

Palynological succession through Gondwana sediments in South Rewa Basin, Madhya Pradesh, India*

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On the basis of relative abundance in association with the other characteristic palynotaxa, nine palynological zones have been identified from Talchir to Pali-Tiki formations in the Gondwana sediments of South Rewa Basin. The occurrence of Karharbari palynoflora in the older part of the Barakar Formation suggests the existence of Karharbari sediments in the basin. Pali Formation is palynologically considered to be a time transgressive unit ranging in age from Late Permian to Early-Middle Triassic since the Middle Member contains Raniganj and the Upper Member shows Panchet (= Scythian -Anisian) equivalent palynofloras. The Tiki Formation contains Late Triassic (Carnic-Noric) palynoflora and is thus younger to the Pali Formation. The earlier suggestion to merge the two as Pali-Tiki Formation is negated here since the two units are lithologically as well as floristically different.

Key-words—Palynology, Gondwana Sequence, South Rewa Basin, India.

INTRODUCTION

SOUTH Rewa is a master basin in the peninsular India which is bounded by three basins, i.e., on the East by Damodar, West by Satpura and on the S.E. by Mahanadi basins. The geological set up of the basin has remained debatable for more than a century with respect to the stratigraphic status of the Supra-Barakar sediments (Pali, Tiki and Parsora formations) and also two or three fold classification of the Gondwana Sequence. In the present communication an effort has been made to resolve this riddle through playnofloral evidences so far known from Talchir to Pali-Tiki formations from the western region of the basin including Singrauli, Sohagpur, Johilla, Korar and Umaria coalfields.

Geological setting: The general lithological succession exposed in the South Rewa Basin is given below (Raja Rao 1983; Srivastava *et al.* 1991).

Upper Cretaceous to Eocene	Alluvium
	Basic rock
Lower Jurassic	Bandhogarh
	-----Unconformity-----

Upper Triassic	Parsora
	-----Unconformity-----
Upper Triassic - Lower Triassic	Tiki
	Pali
	-----Unconformity-----
Lower Permian	Barakar
Upper Carboniferous	Talchir
	-----Unconformity-----
Precambrian/Mahakoshal	

Talchir Formation: This is the lowermost unit of the South Rewa Basin which is underlain by Precambrian/Mahakoshal sediments and overlain by Barakar Formation. The lithofacies comprises tillite, conglomerates (boulders, pebbles, cobbles and clay), sandstone and shale-siltstone. The occurrence of stratified tillites, striated pavements suggests glacial origin of the sediments. The boulder bed is followed by green shales which sometime break into prismatic fragments (needle shale) as observed in Johilla Coalfield, North of the Ponri village (23° 20' : 81° 5').

Barakar Formation: The Barakar sediments are lithologically classified into three members : Lower,

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Middle and Upper. The Lower Member varies in thickness ($\pm 30-100$ m) and is composed of mainly feldspathic, coarse to medium grained sandstone with carbonaceous shales. The Middle Member has grey shale, carbonaceous and sandy shales with a number of coal seams. The coal seams of Singrauli Coalfield are inter-banded by clay which is the characteristic feature of the coalfield. The Upper Member is characterised by massive coarse-grained sandstone with minor amount of grey shale.

Pali Formation: It is divisible into three members-Lower, Middle and Upper. The Lower Pali Member overlies Barakar Formation as observed in Johilla River, near Pali village. Arenaceous clays with patches of red and green coloured sandstone are characteristic features of the Lower Pali Member. The Middle Member of the Pali Formation is marked with fine-grained, micaceous sandstone, carbonaceous shale, coaly shale and coal seams. The Upper Member is characterised by the presence of coarse-grained, ferruginous, gritty to medium-grained, buff to white, brown and yellow coloured sandstone. Sometimes red, green, mottled colour mudstones have been also observed. The contact of Upper and Middle Pali have been marked in Johilla River near Salaia village in Johilla Coalfield and Chundi River section in Sohagpur Coalfield (Tarafdar *et al.*, 1993).

Tiki Formation: The Upper Pali Member is overlain conformably by the Tiki Formation with a sharp contact exposed in Halphal Nala, in northern part of the basin (Tarafdar *et al.* 1993). Sometimes the contact is gradational at places. The lithological characteristics of the Tiki Formation comprises red-green mudstone/shales and white/green/calcareous/feldspathic sandstone with conglomeratic pebble beds. Dutta and Ghose (1972) opined that the rocks around Pali and Tiki area are identical in lithological characteristics.

PALYNOLOGICAL ZONES AND THEIR INTER-BASINAL CORRELATION

In South Rewa Basin nine palynozones have been identified from Talchir-Pali-Tiki formations which have been prepared on the so far available palynodata and are depicted in Table-1.

Talchir Palynozones- Two palynozones have been recognised in the Talchir Formation:

Palynozone-I: In this zone, *Plicatipollenites* is in dominance over *Parasaccites*, the other qualitatively significant taxa in this zone are - *Callumispora*, *Potonieisporites* and striated disaccates.

