ischyosporites sp.</i>							+

from the Rhaetic palynoflora (Dolby and Balme, 1976; Helby et al., 1987; Prasad, 1997). Its absence in the present assemblage supports the Carnian age for this palynocomposition.

Suggested Age: Late Triassic (Carnian), Fig. 4

Assemblage B: Table 4, Fig. 3

Sample Depth: 152.56 m

Lithology: Dark grey - sandy shale

Dominant: *Arcuatipollenites*, *Striatopodocarpites*, *Satsangisaccites*

Subdominant: *Goubinispora*

Age Marker Species: *Lycopodiacidites rugulatus*, *Chasmatosporites apertus*, *C. hians*, *Dictyophyllidites*

surangei, *Retitriletes huttonensis*, *Plicatisaccus badius*, *Dacrycarpites europaeus*, *Classopollis anasillos*, *C. harrisii*, *C. meyeriana*, *Callialasporites turbatus*.

Other Species: Most of the species recorded in Assemblage A continue in Assemblage B. The group of species appearing at 152.56 m depth is: *Cingulizonates indicus*, *C. verrucosus*, *C. rhaeticus*, *Camerozonosporites clivosus*, *Kraeuselisporites verrucifer*, *Lapposporites armatus*, *Conbaculatisporites mesozoicus*, *Spinotriletes echinoides*, *Plicatisaccus badius*, *Staurosaccites quadrifidus*, *Minutosaccus crenulatus*.

Remarks: Compared to the diverse composition of spores-pollen species in Assemblage A (716.15 - 688.70 m depth), Assemblage B (152.56 m depth) is depleted in its species

Table 7: Comparative distribution ranges of Age Marker species in Late Triassic sequences of India (various basins) and Australia

BH/ Depth	Assemb Identified	Dominant taxa	Characteristic species	Key species
SSM-1 152.56m	B	<i>Arcuatipollenites</i> <i>Striatopodocarpites</i> , <i>Satsangisaccites</i>	<i>Cingulizonates indicus</i> , <i>C. verrucosus</i> , <i>C. rhaeticus</i> , <i>Chasmatosporites apertus</i> , <i>Lapposporites armatus</i> , <i>Concavissimisporites penolaensis</i> , <i>Plicatisaccus badius</i> , <i>Araucariacites australis</i>	<i>Dictyophyllidites surangei</i> , <i>Retitriletes huttonensis</i> , <i>Dacrycarpites europaeus</i> , <i>Classopollis meyeriana</i> , <i>Classopollis anasillos</i> , <i>Classopollis harrisii</i> , <i>Callialasporites turbatus</i>
SSM-2 261.75- 487.00m	IIIb	<i>Arcuatipollenites/</i> <i>Striatopodocarpites</i>	<i>Convertubisporites variabilis</i> , <i>Carnisporites raniganjensis</i> , <i>Kraeuselisporites verrucifer</i> , <i>Grebepsora concentrica</i> , <i>Minutosaccus crenulatus</i> , <i>Kamthisaccites ringus</i> , <i>Clavatisporites hamenii</i> , <i>Bartinia communis</i> , <i>Cyclotriletes oligograiner</i> , <i>Labiipollis granulatus</i> , <i>Staurosaccites densus</i>	<i>Ceratosporites holidonensis</i> , <i>Uvaesporites verrucosus</i> , <i>Trilites tuberculiformis</i> , <i>Dictyotosporites filosus</i> , <i>Ischyosporites sp.</i> , <i>Lycopodiacidites rugulatus</i> , <i>Camerozonsporites rufus</i> , <i>Concavissimisporites penolaensis</i> , <i>Undulatisporites dilucidus</i>
SSM-2 504.00- 508.50m	IIIa	<i>Striatopodocarpites/</i> <i>Arcuatipollenites</i>	<i>Aratrisporites parvispinosus</i> , <i>Cingutrilites clavus</i> , <i>Cardargasporites baculatus</i> , <i>Densosporites raceviewensis</i> , <i>Infernopolenites clastratus</i> , <i>Kraeuselisporites saeptatus</i> , <i>Foveosporites triassicus</i> , <i>Striatopodocarpites dubrajpurensis</i>	<i>Camerosporites verrucosus</i> , <i>Enzonalasporites vigens</i> , <i>Concavissimisporites subverrucosus</i> , <i>Tethysispora indica</i> , <i>T. playfordii</i> , <i>Arcuatipollenites damudicus</i> , <i>A. tethysensis</i> .
SSM-1 688.70- 716.50m	A	<i>Arcuatipollenites/</i> <i>Striatopodocarpites</i>	<i>Conaletes gondwanensis</i> , <i>Densosporites raceviewensis</i> , <i>Aratrisporites coryiseminis</i> , <i>Arcuatipollenites noviaulensis</i> , <i>Cerebropollenites sp.</i> , <i>Lecaniella foveolatus</i> , <i>Cadargasporites baculatus</i> , <i>C. verrucosus</i> , <i>C. granulatus</i> , <i>Ovalipollis rarus</i>	<i>Apiculatisporites globosus</i> , <i>Camerosporites secatus</i> , <i>Leptolepidites argentiformis</i> , <i>Polycingulatisporites densatus</i> , <i>Grandispora spinosa</i> , <i>Striatopodocarpites dubrajpurensis</i> , <i>Striatopodocarpites auriculatus</i> , <i>Arcuatipollenites tethysensis</i> , <i>Lunatisporites rhaeticus</i>
SSM-2 514.00- 537.00m	II	<i>Satsangisaccites /</i> <i>Striatopodocarpites</i>	<i>Verrucosporites triassicus</i> , <i>Indotriradites mammillatus</i> , <i>Densipollenites annulatus</i> , <i>Rhizomaspora triassicus</i> , <i>Aumancisporites cf. A. indicus</i>	<i>Arcuatipollenites pellucidus</i> , <i>A. ovatus</i> , <i>Ringosporites fossulatus</i> , <i>Nevesisporites vallatus</i> , <i>Foveosporites moretonensis</i> , <i>Lundbladispora sp</i>
SSM-2 542.00- 547.00m	I	<i>Striatopodocarpites</i>	<i>Densipollenites magnicorus</i> , <i>Distriatites bilateris</i> , <i>Tumoriopollenites baculosus</i> , <i>Verticipollenites gibbosus</i> , <i>Crescentipollenites fuscus</i>	FADs of <i>Krempipollenites indicus</i> , <i>Arcuatipollenites diffusus</i> , <i>Satsangisaccites nidipurensis</i> , <i>Goubinispora indica</i> , <i>Playfordiaspora cancellosa</i>

Fig. 3. Palynoassemblages identified in boreholes SSM-1 and SSM-2 along with their characteristics.

diversity as shown in Table 4. The species which are noted at 152.56 m depth include: *Lycopodiacidites rugulatus*, *Chasmatosporites apertus*, *Dictyophyllidites surangei*, *Retitriletes huttonensis*, *Concavissimisporites penolaensis*, *Dacrycarpites europaeus*, *Classopollis meyeriana*, *C. anasillos*, *C. harrisii* and *Callialasporites turbatus*. These species are reported from the palynoflora of Rhaetic age (Helby *et al.*, 1987; Playford and Dettmann, 1965; Dolby and Balme, 1976; Tripathi, 2001). The record of *Callialasporites turbatus* along with species of *Classopollis* in this assemblage suggests Late Rhaetic age for the Assemblage B.

