



Research Paper

# PALYNODEBRIS ANALYSIS AND DEPOSITIONAL ENVIRONMENT OF YINGKIONG GROUP OF EAST AND UPPER SIANG DISTRICTS, ARUNACHAL PRADESH, INDIA

Diganta Bhuyan<sup>1\*</sup> and Kaustuv Moni Saikia<sup>1</sup>

\*Corresponding Author: Diganta Bhuyan ✉ [diganta@bhuyans.co.in](mailto:diganta@bhuyans.co.in)

The present study was carried out along the Yamne river section of the East and Upper Siang Districts of Arunachal Pradesh. The area presents the Eocene Yingkiong Group of sediments exposed on the road and river sections from the north of Ranaghat up to Yingkiong. The dominating rock types encountered are sandstone, limestone, shale, carbonaceous shale and streaks of coal. The palynological study reveals the scanty occurrence of palynofossils and foraminiferal linings. The palynodebris assemblage is dominated by charcoal and degraded black debris along with considerable amount of amorphous organic matter and well preserved woody structures. Presence of charcoal and degraded black debris indicate oxidizing environment at the time of deposition of the sediments while amorphous organic matters with well preserved woody structures point that the study area experienced recurrence of reducing environment. From the occurrence of foraminiferal linings, the depositional environment can be envisaged to be shallow marine. The palynodebris assemblage together with coal occurrence indicates a tropical to sub-tropical climate with high humidity and heavy rainfall prevailed in the area of deposition.

Keywords: Palynodebris, Depositional environment, Yingkiong group, Arunachal Pradesh

## INTRODUCTION

The present area of investigation occupies the sub-Himalayan zone of the East and Upper Siang districts of Arunachal Pradesh. As the area is densely covered with thick forest and alluvium it is very difficult to get continuous exposures of sedimentary rocks except the road cuttings.

The early Tertiary Yingkiong Group of rocks with associated volcanic sequences is well exposed along the Yamne River valley in the East and Upper Siang district of Arunachal Pradesh. This area falls under the so called eastern syntaxial bend in which different lithosequences occur in the form of distinct thrust-bound litho-tectonic

<sup>1</sup> Department of Applied Geology, Dibrugarh University, Dibrugarh 786004, Assam, India.

belts. These belts exhibit pronounced deflection of trends from NE-SW in the west to NW-SE in the east across the Siang gorge.

The present palynodebris study is confined to the Yingkiong Group of rocks exposed along the Yamne river valley from north of Ranaghat up to Yingkiong. So far no palynodebris analysis has been carried out in this area and present study is carried out to evaluate the depositional environment of the rock types.

### MATERIALS AND METHODS

For the present study, representative samples were collected from different lithotypes. The samples were collected from the road sections joining Pasighat, Mariyang and Yingkiong

(Figure 1). The samples were collected from fresh road cutting surfaces to avoid contamination. During traversing along the road and river sections, different sedimentary formations and structures were observed. Different lithounits were also identified and contacts were demarcated. Various lithologies and their attitudes and contacts were recorded in the field along the river valley with reference to their GPS locations and the geological map of the studied area is prepared (Figure 2). The laboratory investigation comprised of preparation of microslides of the samples. The conventional method of maceration viz. pulverization, treatment with HCl, HF, HNO<sub>3</sub>, etc., was followed.

