Distribution of palynofossils across the Palaeocene-Eocene Boundary in north-east and western India

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Mandal J & Kumar M 1997. Distribution of palynofossils across the Palaeocene-Eocene Boundary in north-east and western India. *Palaeobotanist* **46** (1, 2) : 172-176.

Late Palaeocene-Early Eocene palynoassemblages of north-east and western India have been analysed to assess the behaviour of palynotaxa during the transition. More than 50 per cent of the taxa continue from Palaeocene to Eocene while some are restricted only to Palaeocene. A number of palynotaxa appear at Early Eocene that may be considered as marker. A critical study on the distribution pattern of these palynotaxa indicates that there is no sharp or abrupt change during Palaeocene-Eocene instead majority of taxa are common and differ only in percentage frequency.

Key-words—Palynology, Palaeocene-Eocene transition, North-east and western India.

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सारांश

उत्तर-पूर्व एवं पश्चिमी भारत में पेलियोजीन-ईओसीन सीमा पर परागाणविकरूपकों का वितरण

जगन्नाथ प्रसाद मंडल एवं माधव कुमार

अनंतिम पेलियोसीन-प्रारम्भिक ईओसीन परिवर्तन के समय परागाणुवर्गकों की प्रकृति का मूल्यांकन करने के लिए उत्तर-पूर्व एवं पश्चिमी भारत से उपलब्ध समुच्चयों का विश्लेषण किया गया है। ऐसा देखा गया है कि लगभग 50 प्रतिशत वर्गक उसी प्रकार मिलते हैं जबकि कुछ वर्गक केवल पेलियोसीन काल तक ही मिलते हैं प्रारम्भिक ईओसीन काल में मिलने वाले वर्गक-सूचक वर्गक जाने जाते हैं । इन परागाणुवर्गकों के वितरण के स्वरूप के विशेष अध्ययन से प्रदर्शित होता है कि पेलियोसीन-ईओसीन काल में कोई आकस्मिक अथवा विशेष परिवर्तन नहीं हुआ है तथा अधिकतर वर्गक सामान्य हैं तथा केवल प्रतिशत बारम्बारता में विभिन्नता प्रदर्शित करते हैं।

DISTRIBUTION pattern of palynoflora at Palaeocene-Eocene transition on the Indian subcontinent has not so far been evaluated, however, Palaeocene and Eocene palynoassemblages have been critically assessed (Sah & Kar, 1972; Venkatachala *et al.*, 1989; Kar, 1992; Kar & Bhattacharya, 1991). The present study is based on the analyses of Upper Palaeocene palynoflora of Kutch and Meghalaya and Early Eocene of Kutch and Cambay basins. The floral change across P/E is explained on the basis of taxa restricted only to Palaeocene, common flora during Palaeocene-Eocene transition and rapid increase of palynotaxa at Early Eocene.

DISCUSSION

The Late Palaeocene in Meghalaya is represented by coal-bearing Lakadong Sandstone Member of Sylhet Limestone Formation. The Tura Formation in Garo Hill is time transgressive unit and equivalent to Sylhet Limestone Formation. The middle and upper members of Tura Formation are correlated on lithological characters with Lakadong Sandstone and Umlatdoh Limestone members respectively (Raja Rao, 1981).

In Meghalaya, Late Palaeocene sediments are deposited in shallow marine environment. Very rich palynofossils are documented from these strata (Biswas, 1962; Baksi, 1962; Salujha *et al.*, 1972, 1974; Singh, 1977; Sah & Dutta, 1967,1974; Dutta & Sah, 1970; Singh & Singh, 1978; Kar & Kumar, 1986; Mandal, 1986, 1990). The Early Eocene strata in Khasi Hills are represented by limestone facies (Umlatdoh Limestone Member) which are devoid of pollen-spores.

In Kutch Basin, Matanomadh Formation is deposited in lacustrine environment and Palaeocene in

age. The Gypseous Shale Member, lowermost member of overlying Naredi Formation, is dated to Early Eocene (Biswas, 1992). The palynological data from Matanomadh and Naredi formations also favour Late Palaeocene and Early Eocene ages respectively (Mathur, 1966; Mathur & Pant, 1973; Saxena, 1980; Sah & Kar, 1972; Kar, 1985). The palynoassemblages of Matanomadh Formation and Lakadong Sandstone Member are almost identical. Both the assemblages possess *Dandotiaspora dilata, D. telonata, D. plicata, Matanomadhiasulcites maximus, M. kutchensis, Neocouperipollis kutchensis, Palmaepollenites kutchensis, Laktapollis ovatus, Retitribrevicolporites matanomadhensis, Meliapollis ramanujamii, Triangulorites bellus, Tricolpites crassireticulatus*, etc. (Kar & Kumar, 1986; Saxena, 1980; Kar, 1985).