Suggested Age: Late Triassic (Late Rhaetic), Fig. 4.

Borehole SSM-2 (total depth 542.00-261.75 m): the pattern of species distribution is given in Tables 5, 6.

Assemblage I: Table 5, Fig.3

Sample Depths: 547.00, 543.00; 542.00m

Lithology: Dark grey sandy carbonaceous shales, siltstone.

Dominant: *Striatopodocarpites*

Age Marker Species: *Densipollenites magnicorus*, *Nidipollenites monoletes*, *Callumispora gretensis*, *Arcuatipollenites diffusus*, *Indotriradites mammillatus*, *Falcisporites stabilis*, *F. nuthallensis*, *Krempipollenites indicus*, *Playfordiaspora cancellosa*.

Other Species: *Horriditriletes rampurensis*, *Brevitriletes communis*, *Cyclogranisporites gondwanensis*, *Densipollenites indicus*, *D. invisus*, *D. densus*, *D. annulatus*, *Alete type A*, *Verticipollenites gibbosus*, *Guttulapollenites hannonicus*, *Tumoriopollenites*

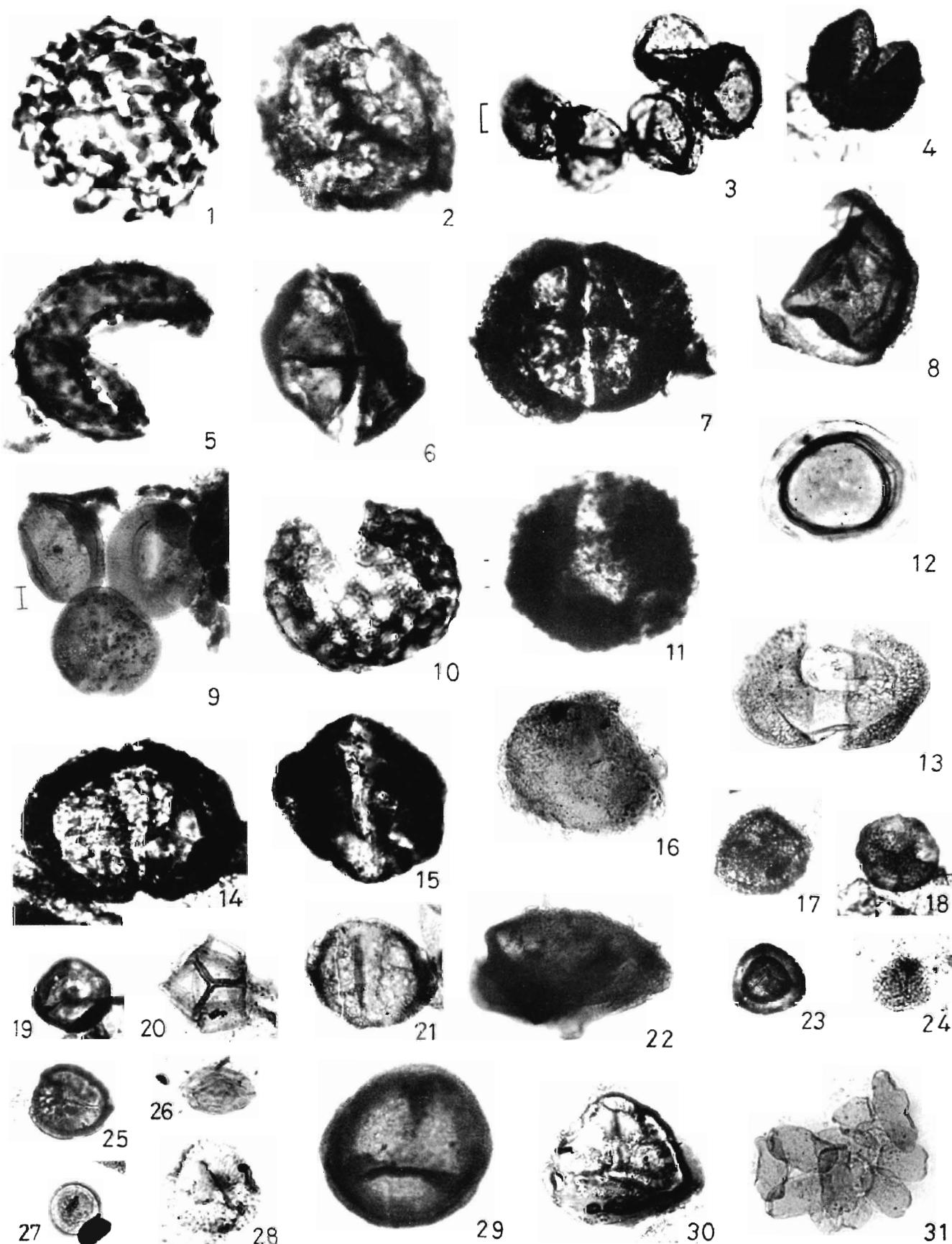
SERIES	STAGE	SOUTH REWA (1)	KRISHNA- GODAWARI (2)	RAJMAHAL (3)	DAMODAR (4)	PRESENT STUDY (5)
LATE TRIASSIC	RHAETIC			<i>Arcuatipollenites tethysensis</i> Assemblage Zone		Assemblage B
	NORIAN	<i>Tikisporites balmei</i> Zone	<i>Enzonalasporites ignacii</i> - <i>Minutosaccus crenulatus</i> Assemblage Zone	<i>Dubrajisporites triassicus</i> Assemblage Zone		Assemblage III b
	CARNIAN		<i>Rimaesporites potoniei</i> <i>samaropollenites speciosus</i> Assemblage Zone	<i>Rajmahalispora rugulata</i> Assemblage Zone		Assemblage III a
MIDDLE TRIASSIC	LADINIAN				<i>Goubinispora indica</i> Assemblage Zone	
	ANISIAN					
EARLY TRIASSIC	SCYTHIAN				<i>Playfordiaspora cancellosa</i> Assemblage Zone	
		<i>Krempipollenites indicus</i> Zone		<i>Krempipollenites indicus</i> Assemblage Zone	<i>Krempipollenites indicus</i> Assemblage Zone	Assemblage II
LATE	PERMIAN			<i>Densipollenites magnicorpus</i> Assemblage Zone	<i>Densipollenites magnicorpus</i> Assemblage Zone	Assemblage I

Fig. 4. Sequential stratigraphic placement (in ascending order) of presently identified palynoassemblages and their comparison with known palynozones in different basins on Indian peninsula.

