

1. PALYNODATING OF DENWA FORMATION, SATPURA BASIN, INDIA

PRAMOD KUMAR

Birbal Sahni Institute of Palaeobotany, Lucknow-226007, India

Abstract

Palynomorphs recovered from the clays of Denwa Formation from a well cutting south of village Anhoni, Satpura Basin, Madhya Pradesh include pollen-spores, *Dinocysts*, fungal, cuticles and tracheidal remains. Quantitatively three palynoassemblages are recognized: Palynoassemblage - A contains *Falcisporites*, *Satsangisaccites*, *Minutosaccus*; Palynoassemblage - B has *Dinocysts*, *Falcisporites*, *Satsangisaccites*, *Brachysaccus*, *Samaropollenites* and palynoassemblage - C possesses *Brachysaccus*, *Falcisporites*, *Aratrisporites*, *Ashmoripollis*, *Corollina*, *Monolites*.

The palynoassemblage of Denwa Formation from Anhoni region is comparable with the Late Triassic palynoassemblages known from the Tiki Formation of South Rewa Gondwana Basin, Dubrajpur Formation of Rajmahal Basin. - D of Krishna-Godavari Basin and *Samaropollenites speciosus* and *Ashmoripollis reducta* Opper Zones (Norian-Rhaetian) of Carnarvon Basin from north-western Australia.

Key words: Palynodating, Late Triassic (Norian-Rhaetian), Denwa Formation, Satpura Basin.

Introduction

Denwa Formation constitutes the middle unit of the Mahadeva Group (in the type area) in the Satpura Basin, Madhya Pradesh (MEDLICOTT, 1873). It is overlain by Bagra conglomerate or Jabalpur Formation and is underlain by the Pachmarhi Sandstone. Later, CROOKSHANK (1936) studied the geology of the northern slopes of the basin. He suggested an Upper Triassic age to this formation, on the basis of animal *labyrinthodont* remains. *Mastodonsaurus indicus* LYDEKKAR (1885) which is very closely allied to *Mastodonsaurus giganteus* JÄGER from the Keuper (Late Triassic). CHATTERJEE and ROY CHOWDHURY (1974) identified *Metaposaurus* and *Paratosaurus* and suggested late Lower Triassic to Middle Triassic age to the Denwa sediments. Some leaf impressions resembling *Phoenicopsis* and the trunk of a tree were reported by CROOKSHANK (1936) from Denwa sediments near Goari village. Recently, NANDI (1996) has recorded palynomorphs from the grey or carbonaceous shales in a Bore-hole ANH-1 (south of village Anhoni) at 100 and 200m depths and has dated it as Late Triassic (Carnian to Norian) age. Thus, the age of Denwa Formation is debatable unless more evidence is available. The present communication deals with the palynodating of this formation.



Stratigraphical Setting

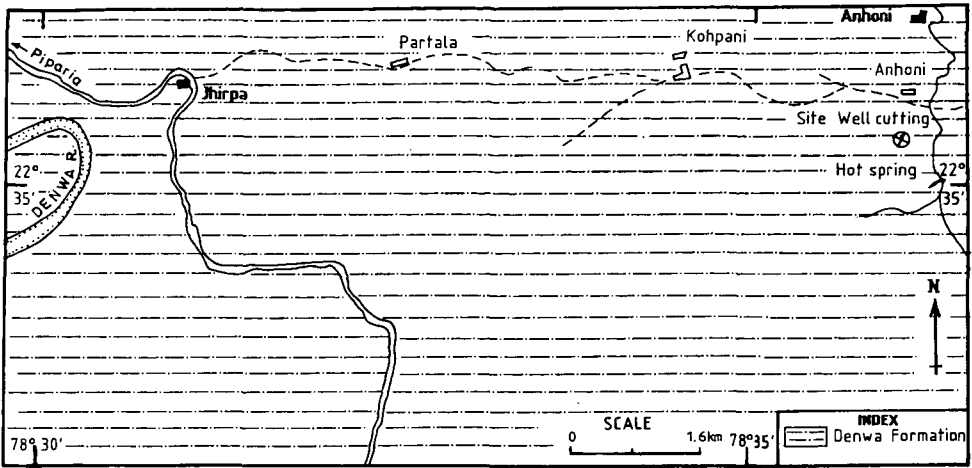
CROOKSHANK (1936) studied the geology of the area in detail. SASTRY et al. (1977), RAJA RAO (1983) have further detailed out the geological sequence as given in GSI Bulletin No. 45 (1983) Map No. 15. is summarised below : (in part).

