

LATE-PERMIAN MONOCOLPATE AND SULCATE POLLEN FROM CHHIDRU FORMATION, SALT RANGE, PAKISTAN

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ABSTRACT: Rock Samples from selected localities of Chhidru Formation of late Permian age were processed for Palynological examination. Seven Monocolpate/Sulcate pollen form species viz, *Paravittatina lucifer*; *Cycadopites follicularis*; *Cycadopites cymbatus*; *Gnetaceaepollenites sinuosus*; *Marsupipollenites triradiatus*; *Praecolpatites sinuosus* were recovered and technically described. Careful comparison of these taxa with extinct and extant plant groups revealed the prevalence of following viz; *Gymnosperm*, *Peltasperms*, *Gnetales*, *Medullosales* and *Ephedrales*.

Keywords: Chhidru Formation, Palynomorphs, Monocolpate, Sulcate, Gymnosperms, Peltasperms, Gnetales, Medullosales and Ephedrales.

Running Title: Monocolpate and Sulcate Pollen from Chhidru Formation

INTRODUCTION

Chhidru Formation belonging to the Permian Group is widely distributed in Salt Range of Pakistan. It belongs to Zaluch Group of Late Permian age. It witnessed significant Geological and Biological cycles. Chhidru Formation has been thoroughly examined by P.J.R.G [1] and Mertmann [2] and four members viz “ Landu Member which predominantly contains sandstone with thin bedded alterations of black shale, Gulakhel Member with medium bedded Sandston, Thatti Member with sandstone intermixed with calcareous sandstones and Jallhar Member composed of weathered, soft, massive white sandstone. With the exception of Balme [3], no exclusive effort has been made to study the palynology of Chhidru Formation (Late Permian age) [2]. The present papers deals with only Monocolpate and Sulcate pollen. These pollen were technically described and their possible affinities were determined [4].

MATERIALS AND METHODS

Rock samples from two stratigraphically measured localities viz “ Nammal and Chhidru gorges were collected at a distance of one meter. Bulk maceration was achieved by treating samples (30g each) in a series with 50% analar Hydrochloric acid, Hydrofluoric acid and nitric acid respectively followed by 8-10 decantation with distilled water for complete neutralization. 1.5% KOH (analar grade) was used for removal of humic acid. The samples were processed using standard techniques [5,6,7,8]. After maceration palynomorphs were separated using ZnCl₂ (1.97 sp.gravity) as medium. Permanent slides were prepared in Canada balsam. Palynomorphs were screened and photographed, coordinates of each sporomorph were noted using Kyowa Medilux Trinocular microscope.

SYSTEMATIC PALYNOLOGY

Pollen Recovered were described in technical terms and tural system of classification was employed as per Balme [3].

Anteturma POLLENITES Pötonie, 1931

Turma SACCITES Erdtman, 1947

Sub turma MONOCOLPATES (Iverson & Troels) Smith, 1967

Genus: PARAVITTATINA Balme, 1970

Type species: *Paravittatina lucifer* Bharadwaj, 1962

P. lucifer Bharadwaj, 1962

Pl. 1 Fig. 1

Occurrence: cf. Table 1

Dimension: cf. Table 2

Description: Pollen grain, monosulcate, overall amb oval to subcircular or rounded quadrilateral. Exine with sharply defined, laevigate exoexinus ribs, individual ribs continuous and looped so that those near to periphery pass without interruption from the proximal to the distal face. However in highly compressed specimens, the ribs run transversely on the proximal face and longitudinally on distal face so that they appear to cross one another at right angles. Sulcus oval to subcircular and free of exoexine.

Slide No.: ZGC 20, NGC 27, CGC 30.

