

MIOSPORES OF LYCOPODIACEOUS ORIGIN FROM EARLY TRIASSIC OF PAKISTAN.

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ABSTRACT: *Lycopods represent one of the major plant groups that flourished during the Early Triassic period now referred to as Salt Range, Pakistan. Certain Lycopodiaceous trilete spores also epitomize the index fossils of the Early Triassic age. In view their abundance and importance, the present paper reports such selected Lycopodiaceous trilete spores recovered during the present investigation i.e; five genera and thirteen species tentatively belonging to Lycopods are morphosystematically described viz; Lycopodiacidites pelagius, Lundbladispora brevicula, L. variabilis, L. obsoleta, L. playfordii, Kraeuselisporites sverdrupensis, K. cuspidatus, K. rallus, K. saeptatus, Nevisisporites fossulatus, Densoisporites nejburgii, D. playfordii and D. complicatus.*

Key words: Early Triassic, Lycopodiaceous, Salt Range.

Running Title: Miospores of Lycopodiaceous spores from Early Triassic.

INTRODUCTION

The Triassic system in Pakistan is represented by three Formations viz; Mianwali, Tredian and Kingriali respectively [1]. Mianwali Formation represents the earliest rocks of Triassic period. Lithologically, Mianwali Formation has been divided into three members viz; Katwai, Mittiwali and Narmia members [2,3]. The present paper reports the Lycopodiaceous spores recovered from the Mittiwali member, Nammal Gorge Section, Western Salt Range, Pakistan. The Mittiwali member is about 96m thick at the Nammal Gorge Section (Lat 32° 39' 27" Long 71° 47' 50") and is dominated by limestone and splintery shales. All the reported triletes spores were in a good state of preservation in the form of polar and off polar compressions and are systematically described according to terminology as adopted by Balme [4].

MATERIALS AND METHODS

Bulk maceration was employed by using analar grades of 50 % HCl, HF and HNO₃ and then 1% KOH treatment followed by preparation of strew mounts slides in Canada Balsam. Microphotography was done under oil immersion objective using Kodak 100 ASA panchromatic film.

Various species were expressed in terms of their relative frequencies as follows:-

Abundant above 25% , Dominant above 15% but less than 25%, Frequent above 10% but less than 15%, Rare above 5% but less than 10% and Very rare less than 5% .

RESULTS AND DISCUSSION

All the reported species have been recovered in a good state of preservation from different members of Mianwali Formation (Nammal Gorge section, Salt Range, Pakistan) in abundant, dominant and frequent forms.

Lycopodiacidites pelagius Balme, 1963

Fig1 a

Occurrence: In between 10-25% and above.

Dimensions: (52 Specimens) Equatorial diameter 45(46) 84 µm.

Description: Trilete, amb originally circular to sub circular or rounded triangular, spore pyramidal in shape, lete not very distinct, arms of leisurae not extending up to the equator, proximal face psilate or with greatly reduced sculptures, distal face heavily sculptured consisting coarse reticulations

and weak coni, coni 8-10 µm in basal diameter, 3-5 µm high, 6-8 coni project beyond the equator, muri 4-8 µm wide, lacunae 10-15 µm broad, exine up to 2-3 µm thick.

Collection: NGM-94/6, NGM-106/3

Lundbladispora brevicula Balme, 1970

Fig b

Occurrence: In between 10-25%.

Dimensions: (61 Specimens) Mean diameter of Exoexine 42(55)64 µm. Mean diameter of Central body 31(42)51 µm.

Description: Trilete, cavate, amb rounded triangular, angles rounded, lete distinct, labra absent, arms of leisurae extending up to the outer margin of the central body, central body excentrically placed with respect to the exoexine, exoexine strongly infravermiculate up to 4 µm thick.

Collection: NGM-94/8

Lundbladispora variabilis (Jansonius) Yaroshenko

Goluveva, 1989

Fig1 c

Occurrence: Above 15% and less than 25%.

Dimensions: (36 Specimens) Mean diameter of Exoexine 35(46)55 µm. Mean diameter of Central body 28(39)42 µm.

Description: Trilete, cavate, amb rounded triangular, sides convex, lete distinct, raised, arms of lete extended up to the outer margin of the cingulum, labra distinct, uniform up to 4 µm broad, central body distinct attached to exoexine below the trilete suture, excentrically placed with respect to exoexine, exoexine distally more thicker, central body infrapunctate, exoexine intragulate to poorly infraconate and infraspinate.