Age	Formation	Lithology (thickness)
Lower Cretaceous	Jabalpur	
	Unconformity	
Rhaetian(?)	Bagra	Predominantly coarse conglomerates with bands of calcareous sandstone, variegated clays, limestone and dolomite (180 - 240 m)
	Unconformity	
Upper part of Lower Triassic to Middle Triassic	Denwa	Soft variegated clays interbedded with sandstone bands, conglomeric at places (about 350 m)
Lower Triassic	Pachmarhi	White coarse-grained cross bedded sandstones with lenses of subangular quartz pebbles. (about 750 m)
Upper Permian	Bijori	Micaceous, flaggy sandstones and shales, at places micaceous

CROOKSHANK (1936) and RAJA RAO (1983) described that the Denwa Formation consists of mainly alternating beds of sandstones and variegated clays which are always calcareous and contain numerous calcareous (calcite) nodules and display a wide range of colours between green, red and buff, the red being most characteristic. SASTRY et al. (1977) and RAJA RAO (1983) believe that the Pachmarhi, Denwa and Bagra grade into one another laterally due to facies variation.

Materials and Methods

The rock samples for the present work have been collected from an artisan well south of the village Anthoni (22°36' : 78°35') Text-fig. 1.1. The material consisted seven samples of Khaki, yellow and Khaki green clays, of which four have yielded palynomorphs marked with an asterisk.



Text-fig. 1.1.

Geological map of Anhoni area. Showing well cutting sites (after CROOKSHANK, 1936).

Sequence of rocks samples investigated from Anhoni area, Satpura Basin

Sample Nos.	Rock types	Thickness of band (in meter)	Total depth (in meter)
8. Top	Coarse grained sandstone	06.30	06.30
7★	Khaki clay	00.30	06.60
	Sandstone	00.40	07.00
6★	Khaki clay	00.30	07.30
5	Khaki-yellow clay	00.20	07.50
	Maroon clay	00.80	08.30
	Sandstone yellow	01.70	10.00
	Maroon clay	01.20	11.20
4★	Khaki-green clay	00.30	11.50
	Sandstone	01.70	13.20
	Maroon clay	00.40	13.60
	Khaki clay	00.30	13.90
2	Maroon clay	02.30	16.20
	Yellow clay	00.30	16.50
	Sandstone yellow	01.50	18.00
Bottom	Yellow clay	00.20	18.20
	Sandstone yellow	00.70	18.90
	Yellow clay	00.20	19.10
	Sandstone yellow	?	?