Figure 1: Arunachal Pradesh Political Map

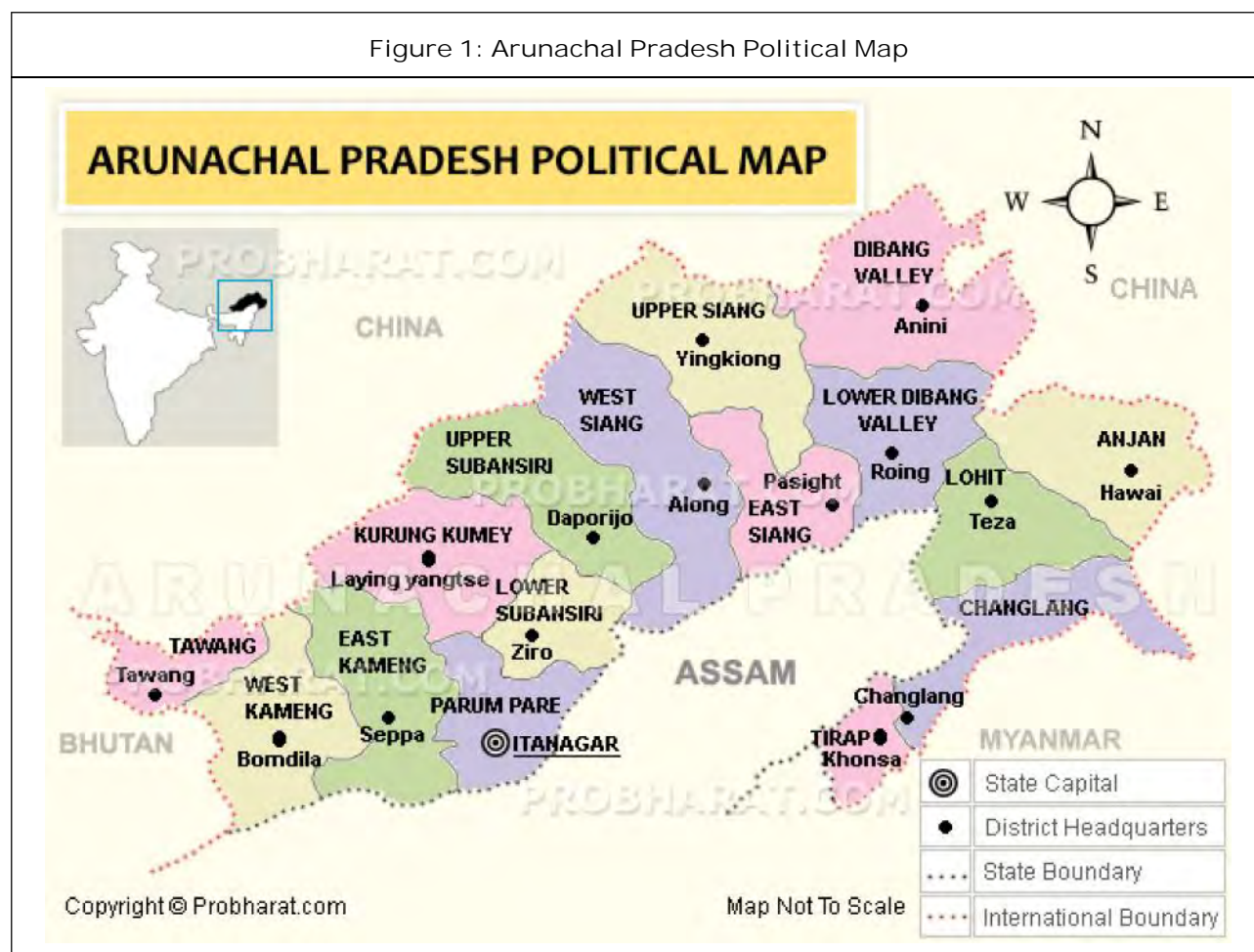


Figure 1 (Cont.)