EXPLANATION OF PLATE II

(Scale bar 10 µm, scale in figure 3 stands for all except figure 9)

1. *Convolutispora* sp., SSM-2/261.75, BSIP Slide No 13010.
2. 8. *Cadargasporites reticulatus*, SSM-2/261.75, SSM-1/39, BSIP Slide No 13008.
3. *Cadargasporites baculatus*, SSM-1/152.56, BSIP Slide No 13009.
4. *Schizosporis* sp., SSM-1/152.56, BSIP Slide No 13009.
5. *Clavatisporites hammenii*, SSM-2/261.75, BSIP Slide No 13010.
6. *Staurosaccites minutus*, SSM-2/487.50, BSIP Slide No 13016.
7. *Staurosaccites tharipatharensis*, SSM-1/152.56, BSIP Slide No 13009.
9. *Labiipollis granulatus*, SSM-2/358.45, BSIP Slide No 13012.
10. *Klukisporites varigatus*, SSM-2/261.75, BSIP Slide No 13010.
11. *Cerebropollenites* sp., SSM-2/504.50, BSIP Slide No 13017.
12. *Grebespora concentrica*, SSM-1/152.56, BSIP Slide No 13009.
13. *Infernopollenites simplex*, SSM-2/462.60, BSIP Slide No 13014.
14. *Plicatisaccus badius*, SSM-1/152.56, BSIP Slide No 13009.
15. *Minutosaccus crenulatus*, SSM-1/152.56, BSIP Slide No 13009.
16. *Accintisporites ligatus*, SSM-2/476.85, BSIP Slide No 13015.
17. *Dictyotosporites filosus*, SSM-2/261.75, BSIP Slide No 13010.
18. *Nevesisporites limatulus*, SSM-1/39, BSIP Slide No 13008.
19. *Lycospora* sp., SSM-1/152.56, BSIP Slide No 13009.
20. *Carnisporites mesozoicus*, SSM-2/261.75, BSIP Slide No 13010.
21. *Rimaesporites aquilonalis*, SSM-2/487.50, BSIP Slide No 13016.
22. *Megaspore Type A*, SSM-2/358.45, BSIP Slide No 13012.
23. *Polycingulatisporites densatus*, SSM-1/152.56, BSIP Slide No 13009.
24. *Uvaesporites verrucosus*, SSM-2/261.75, BSIP Slide No 13010.
25. *Camerozonosporites rudis*, SSM-2/261.75, BSIP Slide No 13010.
26. *Aratrisporites minimus*., SSM-2/537.00, BSIP Slide No 13020.
27. *Circulisporites parvus*, SSM-2/261.75, BSIP Slide No 13010.
28. *Converrucosporites cameroni*, SSM-2/542.00, BSIP Slide No 13021.
29. *Biretisporites potoniei*, SSM-2/358.45, BSIP Slide No 13012.
30. *Tikisporites balmei*, SSM-2/261.75, BSIP Slide No 13010.
31. *Bartenia communis*, SSM-2/476.85, BSIP Slide No 13015.



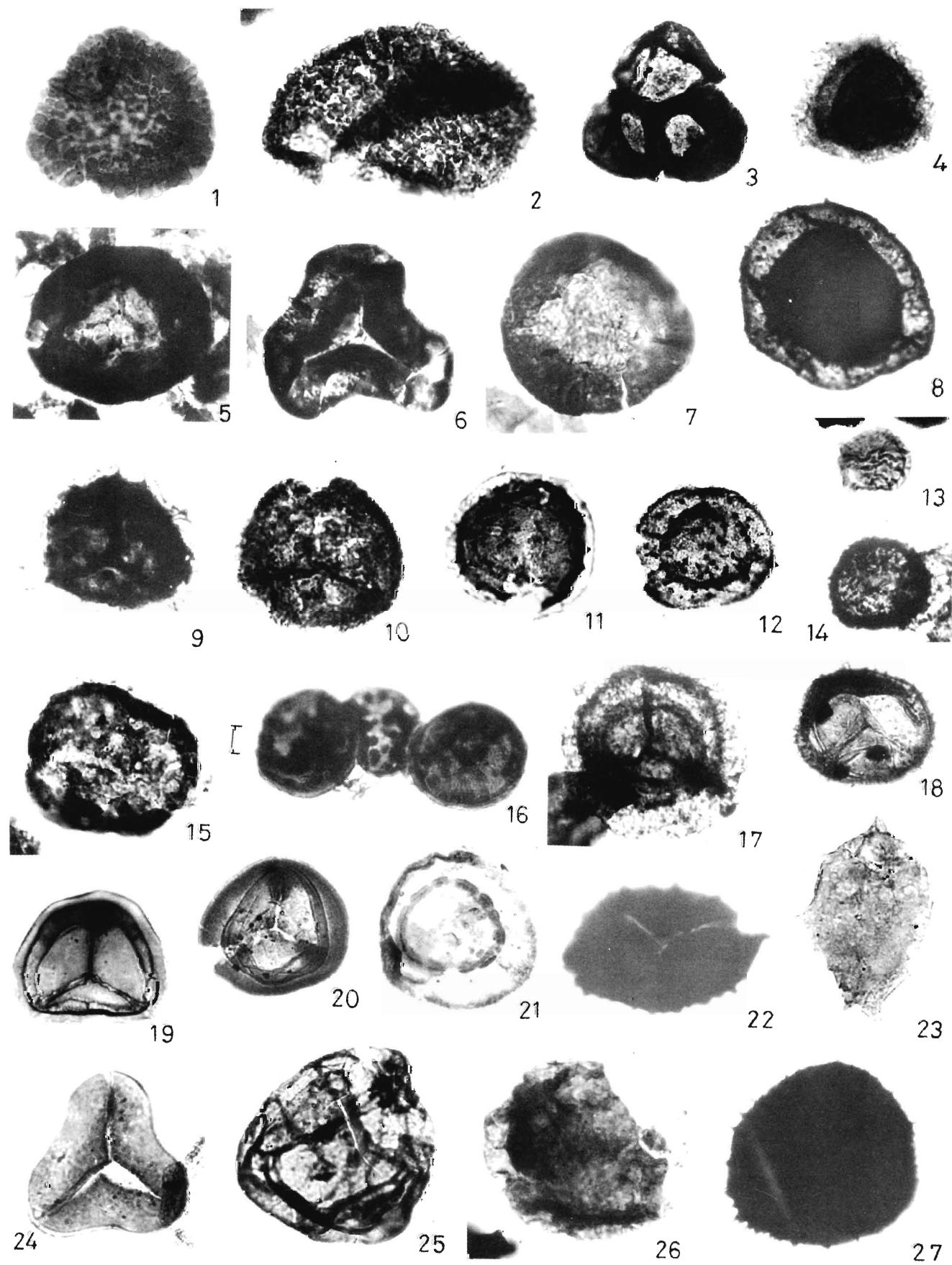
EPOCH	SERIES	AGE	PRESENT ASSEMBLAGE	PALYNOZONES IN LATE PERMIAN & TRIASSIC SEQUENCE	
				INDIA	AUSTRALIA
TRIASSIC	LATE	RHAETIC	ASSEMBLAGE B	<i>Arcuatipollenites tethysensis</i>	<i>Polycingulatisporites crenulatus</i>
		NORIAN	ASSEMBLAGE III b		
			ASSEMBLAGE III a	<i>Tikisporites balmei</i>	
		CARNIAN	ASSEMBLAGE A	<i>Rimaesporites potoniei</i>	<i>Craterisporites rotundus</i>
	MIDDLE	LADINIAN		<i>Goubinispora indica</i>	<i>Aratrisporites parvispinosus</i>
		ANISIAN		<i>Playfordiaspora cancellosa</i>	<i>Aratrisporites tenuispinosus</i>
	EARLY	SCYTHIAN	ASSEMBLAGE II	<i>Krempipollenites indicus</i>	<i>Protohaploxylinus samoilovichii</i>
					<i>Lunatisporites pellucidus</i>
PERMIAN	Late		ASSEMBLAGE I	<i>Densipollenites magnicorpus</i>	<i>Protohaploxylinus microcorpus</i>

