

## EARLY TRIASSIC AZONATE TRILETE SPORES FROM MIANWALI FORMATION, WESTERN SALT RANGE, PAKISTAN.

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**ABSTRACT:** Mianwali Formation represents the Early Triassic strata of the Salt Range, Pakistan that is underlain by Chhidru Formation (Late Permian) and overlain by Tredian Formation (Middle Triassic). The Mianwali Formation has three members in ascending order viz., Katwai, Mittiwali and Narmia member. It is predominantly composed of black shales along with the dolomite, limestone, sandstone and sandy shales. A diverse palynoassemblage was recovered from some sandstones of Mianwali Formation at the Nammal Gorge Section. The detailed palynoflora recovered from Mianwali Formation cannot be covered in a single paper, therefore the present paper deals exclusively with the azonate trilete spores viz; *Calamospora mutabilis*, *Pachytriletes densus*, *Granulatisporites minutes*, *Cyclogranisporites aureus* and *Punctatisporites gratensis*.

### INTRODUCTION

Mianwali Formation represents the lower most Triassic strata of the Salt Range, Pakistan. Lithologically it represents varied composition having coarse and fine grained sandstones, limestone, dolomite and compact, splintery and fissile shales [1,2]. Mianwali Formation overlies the Chhidru Formation of late Permian age, though a paraconformity is indicated on palaeontological and palynological grounds [3]. It is overlain by Tredian Formation of Late Triassic age in the Salt Range and by Chak Jabbi Limestone in the Kalachitta Range [4]. Mianwali Formation has been divided into three members in ascending order i.e., Katwai, Mittiwali and Narmia members, respectively [5]. Rock samples for the present investigation were collected from Nammal Gorge Section (Long 71° 47' 50" Lat 32° 39' 27") located 25 km east of Mianwali city on Musakhel – Mianwali road . Here the Mianwali Formation is approximately 107 m thick (The section was measured accurately in accordance with the internationally recommended procedures [6]) All the members are well exposed. Limited Published literature is available on palynology of the Early Triassic Sediments Salt Range, Pakistan. The most significant and outstanding work was done by Balme[7]. Some later contributions include Masood *et al.*[8] and Masood [9].

### MATERIALS AND METHODS

Rock samples were processed in accordance with the scheme as suggested by[10,11]. Bulk maceration was employed by overnight treatment of samples (50 g) by analar grades of 50 % HCl, HF and HNO<sub>3</sub> followed by neutralizations of acids through several decantations with distilled water. This was followed by 1% KOH treatment and subsequent neutralization. Strew mount permanent slides were prepared in Canada Balsam. Photographs were made under oil immersion X60, X40 objectives on Kodak 100 ASA panchromatic film.

Relative frequencies of various species were expressed 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% . Furthermore sample code was employed in the following manner:-

NGK Nammal Gorge Katwai, NGM Nammal Gorge Mittiwali and NGN Nammal Gorge Narmia. While the numbers 1, 2, 3 etc. represent the sample numbers oblique slide no.

The dimensions are based on specimens preserved in polar view, the values given on right side represent the maximum diameter, the values on the left side represent the minimum diameter while the values in the parenthesis represent the average diameter.

### RESULTS AND DISCUSSION

Most samples contained identifiable and well preserved spores. Spores varied in color from dark yellow to reddish brown in color, polar and off polar compressions were the most common type of preservation. Palynomorphs are intact sporopollenin bearing acid resistant microfossils [12] which are well preserved in a number of depositional environments like sandstone, shales, mudstones [13]etc.