Palynological composition

- Haradisporites mineri* SINGH and KUMAR 1972, *H. scabratus* KUMAR 1973
Osmundacidites sp.
Dictyophyllidites mortonii (DE JERSEY) PLAYFORD and DETTMANN 1965
Monolites anthoniensis KUMAR (Ms)
Alisporites indicus BHARADWAJ and SRIVASTAVA 1969, *A. ovalis* KUMAR 1973
★*Brachysaccus eskensis* DE JERSEY 1972, ★*B. ovalis* MÄDLER 1964, ★*B. indicus* KUMARAN and MAHESHWARI 1980.
★*Falcisporites australis* (DE JERSEY) HELBY 1973, ★*F. nidpurensis* (BHARADWAJ and SRIVASTAVA) KUMARAN and MAHESHWARI 1980, *F. stabilis* BALME 1970
Krempipollenites indicus TIWARI and VIJAYA 1995, *K. schaubergeri* (BHARADWAJ and TIWARI) TIWARI and VIJAYA 1995
★*Minutosaccus crenulatus* DOLBY 1976, ★*M. maedleri* KUMARAN and MAHESHWARI 1980
★*Samaropollenites speciosus* GOUBIN 1965
Satsangisaccites triassicus BHARADWAJ and SRIVASTAVA 1969, *S. royii* BHARADWAJ and SRIVASTAVA 1969
Scheuringipollenites tentulus (TIWARI) TIWARI 1973
Staurosaccites minutus KUMARAN and MAHESHWARI 1980, ★*S. ovalis* KUMARAN and MAHESHWARI 1980
Guttulapollenites hannoniens GOUBIN 1965
Faunipollenites varius BHARADWAJ 1962, *F. bharadwajii* MAHESHWARI 1967
Striatopodocarpites dubrajpurensis TRIPATHI, TIWARI and KUMAR 1990, *S. nidpurensis* BHARADWAJ and SRIVASTAVA 1969
Arcuatipollenites ovatus (GOUBIN) TIWARI and VIJAYA 1995, *A. pellucidus* (GOUBIN) TIWARI and VIJAYA 1995
Callialasporites sp.
★*Cycadopites* cf. *stonei* HELBY 1987, *C.* sp.
Corollina cf. *simplex* (MALJAVKINA) VENKATACHALA and GÓCZÁN 1964
Laricoidites sp.
★*Aratrisporites fischeri* (KLAUS) PLAYFORD and DETTMANN 1965
Striatites cancellatus (BALME and HENNELLY) POTONIE 1958
Protohaploxylinus sp.
★*Rimaesporites potonie* LESCHIK 1955
Fungal remains
Dinocyst Type - A, D. Type - B

Palynoassemblage

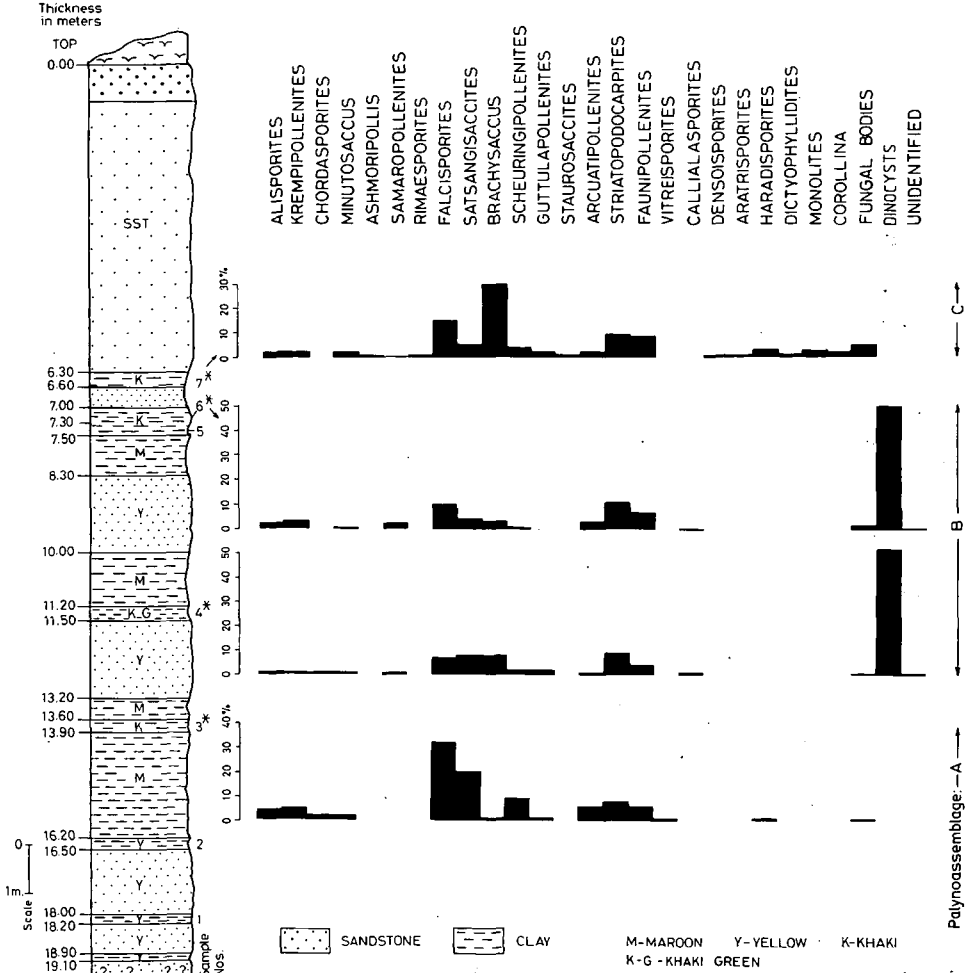
The palynoassemblage of sediments exposed in a well section near Anthoni village belonging to Denwa Formation comprises 25 genera and 39 species, of which *non-striate disaccate* are prominent followed by *striated disaccate* pollen. The *pteridophytic* spores are poorly represented in the assemblage. The percent frequencies have been shown in Text-fig. 1.2. The sample no. 3 (lower in the sequence) contains dominance of *Falcisporites* and *Satsangisaccites*. The samples nos. 4 and 6 possess dominance of "Dinocysts" but pollen and spores are rather fair to poor in occurrence. The sample no. 7 (top) has the dominance of *Brachysaccus* followed by *Falcisporites*. The characteristic