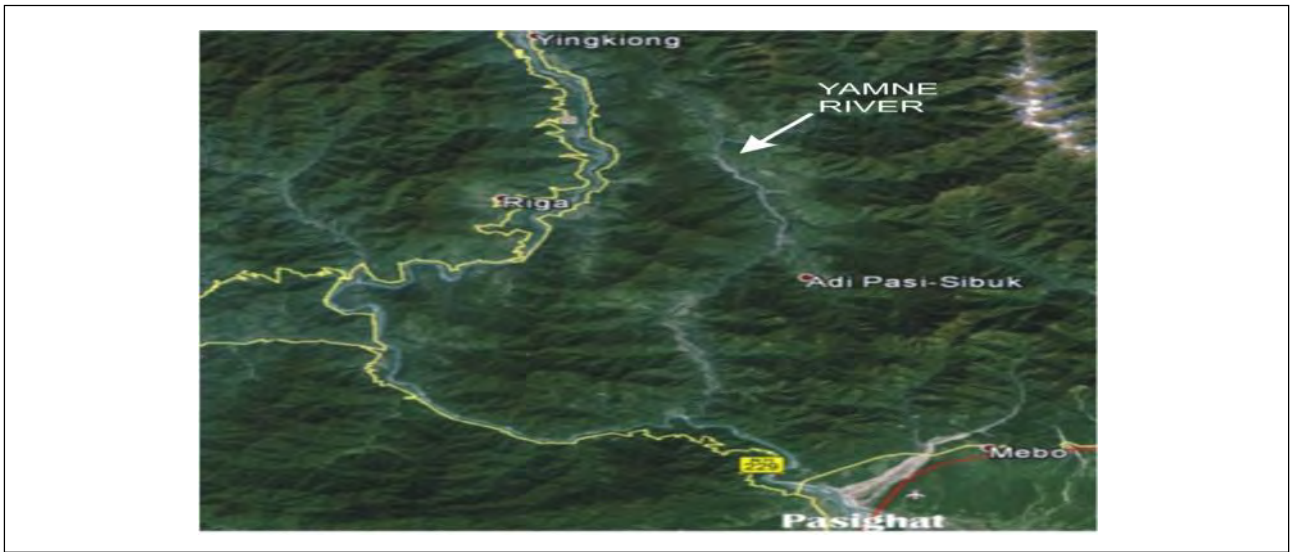


Figure 2: Geological Map of the Study Area

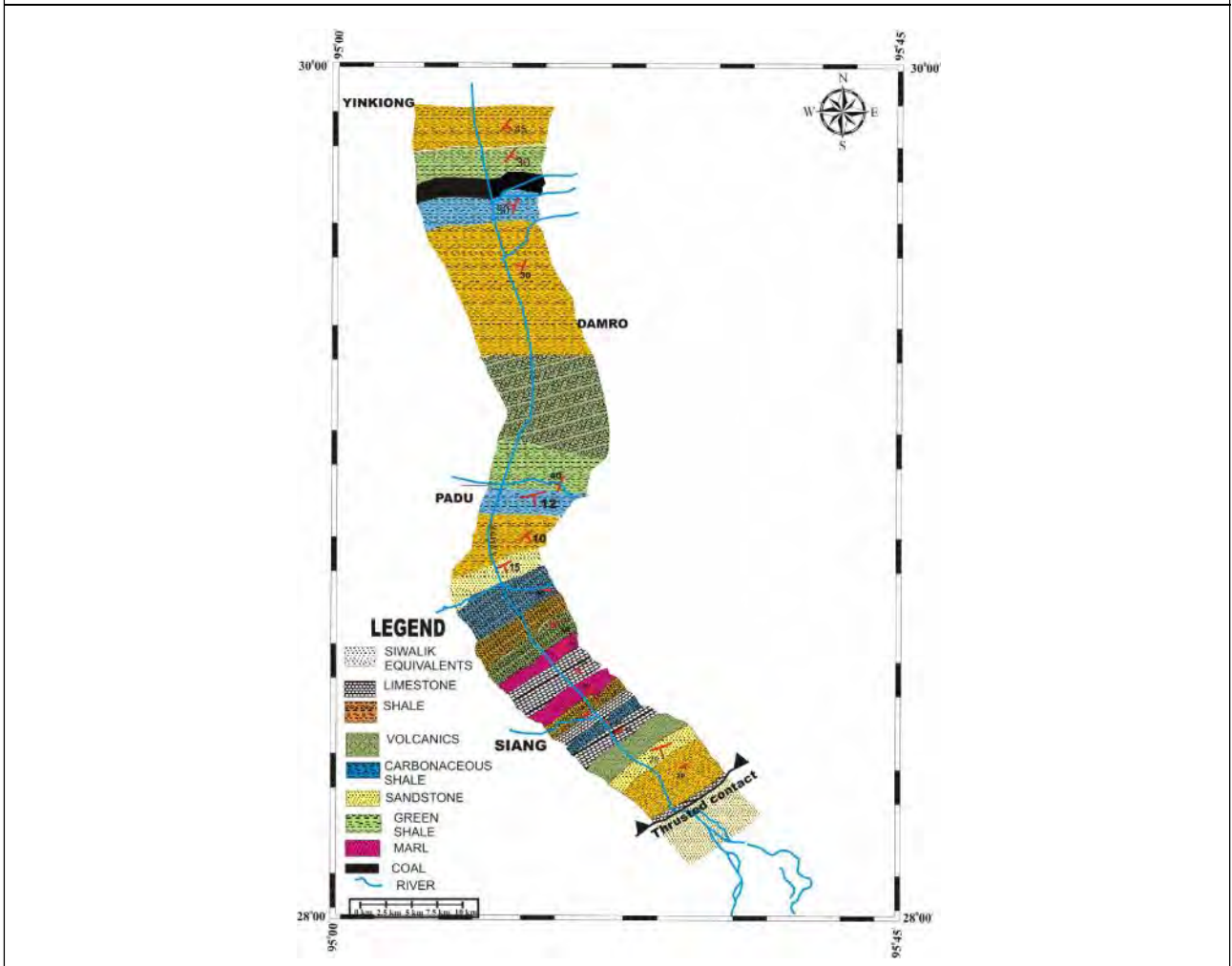


Table 1: Stratigraphic Succession

| Group     | Formation | Lithology   |
|-----------|-----------|---|
| Yingkiong | Dalbuing  | Alteration of grey to dark grey limestone and shale containing foraminifers.      |
|           |           | ? ? ?<br>? ? ?  |
|           |           | Interbedded purple and pale green shale, black shale and sandstone.               |
|           |           | Dark grey sandstone and associated purple and nodular grey shale containing plant |
|           |           | White to grayish white medium grained quartzite.                                  |
|           | Geku      | Purple and green shale (424 m).   |
|           |           | Dark grey to grey vesicular and amygdaloidal mafic volcanic (650 m).              |
|           |           | Purple and green Micaceous siltstone.   |
|           |           | Purplish and grey welded tuffs (? Ignimbrite).                                    |
|           |           |   |

**Stratigraphy**

The presence of Lower Tertiary rocks in Arunachal Pradesh was recorded by Bhandari *et al.* (1974) in the Subansiri district. Jain and Dutta (1978) first recorded the presence of dinoflagellates, spores and pollen grains near from the present area of investigation indicating the presence of marine early Tertiary rocks from the eastern Himalayas.

A sequence of argillo-arenaceous sedimentary rocks associated with basic volcanics mapped

around Yingkiong in the Siang Valley was designated as Yingkiong Formation and was arbitrarily assigned a Precambrian age by Jain *et al.* (1974). This sequence is also exposed further south of Yingkiong along the Yamne Valley. With the discovery of Lower Tertiary Floral remain from the Geku area (Tripathi *et al.*, 1981a) and Early Eocene foraminifera from Dalbuing (Tripathi *et al.*, 1981b; Singh and Singh, 1983; and Tripathi and Mamgain, 1986) two distinct facies were recognized—the lower continental and upper marine facies in the “Yingkiong Formation” and the stratigraphic rank of this unit was raised to a group (Kumar, 1997). The lower unit has been designated as Geku Formation and the upper one as Dalbuing Formation. The stratigraphic succession of the present study area is as follows (After Gopendra Kumar, 1997):