Fig. 5. Chronology and correlation of presently identified palynoassemblages with the spore-pollen assemblages of Latest Permian and Triassic, in India (Maheshwari, Kumaran & Bose, 1978; Tiwari & Tripathi, 1992; Tripathi, 1996) and Australia (Helby *et al.*, 1987).

EXPLANATION OF PLATE III

(Scale bar 10 µm, scale in figure 16 stands for all)

1. *Triletes tuberculiformis*, SSM-2/358.45, BSIP Slide No 13012a.
2. *Verrucosporites morulae*, SSM-2/261.75, BSIP Slide No 13010.
3. *Classopollis meyeriana*, SSM-1/152.56, BSIP Slide No 13009.
4. *Dictyotosporites complex*, SSM-2/261.75, BSIP Slide No 13010.
5. *Chasmatosporites hians*, SSM-1/152.56, BSIP Slide No 13009.
6. *Conbaculatisporites* sp., SSM-1/152.56, BSIP Slide No 13009.
7. *Classopollis harrisii*, SSM-1/152.56, BSIP Slide No 13009.
8. *Porcellispora* sp. cf. *P. longdonensis*, SSM-1/39, BSIP Slide No 13008.
9. *Kraeuselisporites septatus*, SSM-1/152.56, BSIP Slide No 13009.
10. *Spinotriletes echinoides*, SSM-1/152.56, BSIP Slide No 13009.
11. *Spinotriletes senecioides*, SSM-2/261.75, BSIP Slide No 13010.
12. *Grandispora spinosa*, SSM-1/152.56, BSIP Slide No 13009.
13. *Tigrisporites halleinis*, SSM-2/261.75, BSIP Slide No 13010.
14. *Clavatisporites hammenii*, SSM-1/152.56, BSIP Slide No 13009.
15. *Dacrycarpites* sp., SSM-1/152.56, BSIP Slide No 13009.
16. *Taurocuspores verrucatus*, SSM-2/476.85, BSIP Slide No 13015.
17. *Cingulizones rhaeticus*, SSM-2/476.85, BSIP Slide No 13015.
18. *Anapiculatisporites telephorus*, SSM-2/261.75, BSIP Slide No 13010.
19. *Densosporites raceviewensis*, SSM-2/261.75, BSIP Slide No 13010.
20. *Cingulitrites* sp. C. clavus, SSM-2/261.75, BSIP Slide No 13010.
21. *Polycingulatisporites crenulatus*, SSM-2/261.75, BSIP Slide No 13010.
- 22,27. **Megaspore Type B**, SSM-1/39, BSIP Slide No 13008.
23. ? *Dinoflagellate*, SSM-2/261.75, BSIP Slide No 13010.
24. *Concavissimisporites subverrucosus*, SSM-2/261.75, BSIP Slide No 13010.
25. *Callialasporites turbatus*, SSM-1/152.56, BSIP Slide No 13009.
26. *Callialasporites dampieri*, SSM-2/508.50, BSIP Slide No 13018.



