PALYNOLOGICAL CORRELATION OF THE COAL SEAMS OF PATHAKHERA COALFIELD, MADHYA PRADESH, INDIA

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Abstract

The palynological investigations of the working coal horizons and their correlation in Pathakhera Coalfield have been presented here. On the basis of results an Upper Karharbari to Lower Barakar age has been assigned.

Introduction

Crookshank (1936) studied in greater detail the stratigraphic sequence of different formations of Satpura Gondwana Basin where Barakar Formation is the only coal-bearing horizon. The Barakar sediments as well as the coal seams show their maximum development in Pathakhera Coalfield area and that is why this is one of the most important coalfield as far as exploration of coal in this basin is concerned. The coalfield has three coal seams which are being mined in seven sectors. The lowermost coal seam is popularly known as Bagdona seam and is 0.5 to 3.0 m in thickness but for most of the part it is too thin and has less economic value. The Lower Workable coal seam is 2.0 to 5.64 m in thickness (average 1.5 to 3.5 m) while the Upper Workable coal seam varies in thickness between 0.75 to 3.20 m (average 1.5 m). This coal seam has several intercalations of dirt bands. Pathakhera is the only coalfield outside Damodar Valley coalfields containing medium coking coal.

Feistmantel (1879) has classified most of the coal seams of Satpura Basin under Karharbari mainly on the basis of megafloral evidences recovered from the isolated localities like Shahpur and Mohpani. Fox, Medlicott and Crookshank opined that the placement of most of the coal seams of Satpura Basin under Karharbari by Feistmantel is not justifiable from the fact that it is really very difficult to differentiate the Karharbari sediments from that of Barakars due to lithological similarity between the two and less megafloral evidences in the sediments. The present investigation has been undertaken to provide palynological evidence in order to acertain a definite age to the coal-bearing horizons.

General Geology

The coalfield occupies over 204 sq km area of Barakar sediments having Moturs (younger) in the northern side. This area lies within the latitude 22°5'-22°11' N and longitude 78°5'-78'13°E. Archeans form the basement for the lower Gondwana sediments. The Talchirs unconformably overlies the Archeans and are spread in south, east and western portions. The boundary between Talchir and Barakars is faulted in the eastern and western region. Barakar sediments include fine to coarse-grained sandstones with felspar and occasional shale bands and coal seams. Current bedding and joint are

commonly observed in the field. The Motur Formation overlies with the Barakars which lithologically include fine to coarse-grained greenish sandstones and calcareous clay. The next younger sedimnet is represented by Bijori Formation which is characterised by red, yellow and green colours of clay with occasionally thin shale and weathered coal bands.

The samples studied in the present investigation have been collected from various Inclines of Pathakhera Coalfield (Tables 1-3).

Table 1—The samples collected from different working mine of Pathakhera Coalfield

PK:1 INCLINE
TOP SEAM (UPPER WORKABLE SEAM)

Miospores
Present (+)
ABSENT (—)
RARE (•)

Sl. No.	*Sample No.*	*Lithology*	
1.	Shale	Shale	•
2.	PK-1	Semi Bright Coal	•
3.	PK-2	-do-	—
4.	PK-3	Shale	•
5.	K-4	Semi Bright Coal	+
6.	PK-5	Dull Coal	•
7.	PK-6	Semi Bright coal	—
8.	PK-7	-do-	•
9.	PK-8	Dull coal	—

PK-1 INCLINE

MIDDLE SEAM (LOWER WORKABLE SEAM)

1.	M-1	Semi Bright coal	•
2.	M-2	-do-	+
3.	M-3	Shale lense	•
4.	M-4	Bright coal	•
5.	M-5	Semi Bright coal	—
6.	M-6	-do-	—
7.	M-7	-do-	—
8.	M-8	-do-	—
9.	M-9	-do-	—
10.	M-10	Dull coal	—

PK-1 INCLINE

BAGDONA SEAM (LOWER UNIT)

