

# PALYNOLOGY OF THE PERMIAN SEDIMENTS IN KAMENG DISTRICT, ARUNACHAL PRADESH

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## Abstract

West Kameng District occupies the Lesser Himalayan Zone which forms the South-western part of Arunachal Pradesh. The Lower Permian coal bearing sediments of the Elephant Flat in West Kameng District show the dominance of *Callumispora* and *Parasaccites*, a characteristic assemblage of Lower Karharbari palynoassemblage of the Peninsular India.

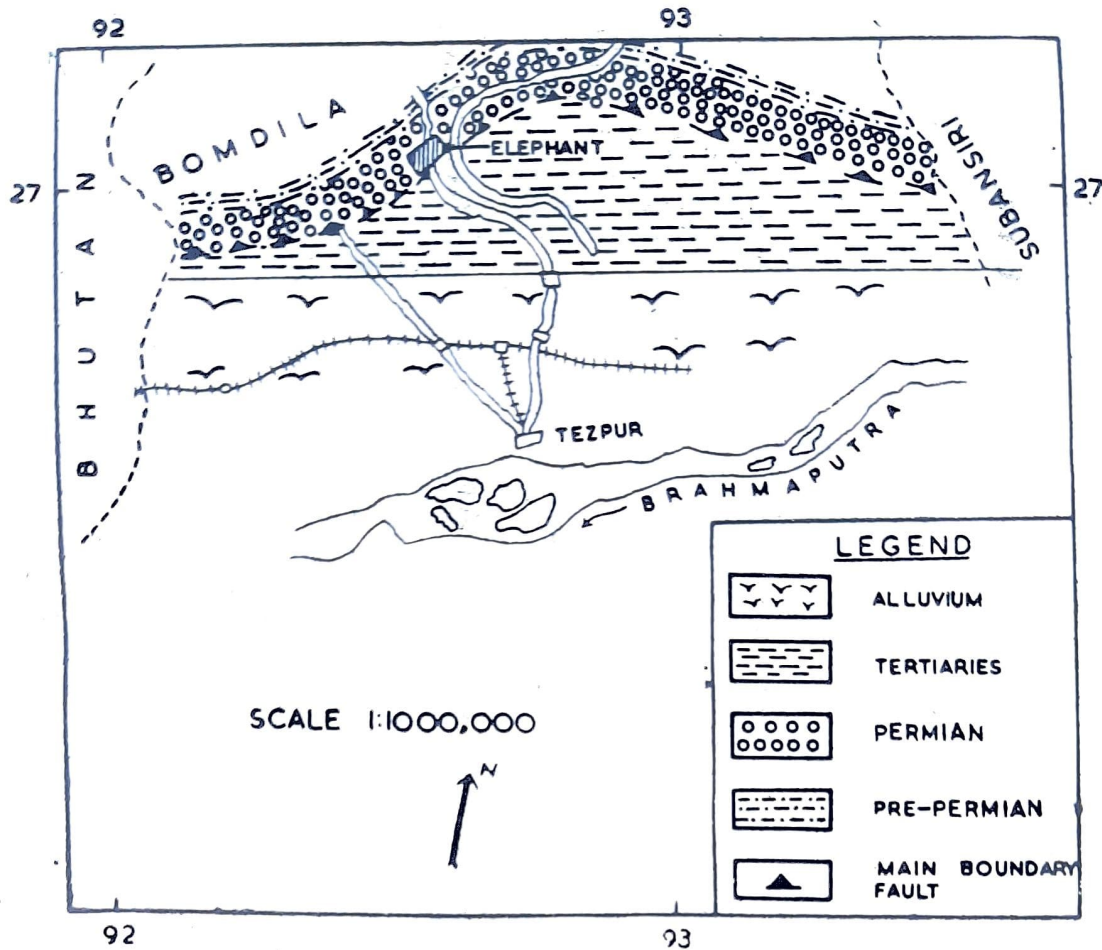
## Introduction

The erstwhile North East Frontier Agency (Assam Himalaya) known earlier in different segments as Aka Hills, Daffa Hills, Miri Hills, Mishmi Hills, etc., now form the territory of Arunachal Pradesh. The hill range of Arunachal Himalaya rises steeply to the height of 1,000—4,000m trending roughly WSW-ENE to the North-West of the Brahmaputra Valley.