**Geku Formation**

It was named by Tripathi *et al.* (1981) which describes the succession yielding plant fossils exposed around Geku village on Dite-Dime to Yingkiong road, unconformably overlying the Abor Volcanic. The lower part is made up of volcano clastic rocks - ignimbrite and tuffs with mafic volcanics and the upper part constitutes the continental facies (Prasad and Dey, 1986) yielding dicot plant fossils like *Apocynophyllum* sp., *Canavalia* sp., *Hicora* sp., *Grewiopsis* sp. and *Sophera* sp. (Tripathi *et al.*, 1981b) and assigned to Lower Eocene and compared with the inter-trappean flora of Kalan in Central India. In view of the presence of Lower Eocene fauna from the overlying Dalbuing Formation, this age assignment needs revision. It may belong to Paleocene, if not Late Cretaceous as evidenced by the presence of mafic volcanic in the basal part of the succession, which, hitherto unknown from Lower Eocene or Paleocene in India. The

Comparison of floral elements with those found in inter-trappeans of central India, also points to an older age. However, till it is resolved, it is assigned to Paleocene.

### Dalbuing Formation

It is exposed in the Yamne valley in a narrow linear NW – SE trending zone from east of Yingking to southeast of Dumro along the eastern limb of the Siang synclinal structure. It was named by Singh (1984a) after the village Dalbuing from where the marine fauna was recorded. The fossiliferous horizon was recorded by Tripathi *et al.* (1981a) who identified presence of *Nummulites atacicus*, *N. lahirij*, *N. obtusus*, *Assilina dandotica*, *A. granulosa*, *Rotalia trochidiformis* and assigned an Early to Middle Eocene age.

### Palynodebris Analysis

In the present study Scanty organic matters could be recovered from the rock samples. Organic matters found are mainly phytoclasts, amorphous organic matter, charcoal, degraded black debris together with palynomorphs and foraminiferal lining. Most of the samples are dominated by charcoal and degraded black debris (Table 2). Following observations were recorded from the studied palynodebris slides :

**Phytoclast:** These are microscopic plant fragments present in the fossil record, usually found in the palynological preparations. In the present study, occurrence of phytoclast is noted to be 0% to 20%.

**Amorphous Organic Matter (AOM):** These are structure less and finely biodegraded plant products. It is an end product of structured and biodegraded phytoclasts as a result of microbial activities. Occurrence of Amorphous Organic Matter is noted to be 4% to 45%.

Table 2: Recalculated Frequency Distribution of Organic Matters

| Slide No | AOM | D.B./Charcoal | Phytoclast |
|----------|-----|---------------|------------|
| 1        | 10  | 81            | 9          |
| 2        | 21  | 75            | 4          |
| 3        | 30  | 60            | 10         |
| 4        | 15  | 80            | 5          |
| 5        | 10  | 82            | 8          |
| 6        | 30  | 50            | 20         |
| 7        | 25  | 60            | 15         |
| 8        | 30  | 55            | 15         |
| 9        | 30  | 55            | 15         |
| 10       | 38  | 60            | 2          |
| 11       | 11  | 85            | 4          |
| 12       | 10  | 85            | 5          |
| 13       | 4   | 90            | 6          |
| 14       | 5   | 95            | 0          |
| 15       | 6   | 90            | 4          |
| 16       | 5   | 95            | 0          |
| 17       | 28  | 72            | 0          |
| 18       | 8   | 92            | 0          |
| 19       | 45  | 50            | 5          |
| 20       | 30  | 70            | 0          |
| 21       | 25  | 75            | 5          |
| 22       | 40  | 50            | 10         |
| 23       | 5   | 95            | 0          |
| 24       | 3   | 60            | 10         |
| 22       | 40  | 50            | 10         |

**Charcoal:** These are black particles and are dominant in the total palynodebris of the rock samples. Occurrence of Charcoal is 50% to 95%.