Collection: NGM-37/15

Lundbladispora obsoleta Balme, 1970

Fig1 d

Occurrence: Above 15% and less than 25%.

Dimensions: (12 Specimens) Mean diameter of exoexine = 42(56) 61 µm. Mean diameter of central body = 34 (45) 51µm.

Description: Trilete, cavate, amb rounded triangular, angles rounded, lete distinct, arms of lete extending up to the outer margin of zone, central body distinct, labra distinct, ragged or sinuous, semi translucent up to 4 µm broad, central body attached to the exoexine immediately underneath the Y radii, otherwise loose and excentrically placed, central body laevigate or infrapunctate to granulate, exoexine markedly thicker along the distal hemisphere than on the proximal

hemisphere, exoexine infragranulate or infravermiculate, central body 2 μm thick, exoexine up to 4 μm thick.

Collection: NGM-46/1-S1, 37/11, 28/6

Lundbladispota playfordi Balme, 1963; Fig1 e

Occurance: Above 25% .

Dimensions: (75 Specimens) Mean diameter of exoexine = 26(48) 65 μm . Mean diameter of central body = 20 (36) 54 μm .

Description: Trilete, cavate, amb rounded triangular, angles rounded, sides convex, trilete distinct, arms of lete extending up to the outer periphery of central body, labra indistinct, commissure smooth, central body thin walled, infragranulate, exoexine intra granulate to infraverrucate or connate, exoexine proximally thinner with narrow equatorial thickening, central body loose, excentrically placed with respect to exoexinal equatorial margin, apical papilla not discernable, ektexine up to 4 μm thick.

Collection: NGM-33/5, 31/13, 42/4, 37/10, 42/3

Kraeuselisporites sverdrupensis Utting, 1994; Fig1 f

Occurance: Above 10% and less than 25%.

Dimension: (48 Specimens) Mean diameter of exoexine = 28(35) 46 μm . Mean diameter of central body = 21 (30) 41 μm .

Description: Trilete, zonate, amb rounded triangular, lete distinct, arms of lete extending up to the outer margin of zone, labra raised, pyramidal completely masking lete, exoexine scrabrate to loosely connate, outer layer of exine extended to form a flange which is closely appressed to the central body covering the distal side, smooth laevigate up to 2 μm thick, structural elements dense sometimes extending up to the distal surface of flange and obscuring it, flange simple with varying width, in few specimens the flange is totally masked by the sculptural elements or variangly damaged.

Collection: NGM-31/14

Kraeuselisporites cuspidatus Balme, 1963; Fig1 g

Occurance: In between 15-25%.

Dimension: (34 Specimens) Mean diameter of exoexine = 45(56) 78 μm . Mean diameter of central body = 36 (42) 61 μm .

Description: Trilete, zonate, amb rounded triangular, lete distinct, arms of lete extending up to the outer margin of zone, outer layer of exine extended to form a flange, exoexine of the proximal face laevigate, flat or slightly raised forming a low pyramid approximately in one plane with flange, distal face characteristically inflated forming hemisphere, exoexine of distal face infraapiculate, infraechinate, intrapunctate or intravermiculate, central body smooth laevigate up to 2 μm thick, structural elements despite being dense not crowded, sometimes may extend up to the distal surface of flange apparently, obscuring it, flange simple with varying width, in

, equatorial

few specimens the flange is totally masked by the sculptural elements.

Collection: NGM-106/3, 46/1, 4, 11-S1

Kraeuselisporites rallus Balme, 1970; Fig1 h

Occurance: Above 25%.

Dimension: (56 Specimens) Mean diameter of exoexine = 50(72) 88 μm . Mean diameter of central body = 24 (36) 56 μm .

Description: Trilete, zonate, amb rounded triangular, lete distinct, arms of lete extending up to the outer margin of zone, outer layer of exine extended to form a flange, flange uniform, exoexine infravermiculate, cristate or connate, labra indistinct, equatorial flange exhibiting uniform width.

Collection: NGM-33/6

Kraeuselisporites saeptatus Balme, 1963; Fig1 i

Occurance: Less than 10%.

