

SOME MIOSPORES FROM THE EARLY PERMIAN TOBRA FORMATION, SALT RANGE, PAKISTAN.

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ABSTRACT:: Palynological investigation of the early Permian Tobra Formation at the Sirin Gorge, Salt Range Pakistan revealed rich assemblage of palynomorphs including Trilete, monoletes, bisaccates, monosaccates and plicates. The present paper describes the systematics, morphological characters and botanical affinities of some related spores viz; *Calamspora flexilis*, *Punctatisporites gretensis*, *Punctatisporites orbicularis* and *Cycadopites follicularis* recovered from Tobra Formation at the Sirin Gorge section. Their affinities tentatively show that equisetopsids, ferns and gymnosperms prevailed along with other plants during the deposition of Tobra Formation.

INTRODUCTION

Salt Range is well-known worldwide for its well exposed sedimentary sequences from Precambrian to recent[1]. Early Permian deposits in the Salt Range are of utmost importance as they represent the glacial period. Tobra Formation in Salt Range Pakistan represents the Early Permian time period[2]. However some workers have regarded the age to be Upper Pennsylvanian carboniferous[3]. Lithology of Tobra Formation varies, mainly consisting of boulders with clay stone, silt stone, granet magnetite, shale and quartzite[1]. In Eastern Salt Range Tobra Formation is characterized by tillites, while in Western Salt Range Clay and sandstone with boulders are main constituents of Tobra Formation where as in the Central Salt Range it is represented by alternating facies of shales and boulders[2]. Initially more than one hundred rock samples from three sections of the Tobra Formation (Sirin Gorge, Tober and Nilawahan Gorge) were thoroughly examined palynologically. Rich and highly diversified palynoflora was recovered, however which would be published later on once Ph.D assignment is over. However miospores reported in this paper were extracted from sample number TBS90270308 from an out crop of the Tobra Formation exposed at Sirin Gorge Western Salt Range Pakistan. The description for sample code is as follows; (TB =Tobra Formation, S =Sirin Gorge, 90=Distance from base in meters, 27=Date of sampling, 03= Month of sampling (January), 08 = Year of sampling)

Figure: 1 indicates the location of Sirin Gorge in the Western Salt Range, Pakistan from where the samples were obtained and palynologically studied, reported in this paper.

METHODOLOGY

50 grams of sample were crushed up to size of 0.5 mm and treated with 50% HCl to remove carbonates. Following the treatment with HCl, samples were oxidized by adding HNO₃ and 1% KOH to remove the humic acids. Heavy liquid separation technique was employed through ZnCl₂ of specific gravity 1.975. Subsequently slides were prepared for microscopic examination.

SYSTEMATICS:

Anteturma SPORITES H. Potonie, 1893[4]

Turma TRILETES (Reinsch) Dettman, 1963[5]

Suprasub turma ACAVITRILETES Dettman, 1963[5]

Sub turma AZONOTRILETES (Luber) Dettman, 1963[5]

Infra turma LAEVIGATI (Bennie & Kidson) Potonie, 1956[6]

Genus CALAMOSPORA Schopf (In Schopf, Wilson & Bentall), 1944[7]

Type species: *Calamspora hertungiana* Schopf, Wilson & Bentall, 1944[7]

Calamspora flexilis Kosanke, 1950[8]

Fig: 2.1

Description: Trilete spore, amb subcircular, tetrad mark clear, exine thin and folded, Laevigate to infrapunctate, 1 μm thick.

Botanical Affinities: Equisetopsids [9]

Infra turma APICULATI (Bennie & Kidston) Pötonie, 1956[6]

Subinfra turma GRANULATI Dybova & Jachowicz, 1957[10]

Genus: PUNCTATISPORITES (Ibrahim) Pötonie & Kremp, 1955[11]

Type species: *Punctatisporites punctatus* (Ibrahim) Pötonie & Kremp, 1955[11]

Punctatisporites gretensis Balme & Hennelly 1956[12]

Fig: 2.2

Description: Trilete spore, amb circular to sub circular, lete distinct, extended upto 2/3 of radius. labra weakly developed, contact area absent, exine intrapunctate to infragranulate, 1.5 μm thick.