1.	B-1	Roof shale	+
2.	B-2	Shale	+
3.	B-3	Semi-Bright Coal	+
4.	B-4	-do-	—
5.	B-5	-do-	—
6.	B-6	-do-	*
7.	B-7	-do-	—

LOWER WORKABLE SEAM

SATPURA-SP-II, INCLINE 7, 8

1.	L-1	Semi-Bright coal	—
2.	L-2	Dull coal	—
3.	L-3	Semi-Bright coal	—
4.	L-4	-do-	—
5.	L-5	Dull coal	—
6.	L-6	Semi-Bright coal	—
7.	L-7	-do-	—
8.	L-8	Dull coal	—
9.	L-9	Semi-Bright coal	—
10.	L-10	-do-	—

UPPER WORKABLE SEAM

SP-II INCLINE

1.	U-1	Shale	+
2.	U-2	Sandstone	+
3.	U-3	Semi-Bright coal	—
4.	U-4	-do-	—
5.	U-5	-do-	—
6.	U-6	-do-	—
7.	U-7	Dull coal	—
8.	U-8	Semi-Bright coal	—

PK-2 INCLINE NO. 3 & 4

UPPER WORKABLE SEAM

1.	UP-1	Semi-Bright coal	*
2.	UP-2	Shale	—
3.	UP-3	Semi-Bright coal	—
4.	UP-4	-do-	—
5.	UP-5	-do-	*
6.	UP-6	-do-	*
7.	UP-7	-do-	*
8.	UP-8	Shale (floor)	+

PK-2 INCLINE 3 & 4

LOWER WORKABLE SEAM

1.	Lr.-1	Semi-Bright coal	—
2.	Lr.-2	-do-	—
3.	Lr.-3	Shale 25 cm	—
4.	Lr.-4	Semi-Bright coal	—
5.	Lr.-5	-do-	—
6.	Lr.-6	-do-	—
7.	Lr.-7	-do-	—
8.	Lr.-8	-do-	—
9.	Lr.-9	-do-	—

Table 2—Samples collected from Upper and Lower workable coal seams of bore hole No. CMPS-35 and 38.

1.	164.96-166	Coal	Upper Workable Seam	—
2.	166-166.10	Shale	-do-	+
3.	166.10-166.60	Shale	-do-	*
4.	182.36-184	Shale	Lower Workable Seam	+
5.	184-184.30	Coal	-do-	*
6.	184.30-185	Shale	-do-	+
7.	185-186	Coal	-do-	*
8.	186-186.50	Shale	-do-	+

BORE HOLE NO. CMPS-38

1.	165.10-165.13	Coal	Upper Workable Seam	—
2.	165.13-165.65	Shale	-do-	+
3.	165.65-166	Coal	-do-	*
4.	166-166.83	Shale	-do-	+
5.	183.50-183.90	Coal	Lower Workable Seam	—
6.	183.90-186	Shale	-do-	+
7.	186-186.95	Coal	-do-	*
8.	186.95-187	Shale	-do-	*
9.	187-187.73	Coal	-do-	+

Table 3—Samples collected from different coal seams of bore-hole CMPS-43, Shobhapur Block, Pathakhera Coalfield

S. No.	Sample No.	Depth in Metres	Lithology	Miospores Present (+) Absent (—) Rare (*)
UPPER WORKABLE COAL SEAM				
1.	A-1	189.32	Shaly coal	+
2.	A-2	189.54-190.20	Coal	—
3.	A-3	189-20-190.82	Shale	+
LOWER WORKABLE COAL SEAM (MIDDLE)				
1.	B-1	211.53-212.25	Coal	—
2.	B-2	212.25-212.42	Carbonaceous Shale	—
3.	B-3	212.42-212.85	Coal	—
4.	B-4	212.85-213.85	Coal	*
5.	B-5	214.40-216.42	Shale	*
6.	B-6	216.42-217	Shaly coal	+
7.	B-7	217.20-217.20	Coaly carb shale	*
BAGDONA COAL SEAM				
1.	BG-1	266-267.20	Coal	*
2.	BG-2	267.20-267.40	Sandy shale	+
3.	BG-3	267.70	Sandstone	+
4.	BG-4	268.35	Coal	*