Genus: CYCADOPITES Wodehouse, 1933

Type species: *Cycadopites follicularis* Wilson, 1944

C. follicularis Wilson, 1944

Pl. 1 Fig. 2

Occurrence: cf. Table 1

Dimension: cf. Table 2

Description: Pollen grain, monosulcate, overall amb oval or oblong oval or may be fusiform if the specimens are not tightly compressed. Sulcus extending full length of grain, narrow near the distal pole, margins of sulcus may slightly or strongly overlap. Exine about 1µm thick, laevigate to infragranulate.

Slide No.: ZGC 25, NGC 26, CGC 78.

C. cymbatus (Balme & Hennelly) Segroves, 1970

Pl. 1 Fig. 3

Occurrence: cf. Table 1

Dimension: cf. Table 2

Description: Pollen grain, monocolpate, overall amb elongate oval to fusiform, colpus distinct, running entire length of grain with a tendency to become narrow in middle with slightly expanded extremities. Exine less than 1µm thick, intragranulose.

Slide No.: ZGC 52, NGC 50, CGC 29.

Genus: GNETACEAEPOLLENITES Thiergart, 1938

Type species: *Gnetaceaepollenites ellipticus* Thiergart, 1938

G. sinuosus Balme & Hennelly, 1955

Pl. 1 Fig. 4

Occurrence: cf. Table 1

Dimension: cf. Table 2

Description: Pollen grain, polypllicate, overall amb elongate oval, extremities sharply to broadly rounded, exine polypllicate with 3-5 or more massive folds on the proximal face running parallel to the long axis of grain and associated

with fold is a narrow linear longitudinal cleft in the exoexine detectable under oil immersion. The clefts are arranged symmetrically around the major axis of the grain. The thickness of these clefts is highly variable. Exine infragranulate to intrapunctate.

Slide No.: ZGC 27, NGC 54, CGC 17.

Turma PLICATES (Naumova) Pötonie, 1962

Subturma PREACOLPATES (Pötonie) Kremp, 1965

Genus: *MARSUPIPOLLENITES* Balme & Hennelly, 1955

Type Species: *Marsupipollenites triradiatus* Balme & Hennelly, 1955

M. triradiatus Balme & Hennelly, 1955

Pl. 1 Fig. 5

Occurrence: cf. Table 1

Dimension: cf. Table 2

Description: Pollen grain, monosulcate, overall amb longitudinally oval to subcircular, sulcus extending full length of the grain on the distal surface, slightly squeezed at pole with a marked oval or suboval outline. Proximal side bears a small triradiate mark with rays upto 12µm long. Exine 2µm thick consisting of very thin transparent intexine, which is only visible in extremely well preserved specimens, exoexine columellate.

Slide No.: ZGC 10, NGC 34, CGC 22.

Genus: *PRAECOLPATITES* Bharadwaj & Srivastava, 1973

Type species: *Praecolpatites nudpurensis* (Balme & Hennelly) Bharadwaj & Srivastava, 1973

P. sinuosus (Balme & Hennelly) Bharadwaj & Srivastava, 1973

Pl. 1 Fig. 6

Occurrence: cf. Table 1

Dimension: cf. Table 2

Description: Pollen grain, polyplicate, overall amb oval or rounded oval, exine clearly differentiated into exoexine and intexine, exoexine infrapunctate to granulate or intrabaculate, 3-5µm thick at equator appearing as a rim, intexine 1.0-1.5 µm thick, laevigate, sulcus smooth running approximately parallel to the long axis of the grain. The proximal surface bear narrow grooves of variable dimensions that form an irregular reticulum.

Slide No.: ZGC 19, NGC 51, CGC 80.>

P. ovatus (Anderson) Backhouse, 1991

Pl. 1 Fig. 7

Occurrence: cf. Table 1

Dimension: cf. Table 2

Description: Pollen grain, polyplicate, overall amb circular to subcircular or broadly oval, exine clearly differentiated into exoexine and intexine, exoexine intragranulate, 3-5µm thick, laevigate. Sulcus smooth, running approximately parallel to the long axis of the grain. The proximal surface bear narrow grooves which are comparatively less in number and are curved and sinuous.

