PALYNOLOGICAL EVIDENCE OF PTERIDOPHYTIC PLANT COMMUNITIES IN LATE PERMIAN (DZULFIAN) PERIOD, WESTERN SALT RANGE, PAKISTAN

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ABSTRACT: *Chiddru Formation belongs to Permian Zaluch Group and is well exposed in the Salt Range, Pakistan\. Palynological study from the topmost ten beds (51-60m from the base) at the type locality (Chhidru Gorge Section) was carried out which revealed a substantial proportion of pteridophytic spore assemblages in addition to pollen and spores of other plant groups. Present paper deals with the identification of trilete and monolete miospore including Calamospora, Punctatisporites, Lophotriletes, Densoisporites, Laevigatosporites and Lunulasporites. Recovered palynomorphs are systematically described and discussed along with their possible plant affinities. The palynoflora suggested the existence of shade loving Pteropsids, Sphenopsids and Lycopsids in considerable numbers. Shallow marine environment has been suggested during the deposition of Chhidru Formation.*

INTRODUCTION

Late Permian (Dzulfian) sediments of the Salt Range were given the name Chhidru Formation by Dunbar [1]. The lower contact with Wargal Limestone is transitional whereas the upper contact with the Mianwali Formation of Triassic age is sharp and is marked by a paraconformity [2]. Its lithology varies from calcareous sandstone and few sandy limestones with minor amounts of feldspar, muscovite, biotite and iron oxide [3]. Chhidru Nala (Lat. 32°31'N; Long. 71 ° 48'E) is said to be the type locality of the Formation where its total thickness reaches up to 64 meters [4].

Despite of its immense importance, no significant botanically oriented palynological work has yet been published pertaining to the miospore assemblages from the type locality. The available literature in this respect is of Virkki [5], Balme [6] and Rehman and Masood [7].

Present study deals with the palynological analysis of the topmost section (51m-60m above the base) of Chhidru Formation. 06 miospore genera were recovered out of which 04 genera belonged to trilete spores while 02 genera belonged to monolete spores. Microflora from comparatively non-productive samples (CC53 and CC55) had an insignificant preservation to be incorporated in the results of present study. The recovered palynomorphs are technically described under the section of systematic palynology.

MATERIALS AND METHODS

The sampling in the field was carried out according to the stratigraphic procedures devised by Masood *et al.,*[8]. Ten samples (51m – 60m above the base) were taken from the type section of the Formation, at an interval of 01m. Standard preparatory techniques as suggested by Doher [9], Phipps and Playford [10], Traverse [11], Masood [12], Masood *et al.,* [13, 14] and Grey [15] were employed to the samples.

The samples were washed thoroughly with water to remove any surface contamination. Samples were crushed in pestle and mortar and small fragments were subjected to the reactivity test [5] to guess their predominant mineral composition using 50% of each HCl, HF and HNO3 [9] Water soluble minerals were removed by decantation with distilled water. Carbonates and silicates removal was carried out by treating with HCl and HF respectively. The humic acid layer was further removed by 1% KOH. Samples were centrifuged after mixing with a ZnCl2 solution having specific gravity (S.G.) of 1.975 . The supernatant was separated, neutralized and permanently mounted on glass slides using glycerin jelly as the mounting medium.

SYSTEMATIC PALYNOLOGY

Great caution was taken while identifying the palynomorphs. The terminology used in the description of miospores was taken from Kremp [16] and Pötonie [17]. The possible plant affinities were adapted from the Looy *et al.,* [18, 19]and Bharadwaj [20].

Anteturma SPORITES Pötonie, 1893
Turma TRILETES (Reinsch) Dettmann, 1956
Suprasubturma ACAVATITRILETES Dettmann, 1963
Subturma AZONOTRILETES (Luber) Dettmann, 1963
Infraturma LAEVIGATI (Bennie & Kidson) Pötonie, 1956
Genus *CALAMOSPORA* Schopf (in Schopf, Wilson & Bentall), 1944
Type Species: *Calamospora hartungiana* Schopf, Wilson & Bentall, 1944
C. hartungiana Schopf, Wilson & Bentall, 1944
Pl.1 Fig. 1-3
Dimension: Equatorial Diameter = 59µm
Description: Miospore, trilete, amb circular to sub-circular, highly variable due to folding, Y-mark distinct, rays extending up to 2/3rd of the radius, exine variously folded, laevigate, about 1µm thick.
Possible Affinities: Equisetales.
Infraturma APICULTI (Bennie & Kidson) Pötonie, 1956
Subinfraturma GRANULATI Dybova & Jachowicz, 1957
Genus *PUNCTATISPORITES* (Ibrahim) Pötonie & Kremp, 1955
Type Species: *Punctatisporites punctatus* (Ibrahim) Pötonie & Kremp, 1955
P. vermiculatus Kosanke, 1950
Pl. 1 Fig. 4, 5
Dimension: Equatorial Diameter = 175µm
Description: Miospore, trilete, amb circular, Y-mark well developed, rays extending up to 2/3rd of the radius with curvaturae imperfectae, contact area well developed, distinct, exine thin at contact area, punctate, upto 2µm thick.
Possible Affinities: Pteridophytic**.**
p. gretensis Balme & Hennelly, 1956
Pl. 1 Fig. 6, 7

Dimension: Equatorial Diameter = 87.5µm
Description: Miospore, trilete, amb broadly triangular, Y-mark distinct, well developed, labra thick, raised, rays extending upto one half of the radius, exine punctate, upto 2µm thick.