From the foot-hills northward, the geology is quite different, both lithologically and tectonically. Here one can distinguish four almost parallel belts of rocks of varying age and width, beginning with the Upper Tertiary (=Siwalik) close to the plains. Next comes a narrow belt of Permian Sequence followed by a wide belt of metamorphosed rocks belonging to the Daling-Darjeeling Group of Precambrian age. In between the Permian and the Dalings there are at places another Sub-group of Precambrian rocks called the Buxa Group, possibly younger than the Dalings. Then follows a belt of Central Himalayan tourmaline granite. Each of these belts is separated from the next by a thrust plane. The thrust form a complex pattern, one thrust-over another.

The Kameng District shows lithology from the Precambrian to Upper Tertiary. The Permian sediments are thrust over the Upper Tertiary rocks and the contact between the Permian and Siwalik rocks in the North-western Himalaya is known as the Main Boundary Fault (Text-fig. 1). Jain *et al.* (1974) has named this thrust as Garu Thrust in Siang District.

La Touche (1885) reported the occurrence of Siwalik and Gondwana sediments at the foot-hill area of the Kameng District. Later on Banerjee (1973), Roy Chowdhury (1974) carried out some geological work in the area. Acharyya *et al.* (1975) carried out the stratigraphic studies in Kameng, Subansiri and Siang districts and classified the Gondwana sediments into Raungit-Pebble Slate, Khelong Formation and Bhareli Formation (Table 1). In 1976, Verma and Tandon studied the the geology



Text-figure 1—Showing geological map around Elephant area in West Kameng District, Arunachal Pradesh.

of Bhulukpung to Se La Area and adopted a similar scheme of classification for the description of diamictites and related rocks of Kameng District.

### Palynology

Palynology of the Permian sediments occupying the Lesser Himalayan zone in Arunachal Pradesh is meagerly known. Srivastava and Dutta (1977), and Singh (1979) described the palynofossils from the Gondwana sediments of Siang District, Arunachal Pradesh. The Permian sediments of Kameng District have not been studied palynologically so far. Therefore, the palynofossils recovered from the Bhareli Formation around Elephant Flat in West Kameng (Text-fig. 2, Table 2) have been described in the present text.

The palynoflora of the West Kameng District, Arunachal Pradesh studied in the present investigation consists of 19 genera and 22 species comprising trilete, monosaccate, disaccate and alete form :

*Leiotriletes* sp.

*Hennellysporites diversiformis* (Balme & Hennelly) Tiwari, 1968

*Callumispora barakarensis* Bharadwaj & Srivastava, 1969

*C. tenuis* Bharadwaj & Srivastava, 1969

*C. tenuis* var. *minor* Bharadwaj & Srivastava, 1969

*Microbaculispora tentula* Tiwari, 1965

*Indotriradites korbaensis* Tiwari, 1965

**Table 1—Stratigraphy of Gondwana sediments in Kameng District, Arunachal Pradesh (after Acharyya, Ghosh, Ghosh & Shah, 1975)**

Gondwana and associated marine sequence	Damuda Group	Bhareli Formation	Floristically rich, coal-bearing <i>Glossopteris</i> spp. (Late Permian)
			-----Thrust-----
		Khelong Formation	Floristically poor, pyritous-carbonaceous sequence, <i>Glossopteris</i> and <i>Gangamopteris</i> assemblage. Bryozoa, gastropods present at places (Early Permian)
			-----Thrust-----
		Rangit-Pebble Slate	Primarily diamictites, bryozoa dominated horizon with crinoid, brachiopod, bivalve, burrows, etc. Other horizons with <i>Eurydesma</i> , <i>Schizodus</i> , etc. (Basal Permian)
			-----Thrust-----
		Buxa Group	Intersliced units
Pre-Gondwana		Daling Formation Lingste Gneiss	

*I. surangei* Tiwari, 1965

*Dentatispora* sp.

*Divarisaccus* sp.

*Caheniasaccites ovatus* Bose & Kar, 1966

*Parasaccites obscurus* Tiwari, 1965

*P. distinctus* Tiwari, 1965

*P. bilateralis* Tiwari, 1965

*Plicatipollenites indicus* Lele, 1964

*P. maculatus* Lele & Karim, 1971

*Plicatipollenites* sp.

*Virkkipollenites orientalis* Tiwari, 1968

*Polonieisporites subtilis* Sinha, 1972

*Vestigisporites densus* Singh, 1964

*Illinites* sp.