forms appeared in the assemblage are *Haradisporites*, *Monolites*, *Minutosaccus*, *Cycadopites*, *Ashmoripollis*, *Staurosaccites*, *Aratrisporites*, *Corollina*, *Samaropollenites* etc. which are new to the assemblage. Thus three palynoassemblages are differentiated.

Palynoassemblage - A (Sample no. 3) has *Falcisporites*, *Satsangisaccites*, *Minutosaccus*.

Palynoassemblage - B (Samples nos. 4 and 6) have *Dinocysts*, *Falcisporites*, *Satsangisaccites*, *Brachysaccus*, *Samaropollenites*.

Palynoassemblage - C (Sample no. 7) has *Brachysaccus*, *Falcisporites*, *Ashmoripollis*, *Corollina*, *Monolites*.



Text-fig. 1.2.

Palynostratigraphy of Denwa Formation, south of Anthoni village, Satpura Basin.

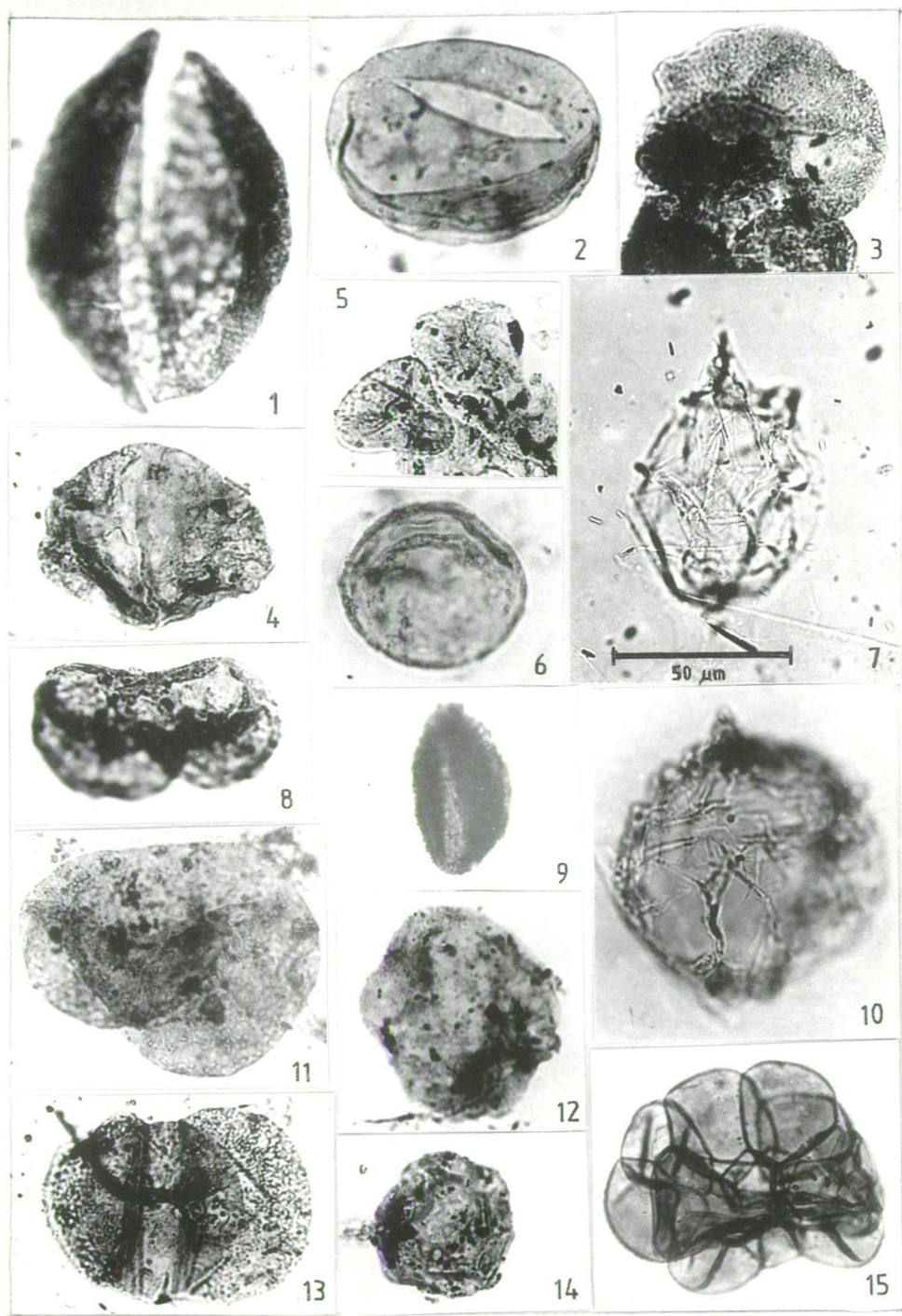


Plate I.1

Status of the present assemblage in the Satpura Basin

The Mahadeva Group in Satpura Basin consists of mainly three units (Formations) viz. Pachmarhi, Denwa and Bagra. The palynoassemblage from the Pachmarhi Formation have been described by KUMAR (1995, 1996) which has the dominance of *Falcisporites* followed by *Satsangisaccites*. The characteristic forms of the assemblage were *Goubinispora*, *Staurosaccites*, *Playfordiaspora*, *Lundbladispota* and *Densoisporites*, etc. The presently studied assemblage of Denwa Formation contains only *Staurosaccites* (in sample no. 7) whereas the sample no. 3 is comparable in having the dominance of *Falcisporites* and *Satsangisaccites*. Samples nos. 4 and 6 do not compare with Pachmarhi Formation assemblage as they contain dominance of *Dinocysts* and the occurrence of *Brachysaccus*, *Minutosaccus* and *Samaropollenites* which indicate a younger aspect. Sample no. 7 (top in sequence) contains dominance of *Brachysaccus* followed by *Falcisporites* - *Satsangisaccites*. This also contains *Monolites*, *Ashmoripollis*, *Rimaesporites*, *Aratrisporites*, *Corollina* and *Haradisporites* further indicates towards the younger aspect. NANDI (1996) recorded palynoassemblages I at 100 m depth and II at 200 m depth (Late Triassic) in the Anthoni region, which have the dominance of *Falcisporites* ($\pm 27\%$) followed by *Satsangisaccites* ($\pm 14\%$). The presence of *Brachysaccus* ($\pm 3\%$), *Minutosaccus* ($\pm 2\%$) *Samaropollenites* ($\pm 5\%$), *Aratrisporites* ($\pm 2\%$) and *Staurosaccites* ($\pm 2\%$) compares with the presently described assemblages. However, *Haradisporites*, *Monolites*, *Ashmoripollis* and *Corollina* are not present in the palynoassemblage I and II described by NANDI. There is no palynological record from the Bagra Formation (Rhaetic ?) of Satpura Basin till date.