Dimension: (28 Specimens) Mean diameter of exoexine = 60(78) 92 μm . Mean diameter of central body = 38 (53) 65 μm .

Description: Trilete, zonate, amb rounded triangular, lete distinct, arms of lete extending up to the outer margin of zone, outer layer of exine extended to form a flange, flange more than 10 μm broad, exoexine intragranulate to intrapunctate or infravermiculate, exoexine of the distal hemisphere, ornamented with low population of spines, conni and baculi which are only discernable upon careful L-O analysis under oil immersion.

Collection: NGM-42/7,4, 31/12,33/2

Nevisisporites fossulatus Balme, 1970; Fig1 j

Occurance: In between 15-25%.

Dimensions: (35 Specimens) Equatorial diameter = 30(45) 52 μm .

Description: Trilete, zonate, amb circular to sub circular or rounded triangular, lete distinct, arms of lete extending up to equator, exine equatorially thick forming a cingulum, distal exine infra punctate, proximal exine infragranulate to infra vermiculate or baculate, structural elements more pronounced and sharply developed in the inter radial area adjacent to leisurae, maximum width of cingulum 6 μm , exine 3 μm thick.

Collection: NGM-44/2, 94/4

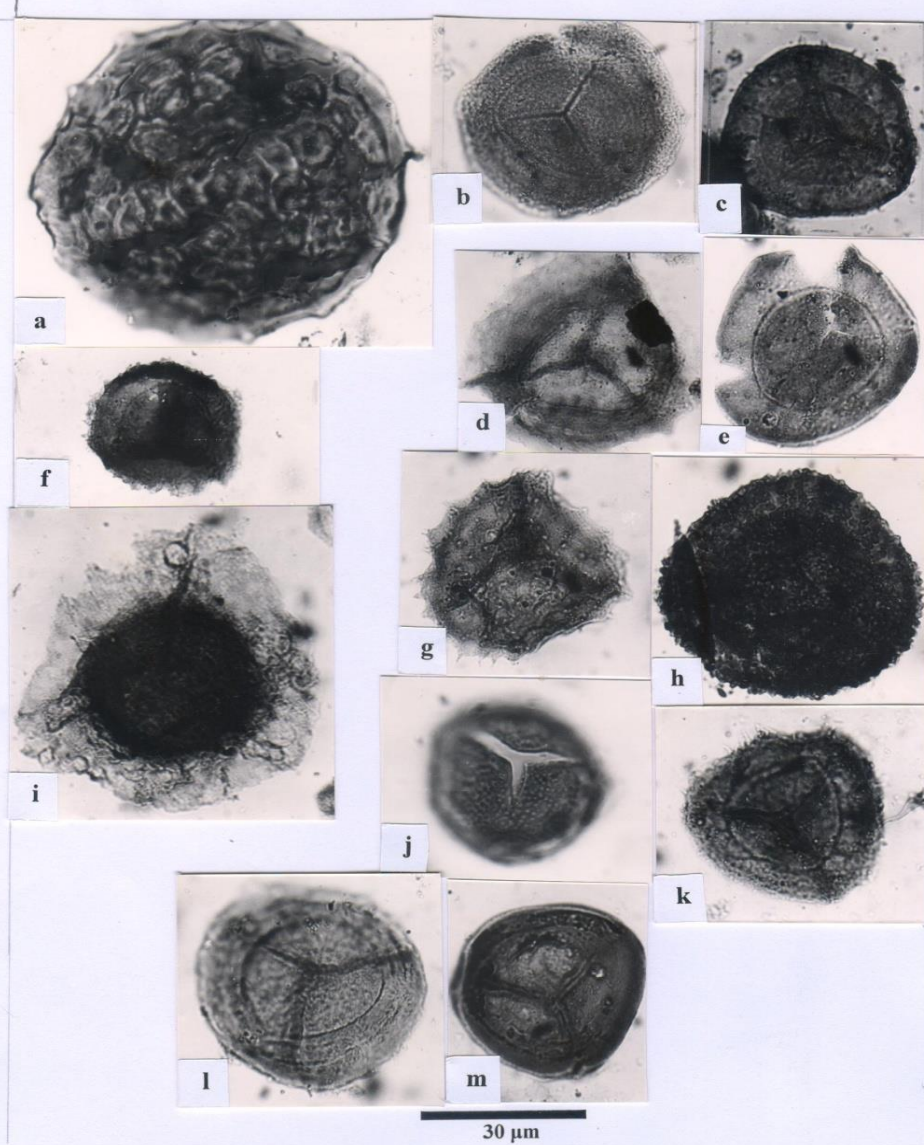
Densoisporites nejburgii (Schulz) Balme, 1970; Fig1 k

Occurance: In between 10-15%.