**Degraded Black Debris:** These are very dark coloured, irregular in outline positively due to degradation by microbial activity or by transportation.

**Palynomorphs:** Only a very few unidentified palynomorphs could be observed in the samples.

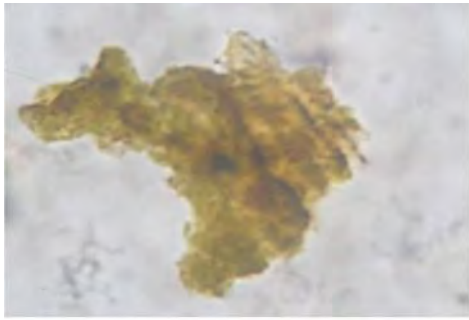
From the samples, a few foraminiferal linings were also recorded.

Apart from the above mentioned palynodebris, very small amounts of structured terrestrial were also recovered from the samples.

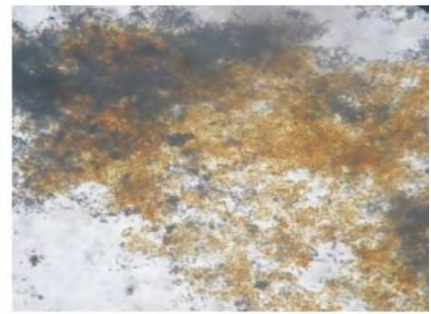
## DISCUSSION AND CONCLUSION

In the present study, abundance of charcoal and degraded black debris indicates an oxidizing environment during the time of deposition of the

Plate 1: 1-Phytoclast; 2-Amorphous Organic Matter Associated with Degraded Black Debris; 3-Woody Structure; 4-Degraded Black Debris; 5-Tracheid; 6- Phytoclast



1



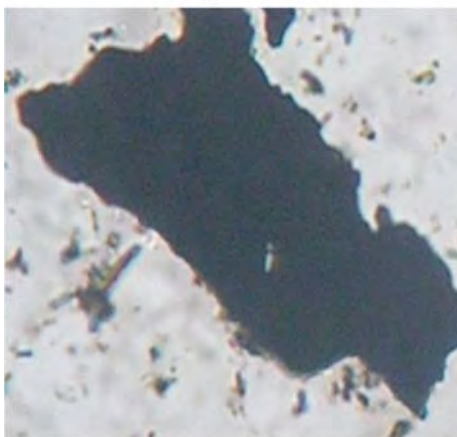
2



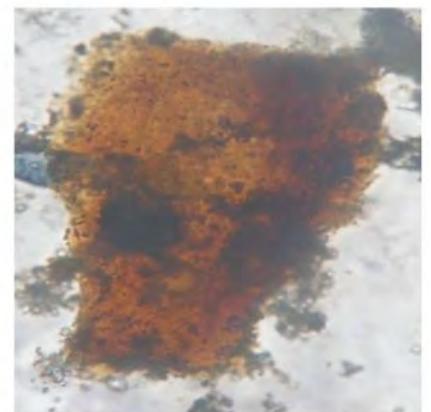
3



4



5



6

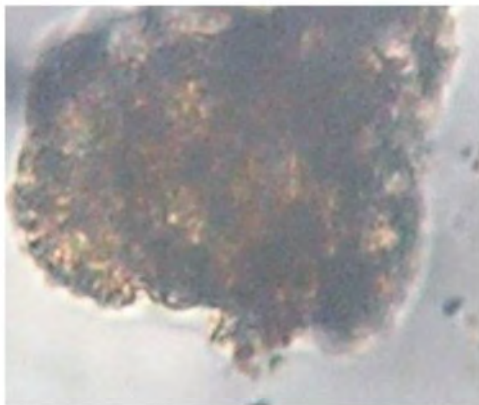
Plate 2: 1-4 Foraminiferal Lining; 5-Unidentified Palynomorph; 6-Fungal Spore