Comparison with other palynoassemblages

Palynoassemblages have been recorded from Nidpur and Gopad River, South Rewa Basin by BHARADWAJ and SRIVASTAVA (1969), TIWARI and RAM-AWATAR (1990, 1992) dated as Early Triassic - Middle Triassic based on prominence of *Satsangisaccites*, *Nidipollenites*, *Weylandites*. TIWARI and RANA (1980) assigned Nidpur palynoassemblage of BHARADWAJ and SRIVASTAVA (1969) to Upper Triassic (Carnian age) in

Plate 1.1.

1. *Brachysaccus indicus* KUMARAN and MAHESHWARI 1979.
2. *Monolites anthoniensis* KUMAR (Ms)
3. *Aratrisporites fischeri* (KLAUS) PLAYFORD and DETTMANN 1965.
4. *Minutosaccus maedleri* KUMARAN and MAHESHWARI 1979.
5. *Haradisporites scabratus* SINGH and KUMAR 1973.
6. *Corollina cf. simplex* (MALJAVKINA) VENKATACHALA and GÓCZÁN 1964.
7. *Dinocyst* Type - A.
8. *Rimaesporites potoniei* LESCHIK 1955.
9. *Cycadopites cf. stonoi* HELBY 1987.
10. *Dinocyst* Type - B.
11. *Samaropollenites speciosus* GOUBIN 1965.
12. *Ashmoripollis reducta* HELBY 1987.
13. *Krempipollenites indicus* TIWARI and VIJAYA 1995.
14. *Callialasporites* sp.
15. Fungal hyphae/fungal spore in a group.

All photomicrograph are magnified 500x unless and otherwise stated scale given in fig. 7.

having *Weylandites*, *Satsangisaccites*, *Praecolpatites*, *Nidipollenites*, *Alisporites*, *Klausipollenites*. MAHESHWARI and KUMARAN (1979) and KUMARAN and MAHESHWARI (1980) described palynofossils from Tiki Formation (Carnian - Norian age) exposed in Son River and Janar Nala Sections, South Rewa Gondwana Basin. Palynoassemblage from Tharipathar had dominance of *Samaropollenites* and *Protohaploxyipinus* which are poorly present in the studied assemblage. The dominant element *Rimaesporites* of Ghiar section is poorly known here on the other hand both have some characteristic forms: *Aulisporites*, *Accintisporites*, *Triradispora*, *Duplicisporites* etc. which are absent in the Anthoni assemblage. The present assemblage has *Ashmoripollis*, *Corollina* and *Monolites* which are absent in the Tiki palynoassemblages whereas *Brachysaccus* is present in dominance in Denwa Formation studied here.

TIWARI et al. (1984) described palynoassemblages A - F from Bore core RJR-2, Kazigaon in Rajmahal Basin. Palynoassemblage - A belonging to Dubrajpur Formation has dominance of *Satsangisaccites* (included here *Falcisporites*) as also seen in sample no. 3 of Anthoni assemblage but the absent of *Rajmahalispora*, *Nidipollenites*, *Lundbladispota*, *Playfordiaspora*, *Goubinispora* in the present assemblage indicate a different composition. The palynoassemblages B and C of Rajmahal Basin closely compare with the Anthoni assemblage (Sample no. 7) in having dominance of *Brachysaccus*, *Satsangisaccites* and the presence of *Minutosaccus*. *Samaropollenites* but the former differs from the latter in having *Infernopollenites*, *Lundbladispota*, *Playfordiaspora*, *Nidipollenites*. The Anthoni assemblage differs from Rajmahal palynoassemblages in having *Ashmoripollis*, *Aratrisporites*, *Corollina*, *Monolites* and *Cycadopites*.