Botanical Affinities: Osmundaceae [13]

Punctatisporites orbicularis Kosanke 1950[8]

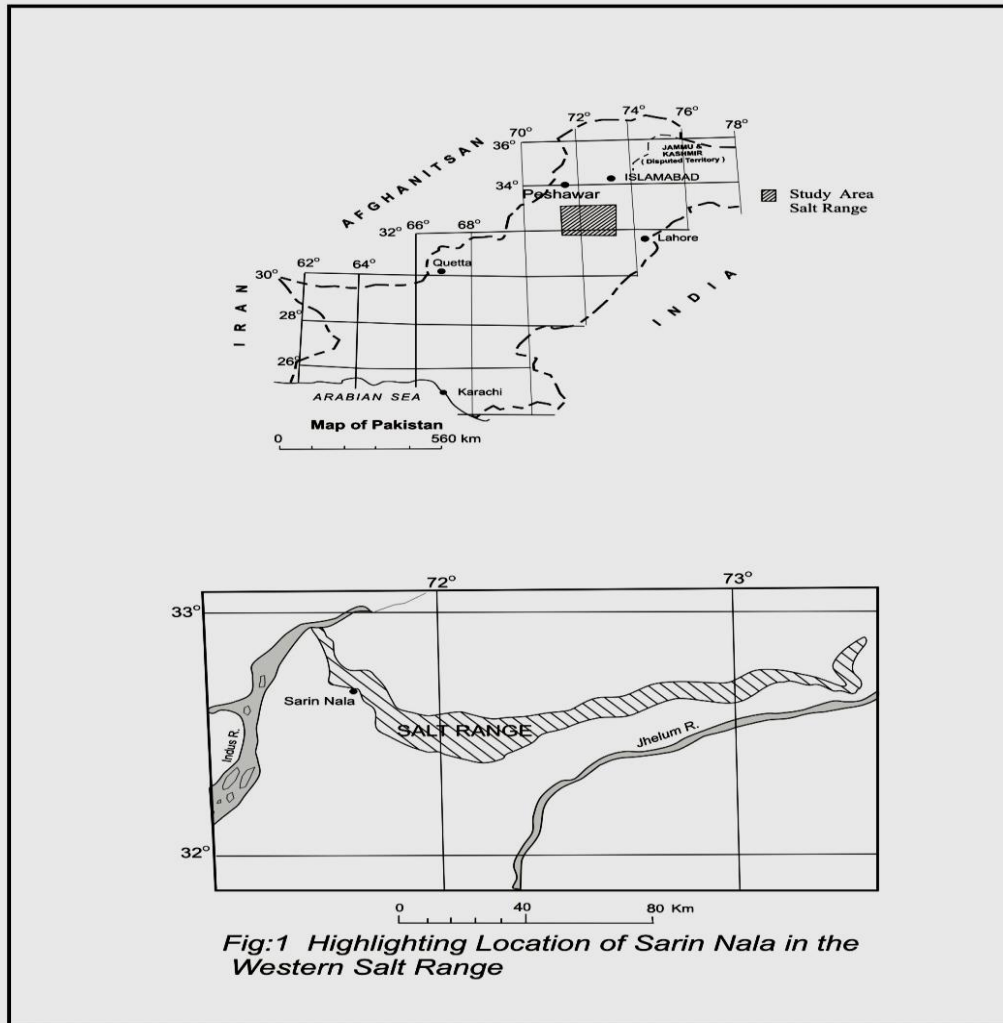
Fig: 2.3

Description: Trilete spore, amb triangular, lete clear, open with distinctive labra. exine infrapunctate, 2 μm thick.

Botanical Affinities: Osmundaceae [13]

Turma MONOLETES Ibrahim, 1933[14]

Suprasubturma ACAVATOMONOLETES Dettman, 1963[5]



Subturma AZONOMONOLETES Lubner, 1935 [15]

Infraturma LAEVIGATOMONOLETI Dybova & Jachovicz, 1957 [10]

Genus LATOSPORITES Potonie and Kremp, 1954 [16]

Type species: *Latosporites latus* (Kosanke) Potonie and Kremp, 1954 [16]

Latosporites colliensis (Balme and Hennelly) Bharadwaj, 1962 [17]

Fig: 2.5

Description: Monolete spore, amb almost circular to sub circular. Lete mark, extended up to equator, exine laevigate to infrapunctate, 1.5 μ m thick

Botanical Affinities: Pteridophytic [18].