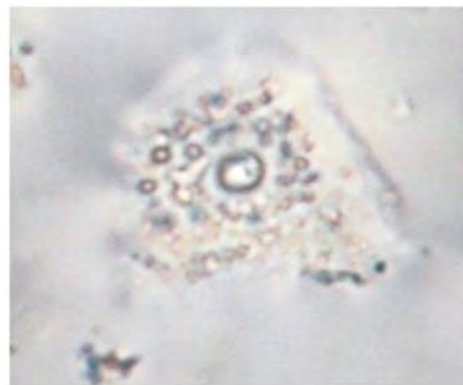
1



2



3



4



5



6

sediments. Presence of considerable amount of amorphous organic matters and well preserved woody structures in the assemblage also point that the study area experienced recurrence of reducing environment. Presence of carbonaceous shale and coal point to a reducing deltaic or lagoonal depositional environment. Occurrence of foraminiferal linings also supports this assumption.

The formation of coal requires supply of plant materials. Tropical to sub-tropical climate with high humidity and heavy rainfall is ideal for abundant plant growth. So, the paleoclimate during Paleocene-Eocene time in the study area can approximately be reconstructed as tropical to subtropical with high humidity.

## REFERENCES

1. Bhandari L L, Fuloria R C and Sastri V V (1973), "Stratigraphy of Assam Valley, India", *Bull. Am. Assoc. Petrol. Geol.*, Vol. 57, pp. 642-654.
2. Jain AK and Thakur V C (1978), "Abor Volcanic of the Arunachal Himalaya", *Geological Survey of India*, Vol. 19, pp. 335-345.
3. Jain AK, Thakur V C and Tandon S K (1974), "Stratigraphy & Structure of Siang District of Arunachal Pradesh (NEFA) Himalaya", *Him. Geol.*, Vol. 4, pp. 28-60.
4. Jain K P and Dutta S K (1978), "Lower Tertiary Dinoflagellates Spores and Pollen Grains from Siang District Arunachal Pradesh", *Jour. Paleont. Soc. Ind.*, Vols. 22 & 23, pp. 106-111.
5. Kumar G (1997), *Geology of Arunachal Pradesh*, G. S. I., Bangalore.
6. Masran T C and Pocock S A J (1981), "The Classification of Plant Derived Particulate Matter in Sedimentary Rocks in: Organic Maturation Studies and Fossil Fuel Exploration", *J. Brooks*, Academic Press, London.
7. Prasad B and Dey A K (1986), "The Occurrence of Eocene Sediments in Arunachal Pradesh—A Palynological Evidence", *Bull. Oil & Nat. Gas Comm.*, Vol. 23, No. 2, pp. 67-74.
8. Singh S (1984), "A Reappraisal of Yingkiang Formation with Reference to Dalbung Area, East Siang District, Arunachal Pradesh", *Ind. Minerals*, Vol. 38, No. 2, pp. 34-38.
9. Singh T and Singh S (1983), "Late Early Eocene Larger Foraminiferids from Siang District, Arunachal Pradesh, India and their Geological Significance", *Geosciences Journal*, Vol. 4, No. 2, pp. 141-146.
10. Tripathi C and Mamgain V D (1986), "The Larger Foraminifera from the Yingkiang Formation (Early Eocene) of East Siang District, Arunachal Pradesh", *Journal of the Paleontological Society of India*, Vol. 31, pp. 76-84.
11. Tripathi C, Gaur R K and Singh S (1981b), "A Note on the Occurrence of Nummulites in East Siang District, Arunachal Pradesh", *Him. Geol.*, Vol. 35, No. 1, pp. 36-38.
12. Tripathi C, Roy Choudhury J and Das D P (1981a), "Discovery of Tertiary Plant Fossils from Geku Formation of Dibang Valley, Siang District, Arunachal Pradesh", *Contemporary Geoscientific Researches in Himalaya*, Vol. 1, pp. 225-230.