Slide No.: ZGC 34, NGC 45, CGC 39.

Table 1: Percentage occurrence of palynomorphs, Chhidru Formation, Western Salt Range, Pakistan.

LOCALITY/GORGE MEMBERS PALYNOMORPHS	ZALUCH				NAMMAL				CHHIDRU			
	Landu	Gulakhal	Thaiti	Jalhar	Landu	Gulakhal	Thaiti	Jalhar	Landu	Gulakhal	Thaiti	Jalhar
<i>Paravittatina lucifer</i> Bharadwaj	15-25	10-15	-	-	-	>25	-	-	10-15	15-25	-	-
<i>Cycadopites cymbatus</i> (Balme & Hennelly) Segroves	5-10	<5	5-10	5-10	5-10	<5	10-15	15-25	5-10	<5	<5	5-10
<i>Cycadopites follicularis</i> Wilson & Webster	<5	5-10	5-10	<5	<5	<5	5-10	5-10	<5	<5	5-10	5-10
<i>Gnetaceaepollenites sinuosus</i> Balme & Hennelly	<5	10-15	<5	5-10	15-25	10-15	<5	5-10	10-15	10-15	5-10	5-10
<i>Marsupipollenites triradiatus</i> Balme & Hennelly	5-10	<5	-	-	<5	5-10	-	-	5-10	5-10	-	-
<i>Praecolpatites sinuosus</i> (Balme & Hennelly) Bharadwaj & Srivastava	<5	5-10	5-10	<5	5-10	<5	5-10	-	-	-	5-10	5-10
<i>Praecolpatites ovatus</i> (Anderson) Backhouse	15-25	5-10	5-10	10-15	10-15	10-15	15-25	15-25	-	-	5-10	10-15

Table.2: Palynomorph Dimensions (µm) Monocolpate / Sulcate Pollen

Palynotaxon	Figured specimen µm	Total specimens measured	Total length µm			Total breadth µm			Colpus / Sulcus µm		
			Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
<i>Cycadopites cymbatus</i> (Balme & Hennelly) Segroves	67×38	20	65	77	68	27	40	36	70	-	-
<i>Cycadopites follicularis</i> Wilson & Webster	42×18	28	40	56	47	15	21	19	39	54	45
<i>Gnetaceapollenites sinuosus</i> Balme & Hennelly	58×22	10	51	69	55	18	27	23	40	45	42
<i>Marsupipollenites triradiatus</i> Balme & Hennelly	38×36 40×38	14	32	39	34	29	35	30	-	-	-
<i>Paravittatina lucifer</i> Bharadwaj	33×30	24	34	44	38	29	39	32	22	28	24
<i>Praecolpatites sinuosus</i> (Balme & Hennelly) Bharadwaj & Srivastava	89×47	38	81	115	92	39	56	40	78	101	90
<i>Praecolpatites ovatus</i> (Anderson) Backhouse	68×44	42	73	101	84	38	56	41	61	94	81

DISCUSSION

Of the recovered palynomorphs, genus *Paravittatina* differs from the genus *Vittatina* in the form and structure of its continuous looped ribs [3]. In *Vittatina* the ribs extend only a short distance on the distal face and then distal extensions are parallel to proximal ribbing. In the presently investigated Chhidru Formation, this palynospecies was observed in abundance, but unfortunately most of the specimens were poorly preserved and broken. Only few intact specimens were available. The affinity of *Paravittatina* is suggested to be Gymnospermous and is being referred for the first time in the Chhidru Formation. It is suggested to represent Peltasperms. The *Cycadopites cymbatus* from Chhidru, varied greatly in outline with the ends of the grain ranging from rather pointed to broadly round. In some specimens the distal furrow is obscured through folding or compression. It also suggested to represent Peltasperms.

