Megaspore biostratigraphy of the Gondwana

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Dispersed megaspores are known from almost all the Gondwana horizons though they are comparatively rare. Approximately, 36 genera and 110 species are known from the Gondwana sediments. The number of genera and species is almost equally divided between Permian and Mesozoic Gondwana. Most of the formations except Talchir, Barren Measures and Upper Tiki have marker megaspore taxa at generic level. The above mentioned three formations have marker taxa only at species level. At the present state of our knowledge megaspores are found useful only for broader zonation. As far as age determination is concerned, the megaspores, as compared to other palynofossils, indicate younger ages.

**Key-words**—Megaspores, Biostratigraphy, Morphotaxonomy, Gondwana (India).

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सारांश

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हरिकुण्य माहेरस्री एवं रजनी तिवारी

शरीरतः

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विकीरित गुरुवीजात्रा प्रायः सभी गोंडवाना सततियों में होती है वायुप कीमाता वे कम सिर्जनते हैं। गोंडवाना अवसादों में इनकी संख्या 36 प्रजातियों एवं 110 जातियों में होती है। सभी में गोंडवाना अवसाद में इन प्रजातियों एवं जातियों की संख्या की आदर्शता बनाने है। तालचिर, तिवारी तिवारी एवं उपरी टिकी के अतिरिक्त अधिकांश वृत्त-समूहों में विभिन्न गुरुवीजात्रा प्रजातियों की संख्या है। बारामी श्री के आधार पर गुरुवीजात्रा के विभिन्न तरंगों पर भंडाल करने में उत्तम निम्नता है और जाति तक आदु निर्विवरण का संक्षेप है गुरुवीजात्रा अर्थ परमाणुविक्रमों की संख्या में अधिक हो रहे हैं।

EXTANT land plants can be divided into two categories on the basis of the spores they produce. Some plants produce almost uniform sized spores. Other plants produce two types of spores, micro- and mega-, which give rise to male and female gametophytes, respectively. In fossil condition where nature of gametophytes produced by the spores is not known, micro- and megs- spores are differentiated on the basis of their respective sizes. The cutoff point between the two has variously been put at 150 μm (Harris, 1961), 200 μm (Zerndt, 1934) and 300 μm (Schopf, 1938). Generally, spores larger than 200 μm in size are considered as megaspores.

Megaspores are known from almost all the horizons, late Devonian upwards. However, their quantitative occurrence, as compared to that of microspores, being rather rare, not much information is available regarding their morphological variation and distribution in time and space.

Megaspores in the Gondwana sediments were first isolated by Carruthers (1869) from the Brazilian
coal beds though he thought them to be sporangia. Zeiller (1895) recognized their true nature as megaspores. One of the first reports of the occurrence of megaspores in the Indian Gondwana is by Mehta (1943) from the Singrauli Coalfield. Sithole (1945) reported megaspores from the Triassic of Salt Range, now in Pakistan. The first detailed account of megaspores from the Permian Gondwana of India was published by Surange, Singh and Srivastava (1953) which was partly revised by Srivastava (1954). Dev (1961) and Singh, Srivastava and Roy (1964) published on megaspores from Early Cretaceous 'Gondwana'.

After, Høeg, Bose and Manum (1955) proved the importance of the nature of the mesosporum (inner body) in morphotaxonomy of Gondwana megaspores from Zaire, Pant and Srivastava (1961, 1964) improvised the technique and methodology and applied it to the morphotaxonomy of
megaspores from Permian Gondwana of India. Later workers have followed almost the same approach.

Megaspores are now known from: Early Permian Talchir Formation (Lelle & Chandra, 1974); Early Permian Karharbari (basal Barakar) Formation (Bharadwaj & Tiwari, 1970; Pant & Mishra, 1986); Early Permian Barakar Formation (Bharadwaj & Tiwari, 1970; Lelle & Srivastava, 1983; Pant & Mishra, 1986); Late Permian Barren Measure Formation (Kar, 1968; Bharadwaj & Tiwari, 1970); Late Permian Raniganj Formation (Bharadwaj & Tiwari, 1970; Agashe, 1979; Jha & Srivastava, 1984; Maheshwari & Bajpai, 1984); Triassic Lower Tiki Formation (Pant & Basu, 1979); Early Triassic Maitur Formation (Maheshwari & Banerji, 1975); Late Triassic Upper Tiki Formation (Banerji, Kumaran & Maheshwari, 1978); Early Cretaceous Jabalpur Formation (Dev, 1961); Early Cretaceous Bhuj Formation (Singh, Srivastava & Roy, 1964; Banerji, Jana & Maheshwari, 1984). References to more publications are given in bibliography.

**DISCUSSION**

Though, a number of workers have contributed to the study of Gondwana megaspores, yet not enough data has been generated to use megaspores for finer stratigraphic zonation and correlation. There are approximately 52 genera and 159 species of Gondwana megaspores out of which some 36 genera and 110 species are known from the Indian Gondwana.

Occurrences of fossil megaspore species in different formations of the Indian Gondwana (*sensu lato*) are plotted in Chart 1. Distribution of megaspores at generic level is summarised in Chart 2. From these distribution charts it is evident that though the megaspores are comparatively infrequent, yet their distribution pattern is such that broad megaspore biostratigraphic zones can be demarcated. As majority of megaspore species are of necessity based on a specimen or two, the incidence of variation within a species is not known. Even then, it seems that majority of them have a restricted distribution and can be, individually or collectively, used for zonation and correlation. Due to paucity of information such zonation has to be provisional. When more data is available a regional zonation scheme may be drawn.

From the distribution pattern it is evident that the megaspore taxa are endemic up to Lower Tiki (or Upper Pali of authors, i.e., the Nidhupuri beds) of probable latest Permian age. Upper Tiki (Tiki formation *sensu stricto*, Late Triassic) onwards cosmopolitan genera start appearing, e.g. *Erlansonisporites*, *Horstisporites*, *Minerisporites*, etc. evidently representing beginning of a connection between Laurasia and Gondwana.

Two cenozones are identifiable, viz.,
A. **Talchirella Banksisporites Assemblage Zone** (Talchir to Lower Tiki/Upper Pali).
B. **Erlansonisporites—Verrutiletes Assemblage Zone** (Tiki to Bhuj).

Following assemblage subzones are recognised:
A2. **Talchirella trivedii—Ancorisporites venkatapralaee Assemblage Subzone** (Karharbari/basal Barakar).
A3. **Talchirella trivedii—Ancorisporites binaensis Assemblage Subzone** (Barakar).
A4. **Talchirella densicarpa—Noniasporites barristi Assemblage Subzone** (Raniganj).
A5. **Talchirella dahia—Banksisporites panchetensis Assemblage Subzone** (Maitur).
A6. **Banksisporites major—Lagenicula spinosa Assemblage Subzone** (Lower Tiki/Upper Pali).
B1. **Erlansonisporites triassicus—Verrutiletes distinctus Assemblage Subzone** (Upper Tiki/Tiki *sensu stricto*).
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