PRASAD and JAIN (1994) recorded four palynoassemblages D - A (Smithian - Norian respectively) in the subsurface at Kommugudem and Mandapeta areas, Krishna-Godavari Basin. The present Anthoni assemblage is comparable to palynoassemblage - A *Minutosaccus crenulatus* zone of Krishna-Godavari in having *Ashmoripollis*, *Staurosaccites*, *Brachysaccus* and *Cycadopites stonei* Carnian-Norian age. Recently, PRASAD (1997) reported palynofossils from Early, Middle and Late Triassic sediments in deep bore cores at Kommugudem - A and Mandapeta - A,C and D wells in the Krishna-Godavari Basin. The Anthoni palynoassemblage compares with the *Minutosaccus crenulatus* zone-I of K-G Basin but the latter differs from the former assemblage in having *Ceratosporites*, *Duplicisporites*, *Voltziaceasporites*, *Dubrajisporites*, *Enzonalsporites*, *Camerosporites*, *Ovalipollis* and *Zebrasporites* which are absent in Anthoni. On the contrary the Anthoni palynoassemblage possesses *Brachysaccus* in dominance (Sample no. 7) and shows appearance of *Corollina* and *Rimaesporites*, *Ashmoripollis* and *Haradisporites*.

LUKOSE and MISRA (1980) reported a Late Triassic palynofossils in the subsurface sediments drilled at Jaisalmer Basin, Rajasthan. The palynoflora contains *Samaropollenites*, *Staurosaccites*, *Ovalipollis*, *Camerosporites*. The latter two forms are absent here, hence it differs from the studied assemblage. The Late Triassic (Rhaeto-Liassic) palynoflora recorded in Banni well No. B in Kutch Basin comprises the dominance of *Gliscopollis* and *Rhaetipollis* which are lacking here. Hence the Anthoni palynoassemblage recovered from Denwa Formation in Satpura Basin indicate an older aspect.

HELBY et al (1987) recorded palynological zones in the Mesozoic sediments of western Australia. They formed *Falcisporites* Super Zone in which *Ashmoripollis reducta* Opper Zone from Carnarvon Basin has been instituted and the occurrence of *Corollina* spp. suggested Rhaetian age. They have also instituted *Minutosaccus crenulatus* Opper Zone (DOLBY and BALME, 1976) HELBY et al. (1987) which also contains *Dictyophylidites*, *Cycadopites stonei* assigned to Carnian to Norian age. The Anthoni assemblage

compares well with the *Falcisporites* Super Zone of Carnarvon Basin particularly Opper Zones *Minutosaccus crenulatus* and *Ashmoripollis reducta* Norian to Rhaetian.

Conclusions

1. The palynoassemblage recorded from the sediments exposed in a well section near Anthoni pertains to Denwa Formation in Satpura Basin and shows dominance of *Falcisporites* and *Brachysaccus*.

2. Sample nos. 4 and 6 contain dominance of *Dinocysts* while *non-striate disaccate Falcisporites*, *Satsangisaccites* and *Brachysaccus* are common elements.

3. Sediments at the top of the sequence (Sample no. 7) possesses the prominence of *Brachysaccus* followed by *Falcisporites*, *Satsangisaccites* but the appearance of younger elements *Corollina*, *Ashmoripollis*, *Monolites* and *Haradisporites* indicates Norian - Rhaetian age.