PLATE-1

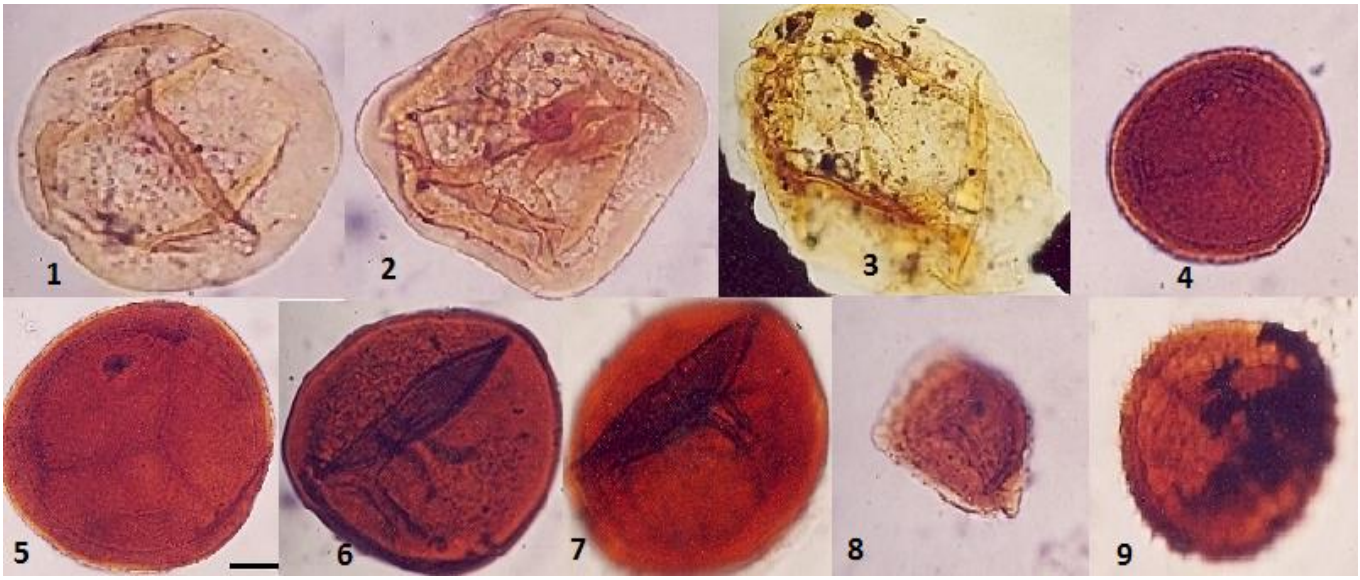


Fig 1-3. ***Calamospora hartungiana*** Schopf, Wilson & Bentall. Fig 4, 5. ***Punctatisporites vermiculatus*** Kosanke
Fig 6,7. ***Punctatisporites gretensis*** Balme & Hennelly, Fig 8. ***Lophotriletes*** sp, Fig 9. ***Densoisporites complicatus*** Balme

PLATE-2

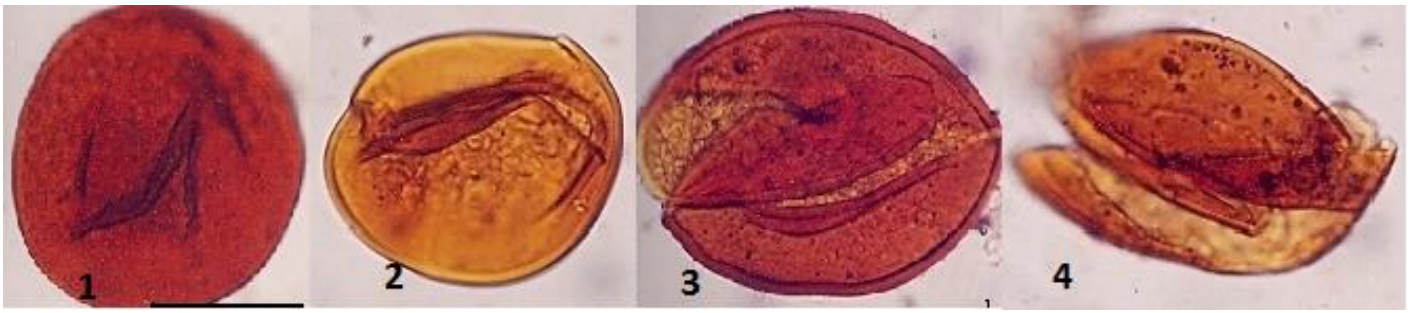


Fig 1-2. ***Laevigatosporites callosus*** Balme Fig 3-4. ***Lunulasporites vulgaris*** Wilson

Possible Affinities: Pteridophytic.
Infraturma NODATI Dybova & Jachowicz, 1957
Genus *LOPHOTRILETES* Naumova *ex* Pötonie & Kremp, 1954
Type Species: *Lophotriletes gibbosus* Ibrahim, 1933
Lophotriletes sp.
Pl.1 Fig. 8
Dimension: Equatorial Diameter = 45µm
Description: Miospore, trilete, amb circular to sub-circular to broadly triangular, Y-mark distinct, reaching up to the radius, exine punctate to vermiculate, up to 2µm thick.