Pl.1 Fig. 1

**Occurrence:** Nammal Gorge: Mittiwali member abundant to common,

**Dimensions:** (45 Specimens) Equatorial diameter 28(32) 45 μm.

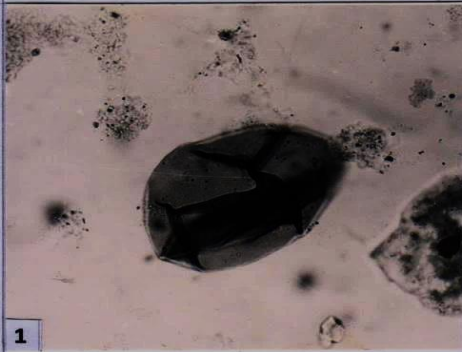
**Description:** Miospore, trilete, amb originally circular to sub circular, distorted due to compressional folds, imparting typical oval or arcuate appearance to the spore, lete distinct, labra sharply developed, raised straight to sinuous, arms of leasurae never extending 1/4 spore radius, a large biconvex compressional fold, intersect rest of the folds at right angle, exine infragranulate 1 μm thick.

**Remarks:** The spore apparently confirm more closely to the spores description by Potonie and Kremp [14] than that of Smith and Butterworth [15]

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

**Possible affinities:** Pteridophytic (Calamitales).

## PLATE 1



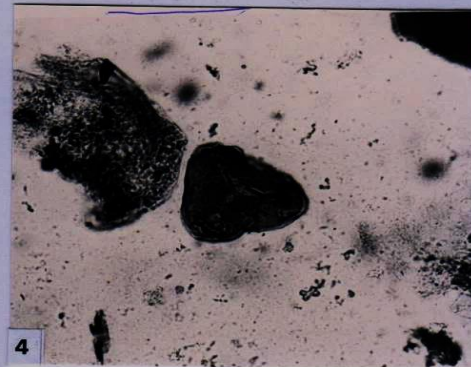
1



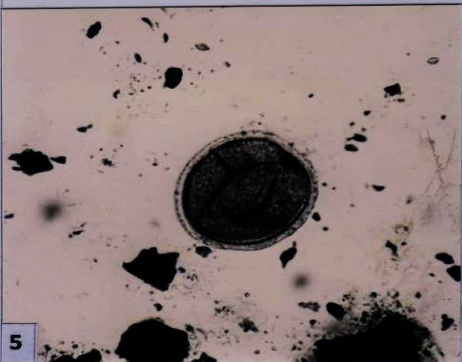
2



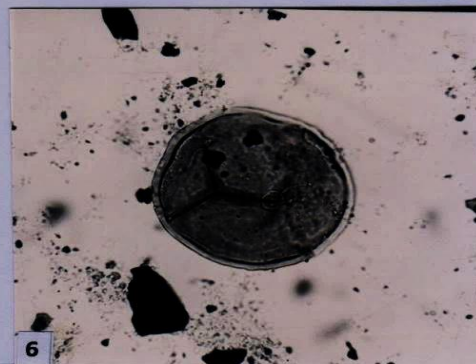
3



4



5



6

Fig. 1: *Calamospora mutabilis* (Loose) Schopf, Wilson and Bental  
Fig. 4: *Granulatisporites minutes* Utting, 1994

2-3: *Pachytriletes densus* Bose and Kar 1966  
Fig. 5: *Cyclogranisporites aereus* Potonie and Kremp, 1955

Fig. 6: *Punctatisporites gratensis* Balme and Hennelly, 1956

Scale bar corresponds to 30  $\mu$ m



*Calamospora mutabilis* (Loose) Schopf, Wilson and Bental.  
*Pachytriletes densus* Bose and Kar, 1966  
Pl. 1 Fig 2,3

**Occurrence:** Nammal Gorge; Mittiwali member common to frequent

**Dimensions:** (54 Specimens) Equatorial diameter 36(41) 62  $\mu$ m.

**Description:** Miospore, trilete, amb triangular, lete distinct, raised, arms of lete extending up to angles, labra distinct, massive, raised, exine up to 2  $\mu$ m thick, infra punctate, exhibiting occasional folding along the margin of the contact area, exoexinal layer generally present

**Remarks:** *Pachytriletes densus* was confined to Mittiwali member of the Mianiwali Formation.

**Collection:** NGM-94/8, NGM-92/1

**Possible affinities:** Pteridophytic (Filicinean).

*Granulatisporites minutus* Utting, 1994

Pl.1 Fig.4

**Occurrence:** Nammal Gorge: Mittiwali member common to rare, Narmia member very rare.

**Dimensions:** (14 Specimens) Equatorial diameter 21(25) 32 µm.

**Description:** Miospore, trilete, amb triangular, angles rounded, sides straight to partially concave, trilete distinct, flat, arms of lete extending up to angles, labra poorly developed, commissure smooth, contact area masked by dark exinal band within the vicinity of "Y" marking, exine infra granulate, grana less than 1µm in diameter appearing flat or rounded, visible only upon careful L-O analysis.