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References

- BHARADWAJ, D.C. and SRIVASTAVA, SHYAM, C. (1969): A Triassic microflora from India. - *Palaeontographica B*, 125, 119-149.
- CHATTERJEE, S. and ROY CHOWDHURY, T. (1974): Triassic Gondwana vertebrates from India. - *Ind. Jour. Earth. Sci.* 1, 96-112.
- CROOKSHANK, H. (1936): Geology of the northern slopes of the Satpuras between the Morand and the Sher Rivers. - *Mem. geol. Surv. India* 66, 242-272.
- HELBY, R., MORGAN, R. and PARTRIDGE, A.D. (1987): A palynological zonation of the Australian Mesozoic. In: *Studies in Australian Mesozoic Palynology*, ed.: P.A. JELL - *Publ. Mem. Assoc. Austr. Palaeont.*, Sydney 4, 1-94.
- KUMAR, P. (1995): Palynofossils from Pachmarhi Formation, Satpura Basin, Madhya Pradesh. - *Geophytology* 24, 237-240.
- KUMAR, P. (1996): Permo-Triassic palynofossils and depositional environment in Satpura Basin, Madhya Pradesh. - *Geophytology* 25, 47-54.
- KUMARAN, K.P.N. and MAHESHWARI, H.K. (1980): Upper Triassic spores dispersae from the Tiki Formation 2 : Miospores from the Janar Nala Section, South Rewa Gondwana Basin, India. - *Palaeontographica B*, 173, 26-84.
- LUKOSE, N.G. and MISRA, C.M. (1980): Palynology of Pre-Lathi sediments (Permo-Triassic of Sumarwali-Talai structure, Jaisalmer, western Rajasthan, India. - *IV Int. Palynol. Conf. Lucknow*, 2, 219-227.
- LYDEKKAR, R. (1885): The reptilia and amphibia of Maleri and Denwa groups. *Notes on the Satpura Coal Basin*. - *Pal. Indica Ser.* 4, 5, 1-16.
- MAHESHWARI, H.K. and KUMARAN, K.P.N. (1979): Upper Triassic spores dispersae from the Tiki Formation-1 : Miospores from the Son River section between Tharipathar and Ghiar, South Rewa Gondwana Basin. - *Palaeontographica B*, 171, 137-164.
- MEDLICOTT, H.B. (1873): Notes on the Satpura Coal Basin. - *Mem. geol. Surv. India* 10, 159.
- NANDI, A. (1996): Palynodating of carbonaceous shales from Denwa Formation, Satpura Basin, M.P., India. - *Nineth Int. Gondwana Symposium. Gondwana - Nine* 1, 79-87.
- PRASAD, B. (1997): Palynology of the subsurface Triassic sediments of Krishna-Godavari Basin, India. - *Palaeontographica B*, 242, 91-125.

- PRASAD, B. and JAIN, A.K. (1994): Triassic palynoflora from the Krishna-Godavari Basin (India) and its stratigraphic significance. - *J. geol. soc. India* 43, 239-254.
- RAJA RAO, C.S. (1983): Coal resources of Madhya Pradesh, Jammu and Kashmir. - *Bull. geol. Surv. India, Ser. A, 45 coalfield of India III*, 1-204.
- SASTRY, M.V.A., ACHARYA, S.K., SHAH, S.C., SATSANGI, P.P., GHOSH, S.C., RAHA, P.K., SINGH, G. and GHOSH, R.N. (1977): Stratigraphic lexicon of Gondwana Formations of India. - *Misc. Publ. geol. Surv. India*, 36, 1-170.
- TIWARI, R.S. and RAM-AWATAR (1990): Palynodating of Nidpur beds, Son Graben, Madhya Pradesh. - *Palaeobotanist* 38, 105-121.
- TIWARI, R.S. and RAM-AWATAR (1992): A palynoassemblage from Mahadeva Formation in Nidpur area, Madhya Pradesh. - *Geophytology* 22, 111-113.
- TIWARI, R.S. and RANA, V. (1980): A Middle Triassic microflora from India. - *Biol. Mem. J.*, 30-35.
- TIWARI, R.S., KUMAR, P. and TRIPATHI, A. (1984): Palynodating of Dubrajpur and Intertrappean beds in subsurface Basin. In: TIWARI et al. eds.: *Proceedings of V. Indian Geophytological Conference, Lucknow, 1983, spl. publ.*, 207-225.