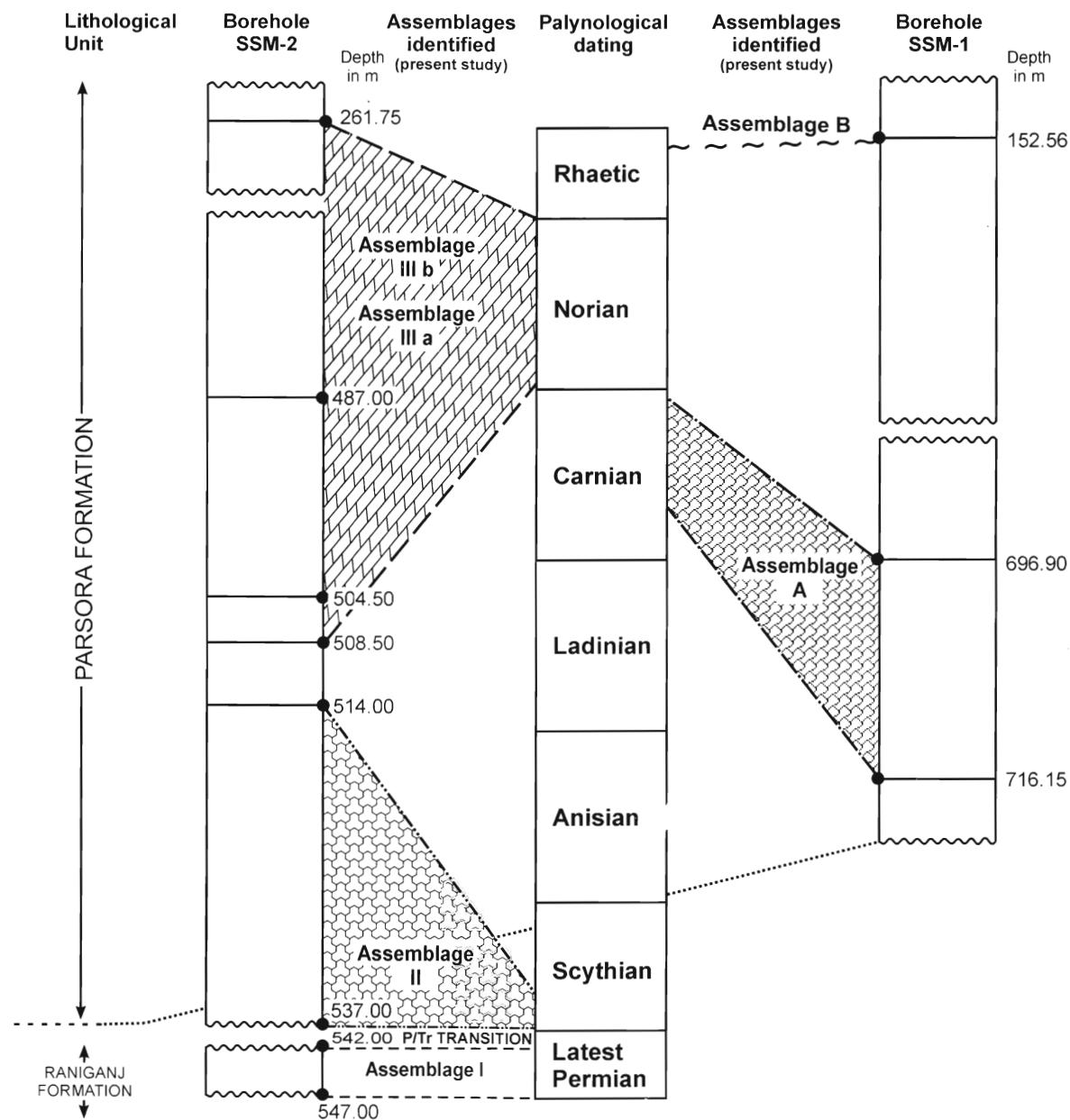
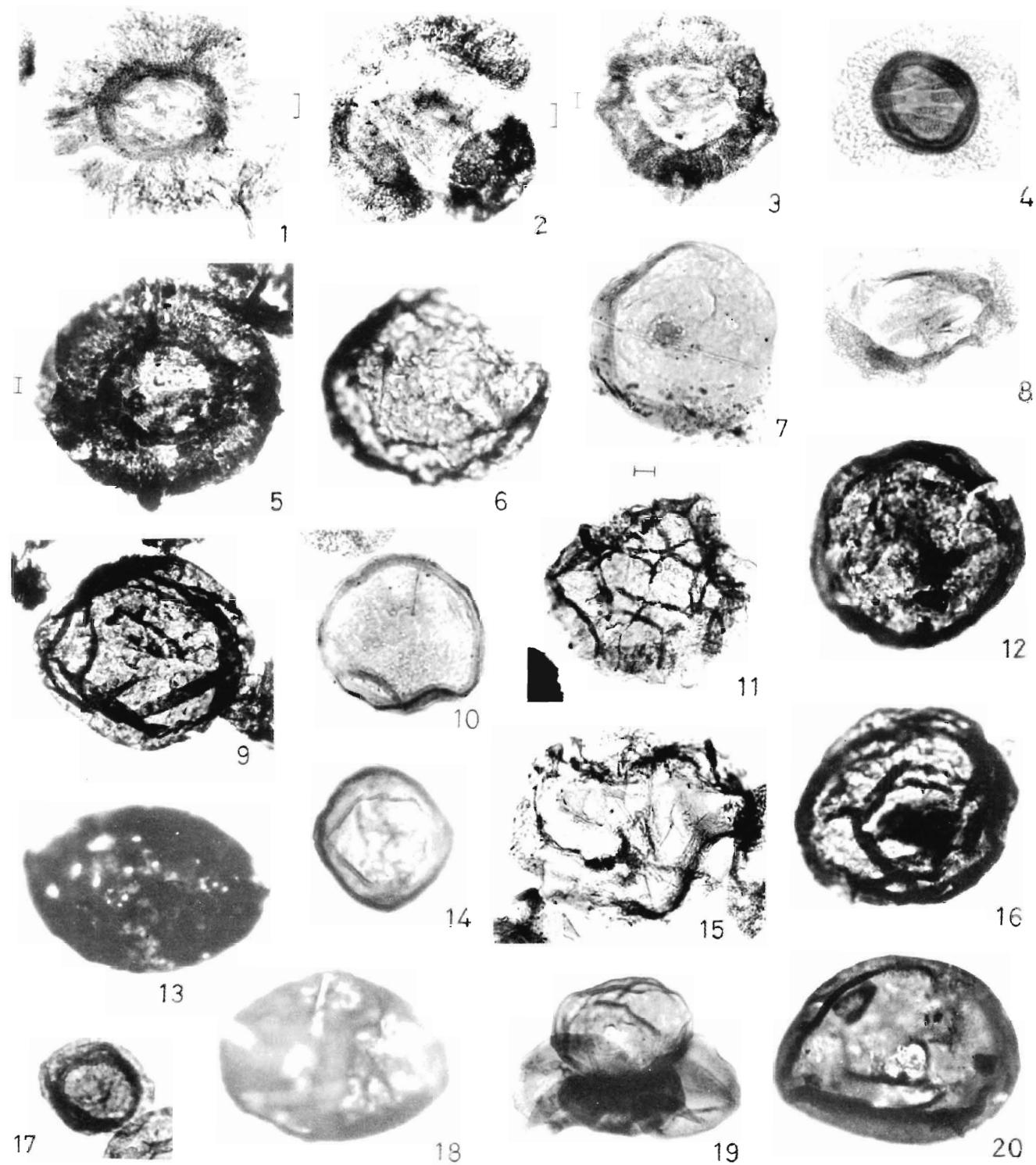


Fig. 6. Stratigraphic status of palynoassemblages - A, B, I, II, IIIa, and IIIb identified in the Raniganj and Parsora formations in two boreholes SSM-1 and SSM-2. Here Permo-Triassic transition is inferred in between 542.00 and 537.00m in Borehole SSM-2.