Throughout Australia *Gnetaceapollenites sinuosus* is chiefly found in upper Permian sediments [9]. It is also known from the upper Permian of Antarctica [10]. It points towards existence of Gnetales. *Marsupipollenites triradiatus* is wide spread in the upper Permian sediments in almost all Gondwanaland countries. In Australia it ranges stratigraphically from Late Sakmarian to Dzulfian but is in general only common in Dzulfian [1]. It is also recorded from the Permian of Africa and Antarctica [10] and India in the Raniganj Coal Fields [11]. It shows affinities with Medullosales. Both *Marsupipollenites triradiatus* and *Praecolpatites sinuosus* are representative of Ephedrales. These miospores also exist in abundance in Indian [11] and Australian [12] late Permian sediments. The affinities of the pollen under discussion were determined in accordance with the scheme proposed by Balme [3] and Looy [4].

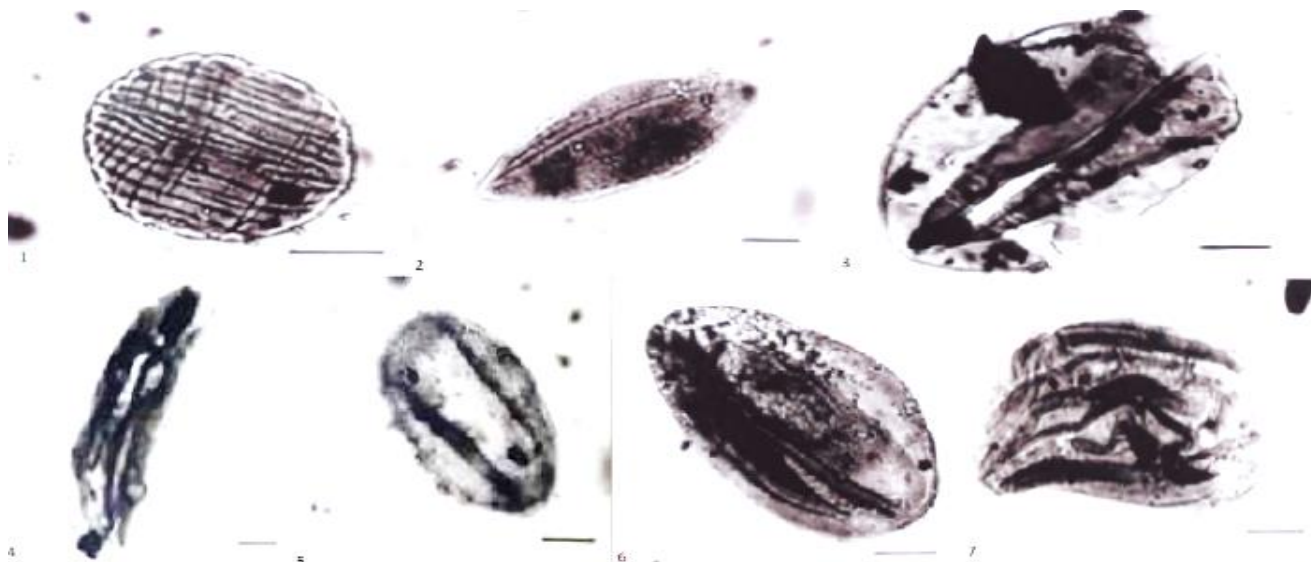


Plate 1: Fig 1 *Paravittatina Lucifer* Bharadwaj , Fig 2, *Cycadopites follicularis* Wilson & Webster Fig 3 *Cycadopites cymbatus* (Balme & Hennelly) Segroves, Fig 4 *Gnetaceapollenites sinuosus* Balme & Hennelly, Fig 5 *Marsupipollenites triradiatus* Balme & Hennelly, Fig 6 *Praecolpatites sinuosus* (Balme & Hennelly) Bharadwaj & Srivastava, 1973, Fig 7 *Praecolpatites ovatus* (Anderson) Backhouse. (Scale bar corresponds to 10µm).

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