Miofloral Succession

The miospore genera which have been commonly observed in the coal seams are : *Brevitriletes crassus* Sinha, 1972; *B. communis* Bharadwaj & Srivastava, 1969; *Densipollenites indicus* Bharadwaj & Shyam C. Srivastava, 1969; *Callumispora tenuis* Bharadwaj & Srivastava, 1969; *Callumispora tenuis* var. minor Bharadwaj & Srivastava, 1969; *Tiwariasporis flavatu* Maheshwari & Kar, 1967; *Weylandites obscurus* (Tiwari) Bharadwaj & Dwivedi, 1981; *Parasaccites distinctus* Tiwari, 1965; *P. plicatus* Lele & Makada, 1972; *P. obscurus* Tiwari, 1965; *P. bilaterlis* Tiwari, 1965; *P. diffusus* Tiwari, 1965; *Virkkipollenites orientalis* Tiwari, 1968; *Faunipollenites perexiquus* Bharadwaj & Salujha, 1965; *F. parvus* Tiwari, 1965; *Striatopodocrpites enigmatus* (Sarate, MS); *S. diffusus* Bharadwaj & Salujha, 1964; *Striatites reticuloidus* Tiwari, 1965; *Crescentipollenites hirsutus* (Kar) Bharadwaj, Tiwari & Kar, 1974; *Lahirites rarus* Bharadwaj & Salujha, 1964; *Scheuringipollenites maximus* (Hart) Tiwari, 1973; and *Ibisporites diplosaccus* Tiwari, 1968.

Palynological Assemblages

The maximum thickness of the Lower Gondwana sediments have been encountered in bore hole CMPS-43 in Shobhapur Block of Pathakhera Coalfield which includes all the three prominent coal seams of the area. The percentage distribution of palynotaxa suggests the existence of two distinct palnynozones.

Palynozone A—The sediments between 273.20 to 243.00 m in CMPS-43 include the lowermost coal seam, i.e. Bagdona seam (263.18-266.44 m) and are characterised by the overall dominance of the genus *Parasaccites* (average 67.5%). The percentage of this genus shows a gradual decrease towards the top and between 243.55-243.00 m it gets associated with nonstriated genus *Scheuringipollenites*. In addition to these *Faunipollenites* and *Breivtriletes* occur though inconsistently.

Similar assemblage has also been observed in Bagdona seam of PK-I Incline of Pathakhera Coalfield. In this area also the *Parasaccites* remains dominant but maintains comparatively a low profile (average 49.0%) as compared with the Bagdona seam in CMPS-43. This coal seam in PK-I Incline contains more amount of *Faunipollenites* (average 22.00%). This tendency is present between 248.00-243.00 m in CMPS-43, i.e. in the younger part of Palynozone A (Table 4).

Palynozone B—The nature of dominance changes between 243.00-61.5 m in bore hole CMPS-43 (Table 5). The monosaccate pollen *Parasaccites* declines (average 12%) and non-striate disaccate *Scheuringipollenites* gains overall dominance (average 51%) and it shows its maximum development between 227-136 m. *Faunipollenites*, a striate disaccate genus, forms the subdominance (average 18%).

Thus, these sediments are rich in nonstriate disaccate pollen grains. The Lower Workable (217.20-211.53 m) and Upper Workable (190.82-189.32 m) coal seams are included within the palynozone No. 2 in Shobhapur Block. The Lower Workable and Upper Workable coal seams encountered in bore holes CMPS-35 & 38 contain similar palynological assemblage as has been found in Palynozone 2 of CMPS-43. However, *Brevitrilites* is slightly more in percentage in bore holes CMPS-35 and 38 (Table 6).