**Remarks:** Granulate nature of exine is not discernible in the microphotograph provided; however it is only detectable under oil immersion objective upon careful L – O analysis.

**Collection:** NGM-31/13

**Possible affinities:** Pteridophytic (Filicinean).

*Cyclogranisporites aureus* (Loose) Potonie and Kremp, 1955  
Pl.1 Fig. 5

**Occurrence:** Nammal Gorge: Katwai member very rare, Mittiwali member common, Narmia member abundant.

**Dimensions:** (31 Specimens) Equatorial diameter 23(31) 42 µm.

**Description:** Miospore, trilete, amb circular to sub circular but never sub triangular, lete distinct, slightly raised, arms of lete never extending more than half or 3/4 radius, labra distinct raised, sinuous, masking lete completely, exine 1.5 µm thick, intragranulate, grana conical to rounded.

**Remarks:** This taxon is same as described and illustrated by Bharadwaj [16]

**Collection:** NGM-94/1, NGN-113/2, NGM-39/9, 46/3-S1

**Possible affinities:** Pteridophytic ( Filicinean).

*Cyclogranisporites minutus* Bharadwaj, 1957

Pl. 1 Fig. 6.

**Occurrence:** Nammal Gorge: Katwai member very rare, Mittiwali member rare, Narmia member very rare.

**Dimensions:** (19 Specimens) Equatorial diameter 29(35) 40 µm.

**Description:** Miospore, trilete, amb characteristically circular, lete distinct, arms of lete approximately half radius, labra absent, commissure smooth, contact area indistinct, exine up to 1.5 µm, intragranulate, grana dense, rounded to conical in outline, exine may exhibit some secondary foldings often in specimens preserved in polar view.

**Remarks:** Despite rough and rugose exine of the proximal hemisphere and clearly defined lete which are strong taxonomic armors to warrant institutions of a new species, I however preferred maintaining it as *Cyclogranisporites minutus* as such minor variations in exinal ornamentation are sometimes induced by differential compression during fossilization.

**Collection:** NGM-44/1, 46/7-S1, 90/2, 34/5

**Possible affinities:** Pteridophytic (Filicinean).

*Punctatisporites gratensis* Balme and Henelly, 1956  
Pl.1 Fig. 6

**Occurrence:** Except Katwai member, this taxon was common to frequent in all the members of the Mianwali Formation.

**Dimension:** (41 Specimens) Equatorial diameter 29(36) 52 µm.

**Description:** Miospore, trilete, amb circular to subcircular, lete distinct, arms of lete never extending 3/4 spore radius, labra well developed, raised, translucent uniform up to 4 µm broad, 2 µm high, contact area indistinct in few specimens may be masked by dark uniform exinal folds parallel to lete, exine up to 1 µm thick, infra punctate to intra punctate, punctae more pronounced and dominant around "Y" marking and equator, compressional folds common usually confined to the distal hemisphere.

**Remarks:** It compares well with an identical taxon described by Maheshwari and Bose [17] from the Kibama River (Lukuga coalfield area). It also compares closely with *Punctatisporites obesur* [14] except for the low ridges and verrucae on the distal surface of the former.

**Collection:** NGM-40/6, 34/7,106/3, NGN-113/2

**Possible affinities:** Pteridophytic (Filicinean).

Early Triassic period was constituted by many plant groups, ferns being the most important and the most dominating group as shown by the well preserved and highly preserved azonate trilete spores. These azonate triletes were with varied morphologies, with distinct lete, and with smooth, infrapunctate, infra or intragranulate exine showing great variations even within a single plant group.

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