The lignite-bearing horizon of Tarkeshwar Formation in Cambay Basin has common palynoflora with the Naredi Formation and palynologically dated as Early Eocene (Rawat *et al.*, 1977; Koshal & Uniyal, 1986; Kar & Bhattacharya, 1992; Kumar, 1996).

In both the areas luxuriant vegetation flourished under the influence of tropical climate occupying roughly same latitudinal position (Broin, 1987). The assemblages, on analysis, reveal that Late Palaeocene flora is represented by 61 genera and 132 species, out of which 17 genera and 45 species belong to pteridophytes and 44 genera and 87 species represent angiosperms. Early Eocene palynoassemblage consists of 90 genera and 162 species. The study also reveals that 77 per cent of genera and 43 per cent of species of pteridophytes and 50 per cent genera and 38 per cent species of angiosperm pollen are common to Late Palaeocene and Early Eocene assemblages. During this transition significant increase of angiosperm taxa is evident while the pteridophytic spores decrease quantitatively at specific level. This is due to the disappearance of many species of the dominant genera like *Lycopodiumsporites, Dandotiaspora, Proxapertites* and *Neocouperipollis* during Early Eocene and increase of the number of species, e.g., *Palmaepollenites* as shown in the following Table:

	Palaeocene	Eocene
Dandotiaspora dilata	+	-
D. densicarpa	+	-
D. plicata	+	+
D. telonata	+	+
D. pseudoauriculata	+	+
Lycopodiumsporites speciosus	+	-
L. umstewensis	+	-
L. compartmentus	+	-
L. palaeocenicus	+	-
L. concavus	-	-
L. duttae	+	-
L. sahii	+	-
L. bellus	+	-
L. parvireticulatus	+	+
Proxapertites emendatus	+	-
P. crassimurus	+	-
P. assamica	+	+
P. microreticulatus	+	+
P. reticulatus	-	+
Neocouperipollis magnus	+	-
N. spinorobustus	+	-
N. robustus	+	-
N. wodehousei	+	-
N. brevispinosus	+	+
N. rarispinosus	+	+
N. perspinosus	+	+
N. echinatus	+	+
N. kutchensis	+	+
Palmaepollenites plicatus	+	+
P. nadhamunii	+	+
P. ovatus	+	+
P. kutchensis	+	+
P. magnus	-	+

(+ present; - absent)

It is certain that at the P/E transition, more than 50 per cent taxa continue from Palaeocene to Eocene. However, some palynofossils disappear at the end of Palaeocene while a number of taxa appear during Early Eocene. These first appeared elements of Early Eocene are much more in number than the taxa disappeared at the end of Palaeocene. The common elements vary in occurrence at both the times, they are either abundant in Palaeocene or Eocene. Therefore, four categories of palynotaxa emerged at the transition level are (i) palynotaxa restricted in Palaeocene, (ii) abundant in Late Palaeocene but rare in Early Eocene, (iii) rare in Late Palaeocene and abundant in Early Eocene, and (iv) appearance of new taxa in Eocene (Text-figure 1). The following are some of the commonly occurred significant taxa representing the following four categories.

Text-figure 1—The chart shows four categories of palynotaxa during the P/E transition.

1. Palynotaxa restricted in Palaeocene

Dandottaspora dilata, Proxapertites emendatus, Kielmeyerapollenites syncolporatus, Droseridites major, Densiverrupollenites eocenicus, Lycopodiumsporites speciosus, L. umstewensis and *Matanomadhiasulcites maximus.*

2. Abundant in Late Palaeocene but rare in Early Eocene

Dandottaspora telonata, Lycopodiumsporites palaeocenicus, Proxapertites assamica, Matanomadhiasulcites kutchensis, Neocouperipollis kutchensis, N. brevispinosus, Triangulorites bellus, T. pachyexinus, Spinizonocolpites echinatus, Tribrevicolporites eocenicus and *Psilastephanocolporites subcircularis.*