The Lower Workable and Upper Workable coal seams, being worked in PK-I, UP-II and SP-II inclines also contain similar dominance of *Scheuringipollenites*. The percentage of *Faunipollenites* has, however, increased in these areas and remains associated as subdominant genus. *Parasoccites* has dropped down to an average of 8 percent.

Table 4—Showing the percentage of miospore genera in different coal seams of Pathakhera Coalfield

Miospore Genera	PK:I Incline Bagdona Seam			UP. workable seam	Mid. workable Seam	SP-II Incline UP. workable Seam		PK:II Incline 3 & 4
Callumispora	6	4	6	3	1	1	1	3
Brevitriletes	2	7	1	—	1	8	1	—
Parasaccites	59	34	54	13	3	1	18	2
Virkkipollenites	2	1	3	—	2	—	—	—
Densipollenites	—	—	—	1	1	—	—	—
Rhizomaspora	—	—	—	1	—	—	—	—
Striatites	1	3	2	1	2	4	1	2
Verticipollenites	—	1	—	1	—	—	—	—
Faunipollenites	17	30	19	38	17	13	37	40
Striatopodocarpites	1	5	2	4	4	2	6	5
Scheuringipollenites	8	10	8	37	69	68	35	46
Tiwaeriasporis	—	—	1	—	—	1	—	—
Aletes	4	5	4	1	—	2	1	2
Sample No.	B-1	B-2	B-3	PK-3	M-3	U-1	U-2	UP-8

Table 5—Showing percentage distribution of the miospores from bore-hole. CMPS-43, Shobhapur Block, Pathakhera Coalfield

Miospore Genera	Bagdona Seam		Lower Workable Seam	Upper Workable Seam	
Leiotriletes	—	—	—	—	1
Callumispora	5	6	—	6	2
Brevitriletes	—	4	—	5	—
Horriditriletes	—	—	—	—	1
Indotriradites	—	—	1	—	—
Parasaccites	73	62	16	10	5
Plicatipollenites	—	—	1	1	—
Virkkipollenites	—	1	—	—	—
Densipollenites	—	—	—	—	1
Rhizomaspora	—	—	1	—	3
Platysaccus	—	—	—	—	3
Striatites	1	1	3	3	5
Verticipollenites	—	—	—	—	1
Faunipollenites	7	9	22	17	9
Striatopodocarpietes	2	1	3	3	4
Scheuringipollenites	10	11	46	54	58
Tiwariasporis	11	—	—	—	1
Ginkgocycadophytus	—	—	—	—	1
Aletes	1	5	5	6	3
Samples Nos.	BG-3	BG-2	B-6	A-3	A-1

Table 6—Showing the percentage of miospore genera in bore-hole no. CMPS-35 and 38

Miospores Genera	BORE HOLE NO. CMPS-35				BORE HOLE NO. CMPS-38			
	Lower Workable Seam		Upper Workable Seam		Lower Workable Seam		Upper Workable Seam	
Callumispora	9	8	—	5	1	—	2	—
Brevitriletes	1	10	2	3	9	3	2	5
Inodotriradites	—	—	—	—	—	1	—	—
Latosporites	1	1	—	2	—	—	—	—
Parasaccites	12	19	2	4	13	20	2	2
Plicatipollenites	—	—	—	—	—	1	—	—
Virkkipollenites	1	1	—	—	2	3	2	1
Densipollenites	—	—	—	—	—	1	—	—
Rhizomospora	—	1	—	—	1	—	2	—
Primuspollenites	1	1	—	—	—	—	—	—
Luckisporites	—	—	—	1	—	—	—	1
Polytsaccus	—	—	1	—	—	—	—	—
Striatites	1	—	2	1	5	4	3	2
Verticipollenites	—	1	—	—	2	—	—	—
Faunipollenites	6	19	13	16	23	33	5	16
Striatopodocarpites	2	3	1	4	7	3	9	4
Scheuringipollenites	50	34	75	61	34	28	70	64
Tiwariasporis	—	1	—	—	—	—	—	—
Weylandites	1	—	—	—	—	—	1	—
Aletes	15	2	3	3	3	3	2	5
Sample No.	8	6	4	2	9	6	4	2

Comparison

The miofloral study of different coal seams, i.e. Upper (Top), Lower (Middle) and Bagdona yielded distinct miofloral assemblage zones. The lowermost Bagdona coal seam is rich in radial monosaccates (*Parascites* assemblage zone-1) while the Upper (Top) and Lower (Middle) Workable coal seams are rich in non-striated disaccates (*Scheuringipollenites* assemblage zone-2).