Palynozone-II: In the younger Talchir palynozone *Parasaccites* becomes dominant over *Plicatipollenites*; the other important taxa being *Tuberisaccites*, *Callumispora*, *Divarisaccus* and *Ginkgocycadophytus*.

Karharbari Palynozones- Two palynozones have been also recorded in the older sediments of lithologically undifferentiated sediments of Barakar Formation:

Palynozone-III: In this zone, *Callumispora* is the dominating element along with monosaccate pollen grains. The other qualitatively important taxa marked in the assemblage are-*Tiwariisporis*, *Crucisaccites*, *Distribamonocolpites* and *Dentatispora*.

Palynozone-IV: In the younger Karharbari Palynozone, *Parasaccites* becomes dominant once again and *Callumispora* declines and shows association with *Horriditriletes*, *Indotriradites* and few striated disaccates.

Barakar Palynozones- From Barakar Formation, two palynozones have been indentified:

Palynozone-V: In the Early Barakar-*Scheuringipollenites*, *Parasaccites*, *Plicatipollenites* have been recorded with rare occurrence of striated disaccate and triletes. In the Early Barakar monosaccates are recorded in outstanding percentage, this is a unique feature of the basin.

Palynozone-VI: This palynozone is marked by *Scheuringipollenites* in dominance followed by *Faunipollenites*. The other significant palynotaxa recorded in the assemblage are:- *Barakarites*, *Indotriradites*, *Parasaccites* and *Plicatipollenites*.

Pali Palynozones - In South Rewa Basin, the Pali Formation is divided into three members and the younger two of them contain distinct palynofloras which are described here:

Palynozone-VII: The Middle Pali Member, considered to be equivalent to Raniganj Formation, is marked with striated disaccates as dominating elements, the other significant taxa being *Densipollenites*, *Gondisporites*, *Guttulapollenites*, *Falcisporites*. The megaspores - *Singhisporites*, *Jhariatrilletes* and *Bokarosporites* are some significant taxa recorded in the assemblage.

Palynozone-VIII: The Upper Member of the Pali Formation contains the non-striate disaccate taxa in dominance alongwith *Brachysaccus*, *Playfordiaspora*, *Densoisporites*, *Lundbladispota* and *Arcuatipollenites*. Besides, *Banksisporites*, *Maiturisporites* and *Pantiella* are important megaspores which have been also recorded in this zone. This palynozone compares with the Panchet palynoflora recorded from Damodar Valley coalfields.

TABLE-1 : Intra-basinal correlation of the South Rewa Basin (Based on the microfioral assemblages)

Age	Forma- tion	Member	Palyno- zones	Important palynofossils	Johilla	Umaria	Korar	Singrauli	Sohagpur
T				<i>Staurosaccites, Duplicisporites, Granuloperculatipollis, Aulisporites, Camerosporites, Enzonialasporites, Samaropollenites, Tikisporites, Hughesporites, Erlansonisporites, Bacutritetes, Nathorstisporites</i>	Maheshwari <i>et al.</i> , 1978; Banerji <i>et al.</i> , 1978; Sundram <i>et al.</i> , 1979; Maheshwari & Kumaran, 1979; Kumaran & Maheshwari, 1980	Ram-Awatar 1996	Assemblage-1 of Tiwari & Ram-Awatar 1987 a	Chandra & Satsangi, 1965; Bharadwaj & Srivastava, 1969; Trivedi & Misra, 1970; Tiwari & Ram-Awatar, 1990, 1992	Ram-Awatar, 1996a (MS)
R			IX						
I									
A									
S									
S			VIII	<i>Banksisporites, Maiturisporites, Pantella, Alisporites, Falcisporites, Densipollenites, Densoisporites, Lundbladispora, Playfordiaspora</i>	Banerji <i>et al.</i> , 1978; Zone-F, and Text-fig.1 of Tiwari & Ram-Awatar, 1987, 1989				
I		UPPER							
C									
LATE PERMIAN									
MIDDLE PERMIAN			VII	<i>Striatopodocarpites, Faunipollenites, Scheuringipollenites, Densipollenites, Gondisporites, Falcisporites, Arcuatipollenites, Jhatriatrites, Singhisporites, Bokarosporites</i>	Banerji <i>et al.</i> , 1978; Jhingran, 1979; Tiwari & Ram-Awatar, 1986, 1987; Ram-Awatar, 1988		Assemblage-2 of Tiwari & Ram-Awatar 1987a	Mareshwari, 1966; Tiwari & Srivastava, 1984; Text-fig. 1 of Tiwari & Ram-Awatar, 1990	Ram-Awatar, 1993, 1996
LOWER ?									
E	B	UPPER	VI	<i>Faunipollenites, Striatopodocarpites, Barakarites, Plicatipollenites, Scheuringipollenites, Striatites</i>	Zone-4 of Anand-Prakash & Srivastava, 1984; Zone-D of Tiwari & Ram-Awatar, 1989	Zone-4 of Srivastava & Anand-Prakash, 1984		Tiwari, 1969, 1971; Bharadwaj & Sinha, 1969; Sinha, 1972	Assemblage-B of Bharadwaj & Srivastava, 1971
A	R								
R	A	LOWER	V	<i>Scheuringipollenites, Parasaccites, Plicatipollenites</i>	Jhingran, 1979; Zone-3 of Anand-Prakash & Srivastava, 1984	Zone-3 of Srivastava & Anand-Prakash, 1984		Tripathi, 1952; Trivedi, 1950, 53; Tiwari, 1971; Sinha, 1972; D. Rozario & Banerjee, 1994	Navale & Tiwari, 1967; Zone A-C of Bharadwaj & Srivastava, 1971
L	R								
Y	K	UPPER	IV	<i>Crucisaccites, Callumispora, Parasaccites, Microbaculispora</i>	Lele & Maithy, 1969; Zone-2 of Anand-Prakash & Srivastava, 1984; Assemblage A+C of Chandra & Srivastava, 1986; Zone-C of Tiwari & Ram-Awatar, 1989	Assemblage B+C of Chandra & Srivastava, 1986			
P	H								
E	B	LOWER	III	<i>Crucisaccites, Jayentisporites, Callumispora, Caheniasaccites</i>	Lele & Maithy, 1969; Jhingran, 1979; Anand-Prakash & Srivastava, 1984; Zone-B of Tiwari & Ram-Awatar, 1989	Maithy, 1968, 1969; Zone-1 of Srivastava & Anand-Prakash, 1984			Assemblage-G of Bharadwaj & Srivastava, 1971
R	A								
M	R								
I	T	UPPER	II	<i>Parasaccites, Plicatipollenites</i>	Potonie & Lele, 1961; Saksena, 1971; Lele & Chandra, 1973, 1974; Chandra & Lele, 1979; Zone-A of Tiwari & Ram-Awatar, 1989	Lele & Chandra, 1969, 1972			Lele & Chandra, 1969, 1972
A	L								
N	C								
	H								
	I	LOWER	I	<i>Plicatipollenites, Parasaccites</i>					