EXPLANATION OF PLATE IV

(Scale bar 10 µm, scale in figure 11 stands for all except figures 1, 2, 3, 5)

- 1, 5. *Gubinispora triassica*, SSM-2/261.75; SSM-1/ 152.56, BSIP Slide No 13010, 13009.
2. *Gubinispora morondavensis*, SSM-2/261.75, BSIP Slide No 13010.
3. *Kamthisaccites kamthiensis*, SSM-2/261.75, BSIP Slide No 13010.
- 4, 8. *Kamthisaccites ringus*, SSM-2/462.60, BSIP Slide No 13014, 13015.
6. *Leiosphaeridia* sp., SSM-1/39, BSIP Slide No 13008.
- 7, 10. *Brazillea punctata*, SSM-2/261.75, BSIP Slide No 13010.
9. *Alete*, SSM-1/ 152.56, BSIP Slide No 13009.
11. *Cymatosphaera* sp., SSM-1/26-152.56, BSIP Slide No 13009.
12. *Alete*, SSM-1/ 152.56, BSIP Slide No 13009.
13. *Lecaniella foveolatus*, SSM-1/39, BSIP Slide No 13008.
14. *Alete*, SSM-2/265.00, BSIP Slide No 13011.
15. *Alete*, SSM-2/261.75, BSIP Slide No 13010.
16. *Alete*, SSM-1/152.56, BSIP Slide No 13009.
17. *Peltacystia* sp., SSM-2/508.50, BSIP Slide No 13019.
18. *Alete*, SSM-1/39, BSIP Slide No 13008.
19. *Lecaniella Tetrads*, SSM-2/265.00, BSIP Slide No 13011.
20. *Aulisporites astigmosus*, SSM-1/152.56, BSIP Slide No 13009.



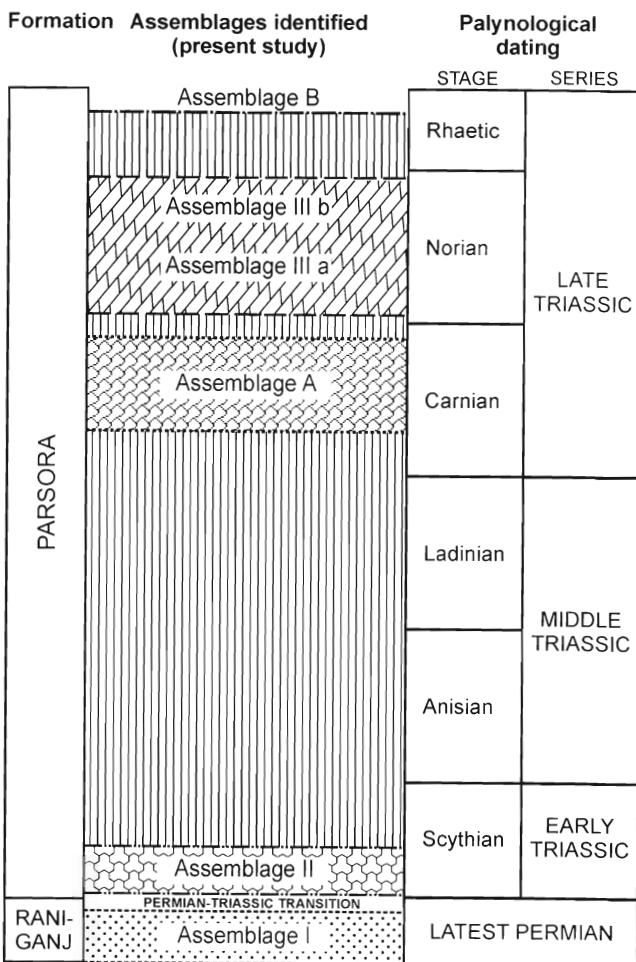


Fig. 7. Palynostratigraphy of the Raniganj and Parsora formations in boreholes SSM-1 and SSM-2, showing hiatus of various magnitudes inferred at the end-Permian and various levels in the Triassic sequence in the Mahuli-Mahersop area, Singrauli Basin, Sarguja District, Chhattisgarh. Vertical lines indicate hiatus.

raniganjensis, *Distriatites bilateris*, *Striasulcites ovatus*, *Schizopollis distinctus*, *Faunipollenites varius*, *Barakarites indicus*, *Weylandites lucifer*.

Remarks: Abundance of genus *Striatopodocarpites* in association with *Densipollenites magnicorpus* at 547.00 m depth suggest Late Permian age. The FADs of *Krempipollenites indicus*, *Arcuatipollenites diffusus*, *Indotriradites mammilatus*, and *Playfordiaspora cancellosa* at 542.00 m depth are of stratigraphic significance, and suggest latest Permian age for this part of the lithosequence which pertains to the Raniganj Formation. The increased frequency of these species in the up-section is indicative of the basal Triassic (Vijaya and Tiwari, 1987).

Suggested Age: Latest Permian, Fig.4

Assemblage II: Table 5, Fig. 3

Sample Depths: 537.00, 514.00 m

Lithology: Dark grey, very fine-grained shaly sandstone having fragmentary plant and carbonaceous shale pieces. Thin ripple laminated micaceous and carbonaceous dirty

white fine-grained sandstone and shale alternation.

Dominant: *Satsangisaccites / Striatopodocarpites*

Subdominant: *Striatopodocarpites / Satsangisaccites*

Age Marker Species: Species present in Assemblage I, except *Densipollenites magnicorpus*, continue in Assemblage II. The additional species recorded are: *Verrucosporites densus*, *V. triassicus*, *Goubinispora indica*, *Nevesisporites vallatus*, *Foveosporites moretonensis*,

Other Species: *Arcuatipollenites ovatus*, *A. pellucidus*, *Polypodiisporites ipsviciensis*, *Playfordiaspora cancellosa*, *Pretricolipollenites bharadwajii*, *Samaropollenites speciosus*.

Remarks: At 537.00m depth, in the lithosequence of Parsora Formation in Borehole SSM-2, dominance of *Striatopodocarpites*, *Satsangisaccites*, and occurrences of species grouped as “age marker” in Fig.3, are definitely of stratigraphic importance. Henceforth, it is here derived that this palynocomposition suggests the Earliest Triassic age for this part of the Parsora Formation in Mahuli-Mahersop area, as it is established in the Panchet Formation (Lower Triassic), Damodar Basin (Tiwari and Singh, 1986; Vijaya and Tiwari, 1987). It is correlatable with the *Krempipollenites indicus* Assemblage Zone by Tiwari and Tripathi (1992).

Suggested Age: Earliest Triassic (Scythian), Fig. 4.

Assemblage III a: Table 5, Fig. 3

Sample Depths: 508.50, 506.80, 505.00, 504.50 m

Lithology: Thin alternation of grey mudstone and fine-grained sandstone, dark greenish grey mudstone, hard, friable, moderate specific gravity palaeosol.