Dimensions: (38 Specimens) Diameter of exoexine = 40(58) 81 μm . Diameter of central body = 22 (36) 68 μm .

Description: Trilete, cavate, amb triangular, angles rounded, sides convex, exoexine intragranulate to infraverrucate up to 3 μm thick, more thicker distally than on proximal face forming an equatorial pseudocollar, central body laevigate up to 1 μm thick, arms of lete extending up to the outer limits of the equator

FIGURE 1



- a: *Lycopodiacidites pelagius* Balme , 1963
- c: *L. variabilis* (Jansonious) Yaroshenko Golubeva, 1989
- e: *L. playfordi* Balme, 1963
- g: *K. cuspidatus* Balme, 1963
- i: *K. saeptatus* Balme, 1963
- k: *Densoisporites nejburgii* (Schulz) Balme, 1970
- m: *D. complicatus* Balme, 1970

- b: *Lundbladispora brevicula* Balme, 1970
- d: *L. obsoleta* Balme, 1970
- f: *Kraeuselisporites sverdrupensis* Utting, 1994
- h: *K. rallus* Balme, 1970
- j: *Nevisisporites fossulatus* Balme, 1970
- l: *D. playfordi* (Balme) Dettman, 1963

flange almost of equal width (10 μm broad) with ragged and undulating margins.

Collection: NGM-94/6, NGM-106/3

Densoisporites playfordi (Balme) Dettman, 1963; Fig 1

Occurrence: Less than 10%.

Dimensions: (18 Specimens) Equatorial diameter = 41(58) 70 μm .

Description: Miospore, trilete, cavate, amb rounded triangular to almost subcircular, equatorial flange divided into two zones through a circular cleft, exoexine intragranulate to infraverrucate up to 3 μm thick, more thicker distally than on proximal face forming an equatorial pseudocollar, central body laevigate up to 1 μm thick, lete distinct extending up to the outer periphery of central body, labra distinct, raised sinuous.

Collection: NGM-28/3, 21/10

Densoisporites complicatus Balme, 1970; Fig 1 m

Occurrence: Above 25%.

Dimensions: (71 Specimens) Diameter of exoexine 43(68) 75 μm . Diameter of central body 21 (36) 64 μm .

Description: Trilete, cavate, amb triangular, angles rounded, sides convex, exoexine intragranulate to infraverrucate up to 3 μm thick, more thick distally than on proximal face forming an equatorial pseudocollar, central body laevigate up to 1 μm thick, lete distinct extending up to the outer periphery of central body, labra distinct, raised sinuous.

Collection: NGM-42/1

The present study reveals that a group of diverse vascular plants existed during the Early Triassic period in the area now occupied by the Salt Range, Pakistan, small lycopods were one of such forms. Lycopodiophyta is the oldest (450 million years old) extant vascular plant division [5]. Lycopodiophyta includes Lycopodiopsida, Isoetopsida and Zosterophyllopsida [6,7].

After the great Permo-Triassic mass extinction event Lycopodiophyta was one of the pioneers plant groups that rehabilitated the moist places. The present paper can be helpful while re-evaluating the plant groups that existed 250 million years ago in the form of palynoflora being in the good state of preservation.

During the present study cavate and zonate trilete spores tentatively representing Lycopods have been reported.

Balme [4] reported Mianwali Formation as a diverse assemblage containing palynomorphs of various plant groups. During the present investigation, there are certain taxa that have been reported for the first time from the Salt Range, Pakistan like *Lundbladispota variabilis* and *Kraeuselisporites saeptatus* while *Lundbladispota obsoleta* has already been reported from Mianwali Formation [4, 8]. In addition to these, *Nevisisporites fossulatus* and *Densoisporites playfordi* was reported from the Tredian Formation [8] and *Densoisporites playfordii* by Balme [4].

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