Tiki Palynozone

Palynozone-IX: This is the youngest palynozone recorded in the South Rewa Basin. The qualitatively important taxa recorded in the assemblage are given in table-1. The other significant taxa encountered in the assemblage are:- *Minutosaccus*, *Samaropollenites*, *Clavatisporites* and *Uvaesporites*. These miospores indicate a Late Carnian-Norian age of the Tiki Formation.

DISCUSSION

The present palynological succession in South Rewa Basin is based on the available data from various surface and subsurface sediments studied in the past and they have been arranged keeping in view the standard palynological succession known from Indian sub-continent, the first appearance and last appearance datum levels, their maximum proliferation, order of superposition of the rocks and also the lithological attributes. The object of this communication is to establish the stratigraphic relationships of different lithounits in the basin.

The Barakar Formation is the principal coal-bearing horizon in South Rewa Basin and occurs in conformable contact with the underlying Talchir Formation. The older sequence of the Barakar Formation contains light grey, soft sandstones interbedded with carbonaceous shale and dull coal. This sequence also contains polymictic pebbles and the dominance of the reworked Talchir matrix (greywack to sub-greywack) in association with heavy minerals (Ghosh & Basu 1969; Pareek 1969). This sequence is normally not differentiated from the Barakar Formation but Tarafdar *et al.* (1993) have recognised it as a Karharbari Formation. Palynoflora from this unit (Palynozone III, IV) have been described from surface sediments from Ganjra Nala (Lele & Maithy 1969; Saksena 1971); Pali Coalmine (Anand-Prakash & Srivastava 1984) in Johilla Coalfield and Umrar River section near Jawalamukhi Temple (Srivastava & Anand-Prakash 1984) in Umaria Coalfield.

The stratigraphic relationship of the post-Barakar sequences in South Rewa Basin has been debated since long and as yet no acceptable model has been evolved. The Pali Formation has been divided into two members (Datta 1988-89, 1989) while Tarafdar *et al.* (1993), Mitra (1993), Kundu *et al.* (1993) preferred to divide it into three members. Some workers also proposed to club Pali and Tiki formations into one unit as Pali-Tiki Formation (Dutta *et al.* 1977; Dutta & Ghosh 1972, 1993). Hughes (1881), Cotter (1918), Fox (1931), Lele (1964) Tiwari and Ram-Awatar (1987) suggested that Tiki is younger than the Parsora Formation.

Rao and Shukla (1954), Sahni and Rao (1956), Dutta and Ghosh (1972, 1979) also favoured the opinion that Parsora Formation is younger than the Tiki Formation.

Thus, it is clear that in the western part of the basin, physical, biological and stratigraphical studies are clubbed with each other without proper demarcation of the sediments from wherever fossils have been recorded. In the present investigation Pali and Tiki are considered to be separate mapable unit as evidenced by their microfossil contents, the latter being younger.

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