Dominant: *Striatopodocarpites / Arcuatipollenites*

Age Marker Species: *Striatopodocarpites dubrajpurensis*, *Arcuatipollenites tethysensis*, *A. damudicus*, *Cadargasporites baculatus*, *Aratrisporites parvispinosus*, *Concavissimisporites subverrucosus*, *Tethysispora playfordii*, *Infernopollenites claustratus*, *Densosporites raceviewensis*, *Cingutriletes clavus*.

Kraeuselisporites saeptatus, *Camerospores verrucosus*, *Foveosporites triassicus*, and *Enzonalsporites vigens* appear at 504.50 m depth.

Other Species: *Converrucosporites cameronii*, *Verrucosporites carnarvonensis*, *V. narmianus*, *V. triassicus*, *Guttatisporites guttatus*, *G. microechinatus*, *Lundbladispora willmotti*, *L. microconata*, *L. brevicula*, *Arcuatipollenites ovatus*, *A. pellucidus*, *Alisporites asansoliensis*. The alete forms recorded here are *Cymatiosphaera*, *Peltacystia*, *Tasmanites*.

Remarks: Although the taxa *Striatopodocarpites / Arcuatipollenites* are the major component of this assemblage, but it is associated with a more diverse group of spore species (Table 5) than recorded in Assemblage II (depth 537.00-514.00 m). The presence of species

Kraeuselisporites saeptatus, *Camerospores verrucosus*, *Foveosporites triassicus*, *Enzonalasporites vigens* at depth 504.50 m is significant in palynodating. These species are widely reported (Table 6) in the Late Triassic (Carnian/Norian) mioflora from Australia (Dolby and Balme, 1976; Helby *et al.*, 1987) and India (Kumaran and Maheshwari, 1980; Maheshwari and Kumaran, 1979; Tripathi, 2000).

Suggested age: Late Triassic (Norian), Fig. 4

Assemblage III b: Tables 5 & 6, Fig. 3

Sample Depths: 487.50, 476.85, 462.60, 424.45, 358.45, 265.00, 261.75 m

Lithology: Dark grey to chocolate coloured sandy and micaceous shale, thin alternation of dark brown shale and grey fine-grained sandstone, fine-grained, fractured, micaceous sandstone, fine- to medium-grained bedded greenish grey sandstone with stringers of sandy carbonaceous shale, grey siltstone, fine-grained dirty white laminated sandstone. Medium- grained greenish gray sandstone.

Dominant: *Arcuatipollenites /Striatopodocarpites*

Age Marker Species: *Staurosaccites densus*, *Convertubisporites variabilis*, *Carnisporites raniganjensis*, *Grebescora concentrica*, *Camerospores verrucosus*, *Undulatisporites dilucidus*, *Aratrisporites paenulatus*, *Minutosaccus crenulatus*.

Other Species: *Rimaesporites aquilonalis*, *Lunatisporites noviaulensis*, *Playfordiaspora hexagonalis*, *Cristatisaccus cristatus*, *Verrucosiporites varians*. Besides, the species recorded in Assemblage IIIa continue up in this section. The aleo forms recorded here are *Hemisphaeridium sp*, *Pyramidosporites racemosus*.

Remarks: The species *Arcuatipollenites tethysensis* is frequent in Assemblage IIIb. As discussed and specified above, several species are common in Assemblage IIIa and Assemblage IIIb. The most significant feature of Assemblage IIIb is the gradual incoming of new species in the up sequence, as given in Tables 5, 6. The overall composition of this assemblage suggests continuity of the palynoflora from the older horizon in the present sequence of Parsora Formation. However, in the uppermost sample (261.75 m depth), an influx of new species is recorded. This group of species contributes significantly in the age determination of the strata in between 487.00-261.75 m depth (Table 5).

On the basis of certain qualitative change in the species composition (Fig. 3), this younger part (487.00 to 261.75 m depth) reveals a younger age correlation in the Late Triassic sequence.

Suggested age: Late Triassic (Norian), Fig. 4

The occurrence of stratigraphically important species (Table 5) indicates continuity of palynoflora within 508.50 to 504.00 and 487.00 to 261.75 m depths. On the basis of available palynological data, the Assemblage IIIa and IIIb represent some

level within the Norian age.

CORRELATION AND DISCUSSION

The most important geological observation in Mahuli-Mahersop area of Surguja District, Chhattisgarh, is the identification of Paleosol horizon at 509.50m depth in Borehole SSM-2 (Fig. 2). This can readily be used in inter- and intra-basinal correlation of the stratigraphic horizons. The Permo-Triassic contact is provisionally marked at 509.50m depth in this borehole. However, the palynological study has revealed the presence of *Densipollenites magnicarpus* Palynozone at 542.00m (Latest Permian) and *Krempipollenites indicus* Palynozone (Earliest Triassic) at 514.00 to 537.00m depth. This means that Permo-Triassic transition lies inbetween 537.00-542.00m in Borehole SSM-2 (Fig. 6). The palynofloral change has preceded the lithological change in this borehole.

In all, five palynological assemblages have been identified in - (1) Parsora Formation, 152.56-716.15 m depth in Borehole SSM-1, and (2) Raniganj and Parsora formations, in 261.75 to 542.00 m depth in Borehole SSM-2. On the basis of suggested age for each assemblage (Assemblage-I, Assemblage-II, Assemblage-A, Assemblage-III a, III b, and Assemblage-B), their sequential stratigraphic placement is shown in Fig. 5. The palynological record from the Late Permian (Tiwari and Tripathi, 1992; Tripathi 1996) and Triassic rock strata (Koshal, 1975, 1984; Maheshwari *et al.*, 1978; Prasad 1997; Nandi 1996; Kumar, 2000; Tripathi, 2000) in various basins on Indian peninsula has been reviewed to understand the compositional resemblance with the presently identified assemblages. And here it is observed that present assemblages show similarity in the occurrences of age marker species with those reported in the palynozones recognised in - South Rewa, Krishna-Godavari, Damodar and Rajmahal basins. Hence, this data is accounted here for the comparative age assessment and correlation (Fig. 4, Table 7).

The basal most Assemblage I, in the Raniganj Formation of Borehole SSM-2 (547.00 to 542.00m depth) is dated to be Latest Permian in age by having *Densipollenites magnicarpus* Assemblage Zone (Tiwari and Tripathi, 1992).

The Assemblage II, oldest in the present sequence of Parsora Formation in Borehole SSM-2 (537.00-514.00 m depth) is characterised by having the abundance of *Satsangisaccites* in association with *Striatopodocarpites*, along with definite occurrences of key species given in Fig. 3. It is closely comparable with the *Krempipollenites indicus* Assemblage Zone which is Early Triassic (Scythian) in age, widely recognised (Fig. 4) in South Rewa, Rajmahal and Damodar basins (Maheshwari, Kumaran and Bose, 1978; Tripathi and Ray, in press; Tiwari and Tripathi, 1992).