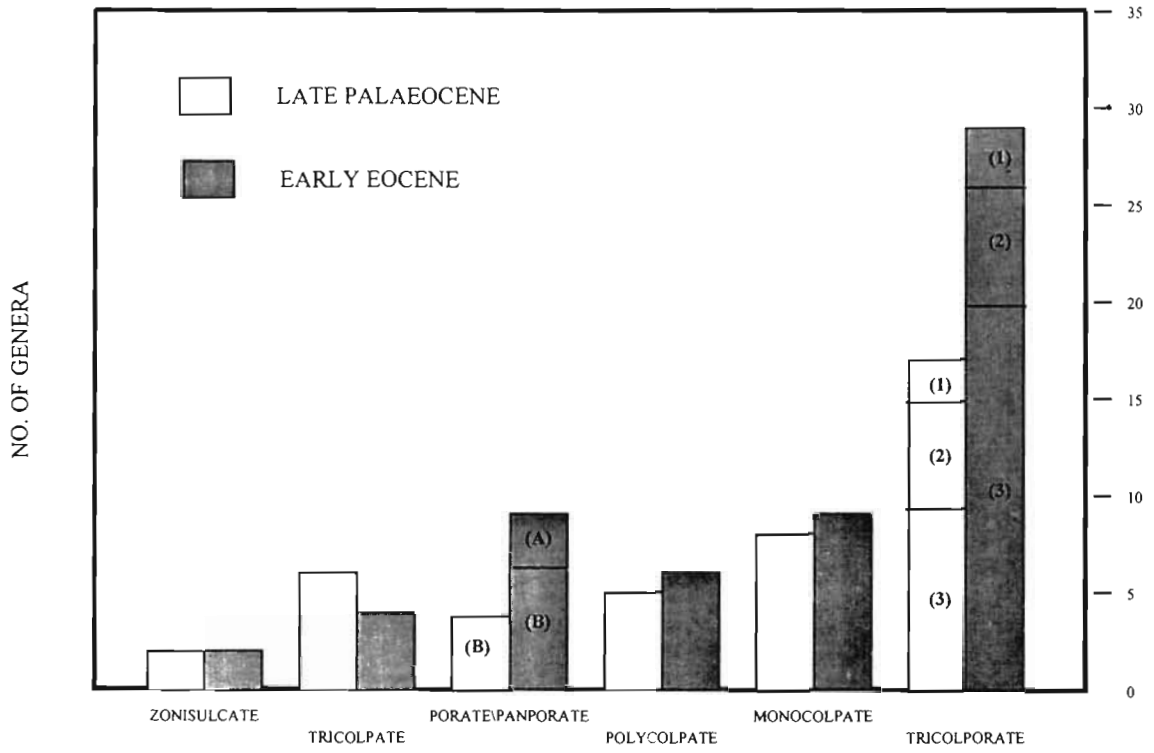
3. Rare in Late Palaeocene and abundant in Early Eocene

Lakiapollis ovatus, Meliapollis spp., *Racemonocolpites thanjinathensis, Margocolporites tsukadai, Retitri-brevicolporites matanomadhensis, Dermatobrevicolporites triangulus, D. exaltus, Striacolporites cephalus* and *Polymargocolporites mawlensis.*