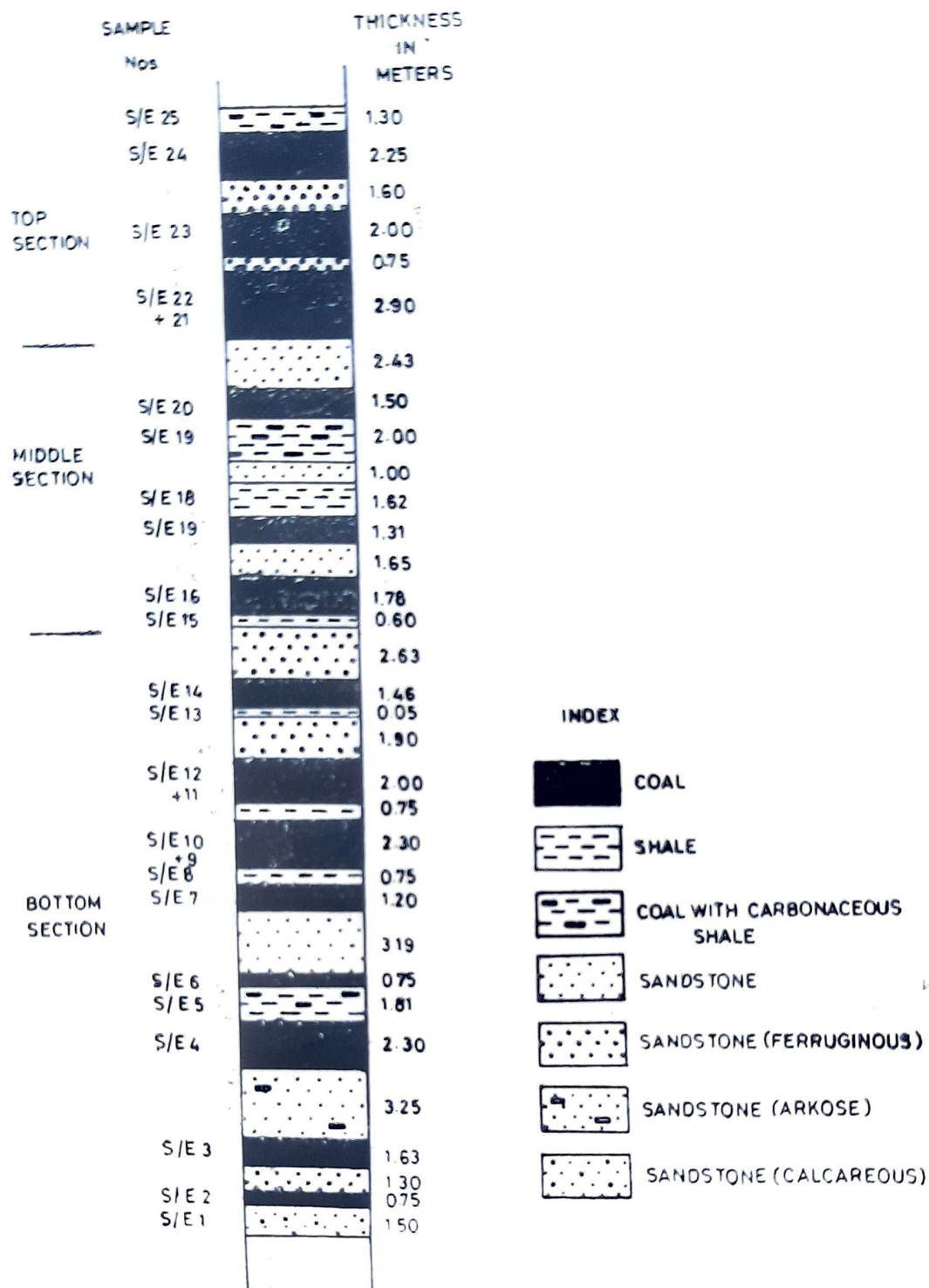
*Limitisporites diversus* Lele & Karim, 1971