The Assemblage A, next in the sequence (SSM-1, 716.50-688.70 m depth) has the dominance of *Arcuatipollenites/ Striatopodocarpites*. It is qualitatively diversified and differs

in species composition from the older Assemblage II, in having a group of many new species (Fig. 3). It shows close compositional resemblance with the *Rimaesporites potoniei* zone of South Rewa (Maheshwari *et al.*, 1978) and *Rimaesporites potoniei-Samaropollenites speciosus* Assemblage zone of Krishna-Godavari Basin (Prasad, 1997), which are Carnian in age (Fig. 4).

The subsequent younger Assemblage III (IIIa, 508.50 - 504.50 m depth and IIIb, 487.00-267.75 m depth in Borehole SSM-2) also has the abundance of *Arcuatipollenites / Striatopodocarpites*. At this level, certain new species have been introduced (Fig. 3), which give a younger aspect to this assemblage than the older Assemblage A. In view of the occurrences of age marker species in Assemblage III (Table 5), it has been correlated with the *Tikisporites balmei* Zone (Fig. 4) in the Late Triassic sequence of South Rewa Basin, which is Carnian-Norian in age (Maheshwari *et al.*, 1978). However, in the younger part of the Assemblage III (IIIb) at 261.75 m depth, new set of key species (Table 6) contributes a younger age to this part of Parsora Formation that is Norian in age.

In the Assemblage B, youngest in the sequence of Parsora Formation from Borehole SSM-1 at 152.56 m depth, the dominance of *Arcuatipollenites/Striatopodocarpites/Satsangisaccites* continues from the older assemblages. The key species (Fig. 3), particularly *Classopollis meyeriana*, *C. anasillos*, *C. harrisii* and *Callialasporites turbatus* help in correlating and dating this assemblage. It is comparable with the *Arcuatipollenites tethysensis* Assemblage Zone identified in the Rajmahal Basin (Tripathi, 2002). A Rhaetic age has been assigned to the Assemblage B (Fig. 4).

The assemblages recorded in the present study from Mahuli-Mahersop area are compared (Table 7, Fig. 5) with the known palynozones from the Late Permian and Triassic sequences of Australia (Helby *et al.*, 1987). Assemblage I, of the present study compares with the *Protohaploxiipinus microcorpus* Palynozone, and the subsequent Assemblage II with the *Lunatisporites pellucidus* Palynozone of Australia. Amongst the Late Triassic assemblages, the Assemblage A is correlatable with the younger part of *Craterisporites rotundus* Palynozone and is dated Carnian in age. The Assemblage III is comparable with the older part of *Polyzingulatisporites crenulatus* Palynozone, which is Norian in age. The Assemblage B is assignable to the younger part of *Polyzingulatisporites crenulatus* Palynozone, which is Rhaetic in age (Fig. 5).

The spore-pollen analysis in these two boreholes SSM-1 (Parsora Formation, 716.15 to 152.56 m) and SSM-2 (Raniganj and Parsora formations, 542.00 to 261.75 m), has revealed the presence of Uppermost Permian and Triassic strata in the Mahuli-Mahersop area, Chhattisgarh. The non-yielding nature of the strata limits the recovery and continuity of the palynofloral succession in the presently studied sequence.

However, depositional / erosional hiatus is inferred between 514.00 - 508.50 m in the Parsora Formation of Borehole SSM-2 in this part of the basin. This unconformity explains the non deposition/erosion of most of the Lower Triassic and Middle Triassic strata in this area. The deposits of uppermost Permian, and Lower Triassic (partly) and major part of the Upper Triassic (Carnian-Rhaetic) are proved here. The Permo-Triassic transition is inferred on the top of Raniganj Formation between 542.00-537.00m depth in Borehole SSM-2 (Fig. 6). Hence, it is derived that P/Tr boundary may exist within the passage from Raniganj Formation to Parsora Formation. The palynological assemblages presently identified in the Parsora Formation represent various levels in Late Triassic, which are again not in continuity with older and subsequent younger palynozones in the sequence (Fig. 7). Further more extensive palynological investigations are needed to build-up the palynostratigraphy of the Gondwana Sequence in this part of the Chhattisgarh.

CONCLUSIONS

On the basis of present palynological study, the following conclusions are drawn (Figs. 6, 7):

1. This is the first report of Upper Permian, Lower and Upper Triassic strata in Mahuli- Mahersop area, Sarguja District of Chhattisgarh.
2. Five palynoassemblages have been identified from the Raniganj and Parsora formations in the studied sequence of boreholes SSM-1 and SSM-2 (Fig. 6).
3. Assemblage I, oldest in the sequence, in Borehole SSM-2 (547.00, 543.00, 542.00 m depth) is equated with *Densipollenites magnicorpus* Assemblage Zone and is dated as Latest Permian (Fig. 6).
4. Assemblage II in Borehole SSM-2 (537.00 and 514.00 m depth) is equated with *Krempipollenites indicus* Assemblage Zone (Fig.6) and evidences presence of lowermost Triassic strata.
5. Assemblage A, Borehole SSM-1 (716.15 - 688.70 m depth) is comparable with *Rimaesporites potoniei* Palynozone, which is Carnian in age.
6. The next assemblage in the sequence – Assemblage III in Borehole SSM-2 (508.50-216.75 m depth) evidences Upper Triassic strata of Norian age (Fig. 6).
7. The Assemblage B in Borehole SSM-1 (152.56 m depth), youngest in the sequence is correlatable with the *Arcuatipollenites tethysensis* Assemblage Zone of Rhaetic age, which reveals the presence of uppermost part in the Upper Triassic sequence.
8. The presently identified assemblages are not continuous and complete in the sequence, and represent various levels in the time span of Late Permian and Triassic. Hence, hiatus of varied magnitude are inferred at different intervals (Fig. 7). Palynologically, the Permo-Triassic bound-

- ary is suggested in between 542.00 to 537.00m on the top of the Raniganj Formation in Borehole SSM-2 (Fig. 6).
9. Paleosol horizon at 509.50m depth in Borehole SSM-2 is identified as an useful marker in regional correlation and is referred as lithological signature to mark Permo-Triassic boundary.

ACKNOWLEDGEMENTS

Authors are extremely grateful to Sri A.B. Dutt, the then Deputy Director General, Coal Wing, for his keen interest in this project, field visit and constant monitoring and permission for the publication of the results. Sincere thanks and appreciation is extended to Sri K.K. Sen for the critical discussions during the progress of the present work. The help of Sri V. Ganguly is thankfully acknowledged. Professor Dr G Playford's comments on the original manuscript have immensely improved the quality of the subject matter.

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