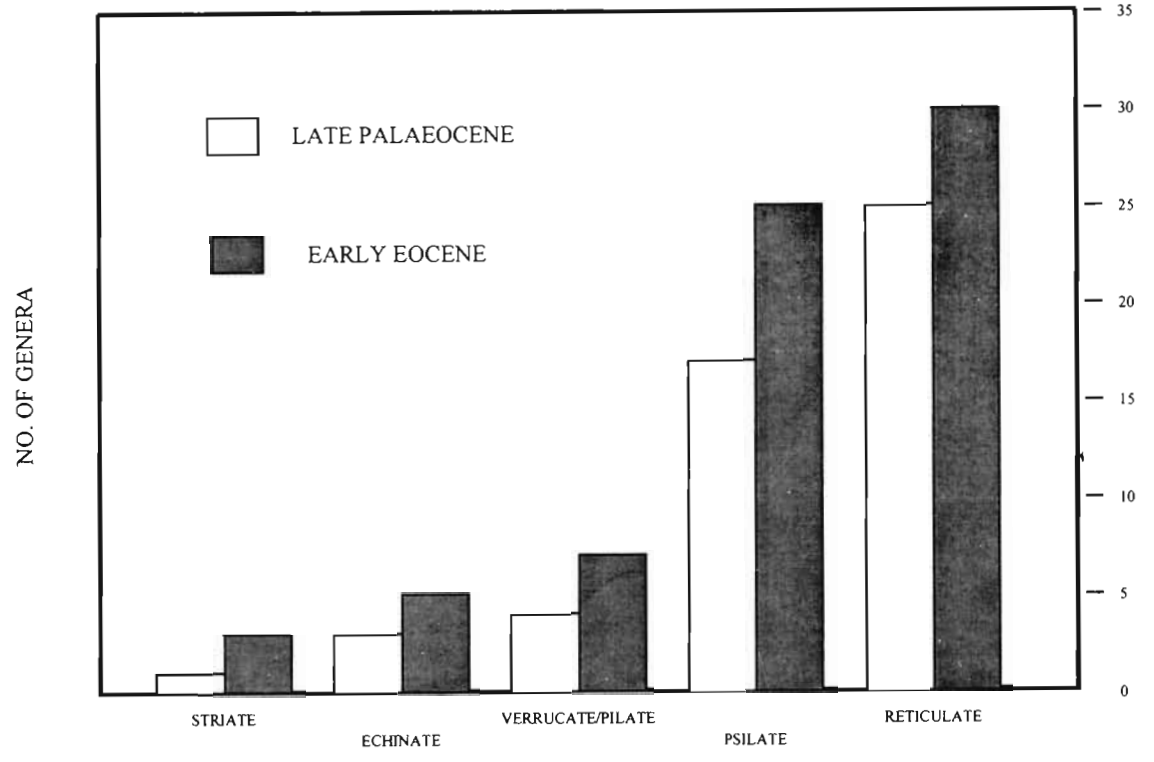
4. Taxa appeared in Eocene

Cheilanthoidspora monoleta, C. enigmata, Pelliciteroipollis langenheimii, Lanagiopollis rugularis, Acanthotricolpites bulbospinosus, Tricolporopilites robustus, Marginipollis kutchensis, Arengapollenites achinatus, Umbelliferoipollenites ovatus, U. constrictus, Retitrilatiporites kutchensis, Retitetrabrevicolporites granulatus, Longapertites retipilatus, Angulocolporites microreticulatus, Clavaperiporites clavatus, and *Minutitricolporites minutus.*

The above mentioned distribution and analyses of palynomorphs demonstrate that Palaeocene-Eocene transition is not marked by the drastic change of palynofossils. This is rather characterized by common elements having different percentage representation. However, restricted palynotaxa to Palaeocene are not at the generic level but they are only at the specific rank. The taxa *Dandottaspora dilata* and *Matanomadhiasulcites maximus* restricted in Palaeocene and occurring uniformly in both the areas can suitably be used as Late Palaeocene marker. The other stratigraphically restricted taxa, viz., *Kielmeyerapollenites syncolporatus, Polycolporites indicus* and *Droseridites major* are confined to Meghalaya (Kar & Kumar, 1986), while *Sonneratiapollis bellus, Psilastephanocolporites guaduensis* and *Osmundacidites microgranifer* are restricted in Kutch (Kar, 1992). The taxa *Lycopodiumsporites speciosus* and *Proxapertites emendatus* are more common in Meghalaya than Kutch. The notable event during this transition is the appearance of angiosperm taxa of various families in Early Eocene. The introduced palynotaxa which can definitely be tagged with the modern families are Arecaceae (*Arengapollenites*), Alangiaceae (*Lanagiopollis, Tricolporocolumellites, Tricolporopilites, Pelliciteroipollis*), Barringtoniaceae (*Marginipollis*), Linaceae (*Clavaperiporites*), and Apiaceae (*Umbelliferoipollenites*). The definite modern affinity of some other taxa, e.g., *Dermatobrevicolporites, Striatricolpites, Cheilanthoidspora,*



Text-figure 2—Histogram shows the relative frequencies of aperture types (**A-** panporate; **B-** triporate; **1-** syncolporate; **2-** brevicolporate; **3-** (longi-)colporate).



Text-figure 3—Bars show the comparison of different kinds of exinal features of angiosperm taxa.

Acanthotricolpites, Minutitricolporites of Early Eocene could not be ascertained.

Palm pollen are rich both in variety and number during Eocene which is an universal feature of that time because of maximum development and extension of the tropical climate (Traverse, 1988). Polycolpate forms are also common along with palm pollen but quantitatively more rich during Palaeocene. However the distinction of Late Palaeocene and Early Eocene assemblages on the basis of abundance of polycolpate and palm pollen, can only be possible when both the assemblages are studied side by side.

Apart from the assessment of palynological distribution, an analysis on the morphological characters of palynomorphs has been made. This analysis has revealed that some changes have occured in the aperture type during the Early Eocene. The apertures like monosulcate, zonisulcate, tricolpate and colporate types are common in Palaeocene-Eocene palynoassociation. The dominant aperture type during Late Palaeocene is tricolpate while colporate in Early Eocene. It is also observed that the triporate aperture are uncommon during Palaeocene but quite a few taxa have been recorded in later time along with panporate type which appears at the Early Eocene (Text-figure 2). However, no change has been noticed in the sculptural features on the pollen exine (Text-figure 3).

CONCLUSIONS

1. No sharp palynofloral change is observed during Palaeocene-Eocene interval but is marked by transition of flora.
2. Disappearance of *Dandottaspora dilata, Proxaperttes emendatus, Ktelmeyerapollenites syncolporatus* and *Lycopodiumsporites spectosus* marks the end of Palaeocene.
3. Several new angiospermic taxa have appeared at Early Eocene.
4. Angiosperm families Alangiaceae, Barringtoniaceae, Apiaceae and 'panporate' aperture are introduced at Early Eocene.

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