The dominance of *Parasaccites* among the coal seems was described by Bharadwaj and Srivastava (1973, younger subzone of zone 2) from the subsurface of Korba Coalfield.

Subsequently, Tiwari (1973) observed a similar dominance in Pusia Nala of the Barakar type area in Raniganj Coalfield. Such miofloral assemblage zone was ascribed to Upper Karharbari palynozone. Thus, the palyno-assemblage zone-1 delineated in Pathakhera Coalfield belongs to Upper Karharbri which also includes Bagdona coal seam of the area. The Bagdona seam of CMPS-35, 38, and 43 from Shobhapur area are correlatable with the Bagdona seam of PK-I Incline of Pathakhera Coalfield (Text-fig. 1).

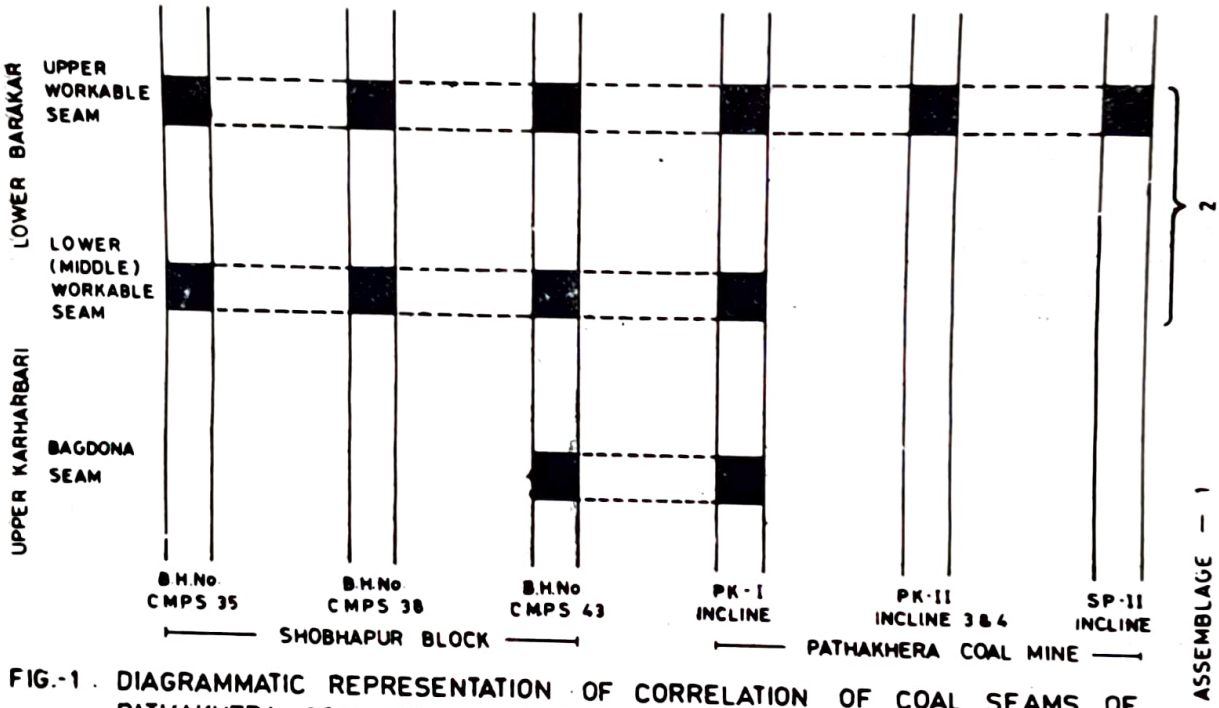

FIG.-1. DIAGRAMMATIC REPRESENTATION OF CORRELATION OF COAL SEAMS OF PATHAKHERA COAL MINE AND SHOBHAPUR BLOCK OF PATHAKHERA COALFIELD, M.P., INDIA.