Possible Affinities: Pteridophytic.
Suprasubturma LAMINATITRILETES Smith & Butterworth, 1967
Subturma ZONOLAMINATITRILETES Smith & Butterworth, 1967
Infraturma CINGULATI Smith & Butterworth, 1967
Genus *DENSOISPORITES* Weyland & Krieger, 1953
Type Species: *Densoisporites velatus* Weyland & Krieger, 1953
D. complicatus Balme
Pl.1 Fig. 9

Dimension: Equatorial Diameter = 60µm
Description: Miospore, trilete, amb sub-circular to broadly triangular, Y-mark well developed, discernible, reaching upto the margins, exine echinate, upto 3µm thick.
Possible Affinities: Lycopodiales.
Turma MONOLETES Ibrahim, 1933
Suprasubturma ACAVATOMONOLETES Dettmann, 1963
Subturma AZONONOMONOLETES Luber, 1935
Infraturma LAEVIGATOMONOLETI Dybova & Jachowicz, 1957
Genus *LAEVIGATOSPORITES* Ibrahim, 1933
Type Species: *Laevigatosporites vulgaris* Ibrahim, 1933
L. callosus Balme, 1970
Pl.2 Fig. 1, 2
Dimension: Equatorial Diameter = 85µm
Description: Miospore, monolete, amb circular, lete well developed, labra thick, raised, contact area well developed, exine thin, laevigate to infrapunctate, up to 2µm thick.
Possible Affinities: Pteridophytic.
Genus *LUNULASPORITES* Wilson, 1982
Type Species: ***Lunulasporites vulgaris*** Wilson, 1982
L. vulgaris Wilson, 1982
Pl. 2 Fig. 3, 4
Dimension: Equatorial Diameter = 97.5µm
Description: Miospore, monolete, amb broadly oval, lete well developed, rays extending up to the margins, exine thin, laevigate to infrapunctate, 1-1.5µm thick.
Possible Affinities: Pteridophytic.

RESULTS AND DISCUSSIONS

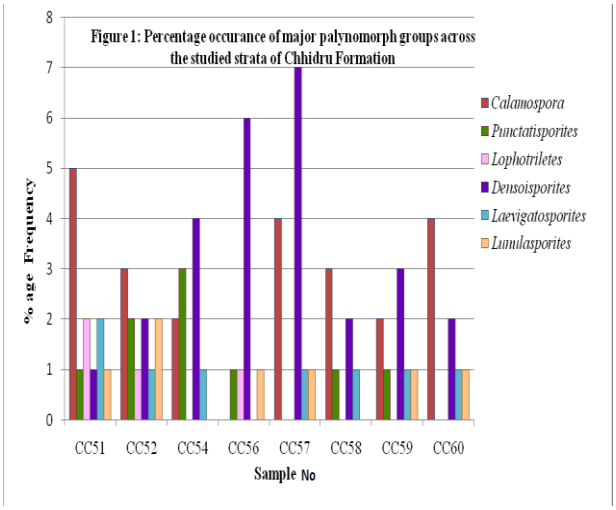
The recovered palynoflora was consisted of greater proportion of bisaccate pollen. Trilete and monolete spores were the next important counterparts showing fragmentary but stable population.

The palynoassemblage was comprised of five (05) palynomorph species belonging to four (04) trilete form genera i.e., *Calamospora hartungiana, Punctatisporites vermiculatus, P. gretensis, Lophotriletes* sp. and *Densoisporites complicatus*) and two (02) palynomorph species belonging to two monolete form genera viz; *Laevigatosporites callosus* and *Lunulasporites vulgaris.*

Densoisporites, Calamospora and *Laevigatosporites* were long ranging form taxa i.e., they occurred almost in all horizons while others were restricted to few samples e.g., *Punctatisporites, Lophotriletes* and *Lunulasporites* (Figure 1).

Among trilete spores, azonate smooth, azonate sculptured and smooth cavate triletes were observed. Amongst those, zonate smooth were abundantly encountered during present investigations. Palynoflora was represented in fairly good complexion. Only one cavate/perinosporate trilete genus was observed probably of lycopodialean origin, i.e. *Densoisporites complicatus* inhabited nearly in all productive samples (Figure 1).

Among monoletes, *Laevigatosporites* and *Lunulasporites* were recorded in most of the samples (Figure 1). Preservational status of palynomorphs was fair to poor.



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