Turma PPLICATES (Naumova) Potonie, 1962 [19]

Subturma MONOCOLPATES Iverson & Troels Smith,

1950 [20]

Genus CYCADOPITES Wodehouse, 1933 [21]

Type species: *Cycadopites follicularis* Wilson & Webster 1946 [22]

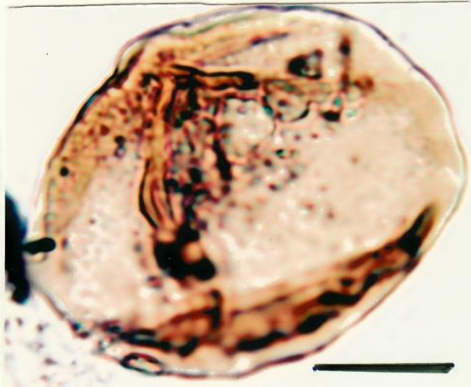
Cycadopites follicularis Wilson & Webster 1946 [22]

Fig: 2.4

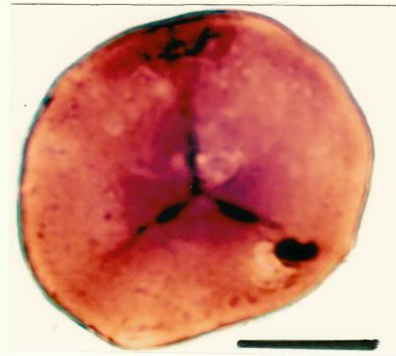
Description: Pollen grain, monocolpate, amb oblong to oval elliptical, extremities rounded or blunt, colpus distinct, extending full length of grain, colpus broad in middle with sharp ends, usually marked by parallel, exinal folds on sides, folds Plano convex or biconcave in some cases additional intexinal folds may accompany the major folds, exine laevigate, 1.5 μ m thick.

Botanical Affinities: Gymnospermic (Cycadales, Bennettitales) [09]

Figure: 2



2.1: *Calamspora flexilis* Kosanke, 1950



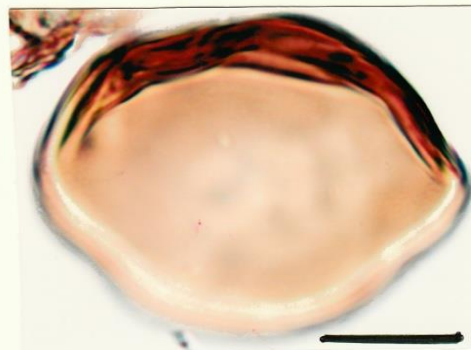
2.2: *Punctatisporites gretensis*
Balme & Hennelly 1956



2.3: *Punctatisporites orbicularis* Kosanke 1950



2.4: *Cycadopites follicularis* Wilson & Webster 1946



2.5: *Latosporites colliensis* (Balme and Hennelly)
Bharadwaj, 1962

Scale bar = 10µm

DISCUSSION:

The recovered palynoflora from Tobra Formation depicts existing of diversified flora in the Salt Range Pakistan, when the Tobra Formation was being deposited. Botanical affinities of isolated palynomorphs included in this paper indicate the presence of sphenopsids (Equisetopsids) and ferns (Osmundaceae) during the early Permian period along with gymnosperms (Cycadales, Bennettitales). Members of Osmundaceae (Ferns) are herbaceous, cosmopolitan in occurrence and live in moist conditions. Equisetopsids is an extant group of plants inhabiting humid conditions, common in tropical to subtropical areas[23]. Bennettitales, an extinct order of gymnosperms were medium sized trees of wet and warm environment, where as Cycadales an extant order of gymnosperms occupied tropical to subtropical areas[24]. On the basis of probable botanical affinities of recovered palynomorphs, it can be tentatively concluded that there was a great diversity of plants in the Gondwanaland during the Early Permian period. Upland areas might have exhibited cool tropical to cool moist temperate environmental conditions. Gymnosperms were proliferating rapidly along with the other important components of vegetation including lycopsids and sphenopsids. Whereas the area within the close vicinity of the depositional site of the Tobra Formation was under the influence of glaciation.

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