Scheuringipollenites dominant assemblage succeeds the *Parasaccites* dominant assemblage in a confirmable sequence in Korba and Raniganj coalfields referred above. In Pathakhera Coalfield also a similar succession has been observed which obviously represents the Lower Barakar Palynozone (Assemblage zone 2). The Lower and Upper Workable coal seams contain similar palyno-assemblage and belong to Lower Barakar palynozone.

Kar (1973) studied the palynology of the samples from Bore Core K. B.-21. The mioflora recorded at the depth 405.6 m is closely similar to miofloral assemblage Zone -2 of present investigation. Assemblage zone A which has been recorded from Argada 'S' seam of South Karanpura by Bharadwaj and Tripathi (1978) is also similar to miofloral assemblage Zone-2 of present investigation. Tiwari *et al.* (1981) also recorded *Scheuringipollenites* dominant zone from Katri Nala Section of Jharia Coalfield. Srivastava, A. K. (1982) recorded a similar mioflora (assemblage Zone-2 of present investigation) from Raniganj Coalfield and he assigned a Lower Barakar age to this mioflora. Srivastava and Anand-Prakash (1984), Anand-Prakash and Srivastava (1984) recorded *Scheuringipollenites* rich mioflora from Umaria and Johilla Coalfields.

Thus the Upper (Top) and Lower (Middle) Workable coal seam of Pathakhera Coalfield contain the mioflora rich in non-striated disaccates *Scheuringipollenites* which very closely resembles with the mioflora known from Lower Barakar sediments. In this respect all these coal seams correlate with each other (Fig. 1).

References

ANAND-PRAKASH & SRIVASTAVA, SURESH C. (1984). Miofloral studies of Lower Gondwana sediments in Johilla Coalfield, M. P. India. *Palaeobotanist*, **32**(3) : 243-252.

BHARADWAJ, D. C. & SRIVASTAVA, SURESH C. (1973) Sub-surface palynological succession in Korba Coalfield, M.P., India. *Palaeobotanist*, **20**(2) : 137-151.

BHARADWAJ, D. C. & TRIPATHI, A. (1978) A palynostratigraphic study of Lower Gondwana sediments from South Karanpura Coalfield, Bihar, India. *Paleobotanist*, **25** : 39-61.

CROOKSHANK (1936) Geology of Northern slopes of Satpuras between Morand and Sher River *Mem. geol. Surv. India*, **66**(2) : 173-381.

FEISTMANTEL, O (1879) Palaeontological Notes from Satpura Coal-basin. *Rec. geol. Surv. India*. **12** : 74-83.

KAR, R. K. (1973). Palynological delimitation of the Lower Gondwanas in the North Karanpura sedimentary basin, India. *Palaeobotanist*, **20**(3) : 300-317.

SRIVASTAVA, A. K. (1982). A Lower Barakar mioflora from Raniganj Coalfield. *Geophytology*, **12**(1) : 131-132.

SRIVASTAVA, SURESH C. & ANAND-PRAKASH (1984). Palynological succession of Lower Gondwana sediments in Umaria Coalfield, M. P. India. *Palaeobotanist*, **32**(1) : 26-34.

TIWARI, R. S. (1973). Palynological succession in the Barakar Type Area. *Geophytology*, **3**(2) : 116-133.

TIWARI, R. S. SRIVASTAVA, S. C. TRIPATHI, A. & SINGH, V. (1981) Palynostratigraphy of Lower Gondwana sediments in Jharia Coalfield, Bihar. *Geophytology*, **11**(2) : 220:237.