*Fauripollenites varius* Bharadwaj, 1962

*Striatopodocarpites brevis* Sinha, 1972

*Maculatasporites punctatus* Peppers, 1970

*Liosphaeridia indica* Lele & Chandra, 1972



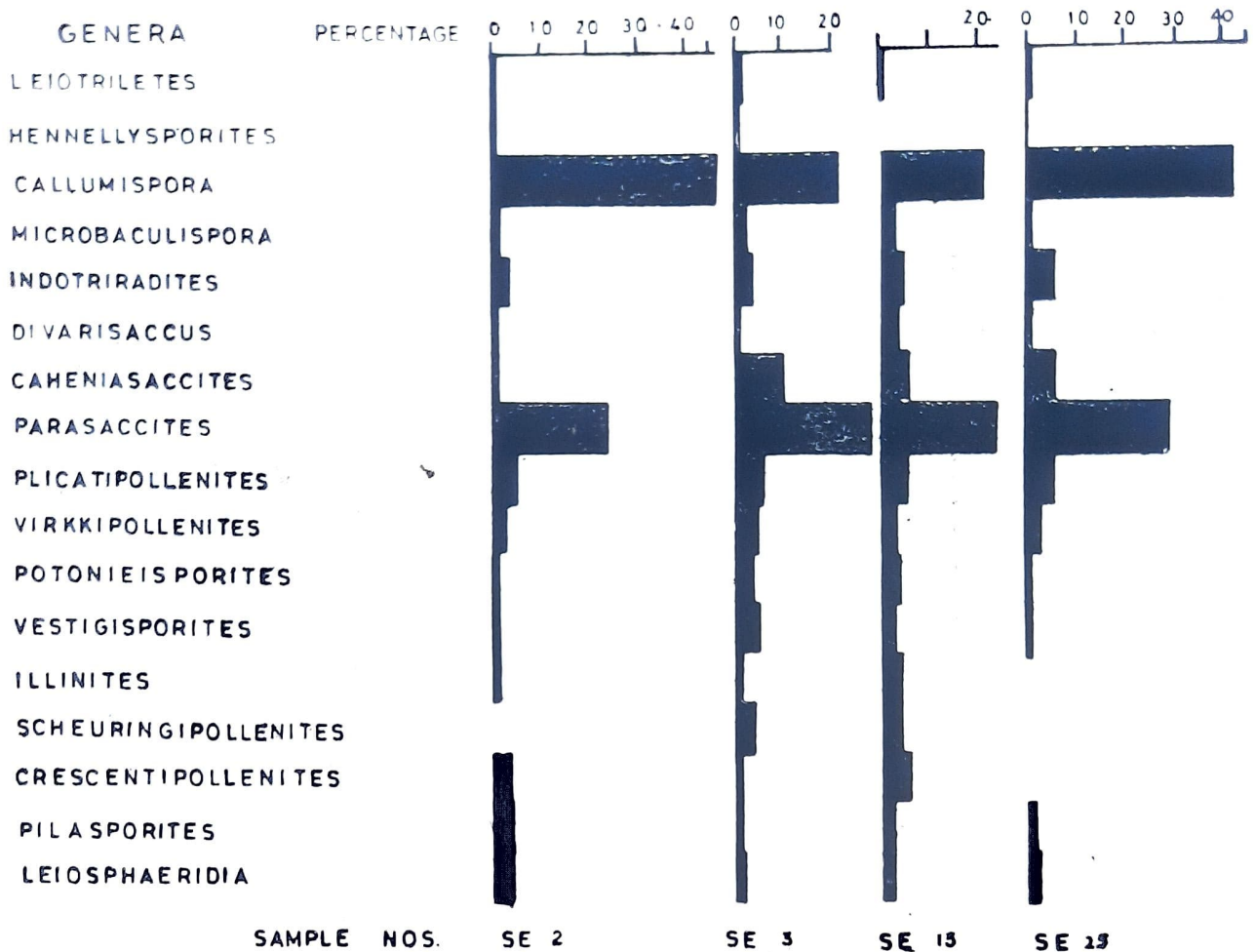
Text-figure 2—Lithological succession of Permian sediments around Elephant area in West Kameng District, Arunachal Pradesh.

The quantitative estimation of various palynotaxa (Histogram 1) shows that the assemblage is dominated by the genus *Callumispora* between 22-47 per cent (average 34%). *Parasaccites* occurs next to it and forms the subdominance being present between 24-29 per cent (average 25%). *Plicatipollenites* (6%) and *Indotriradites* (6%) both occur next to the subdominant genus. *Caheniasaccites* is low in the lowermost sample S/E2 but increases to 10 per cent in samples no. S/E3 and again declines in further younger samples. Thus, the trilete miospores total up to 43 per cent on an average while

Table 2—List of samples investigated around Elephant in Kameng District, Arunachal Pradesh

Locality : Tezpur-Bomdila Road around Elephant  
(composite section of Bhareli Formation)

Lithology	Thickness (in meters)	Samples Nos.
<i>Top Section</i>		
Carbonaceous shale	1.30	S/E <sub>25</sub>
Coal with carbonaceous shale	2.25	S/E <sub>24</sub>
Ferruginous sandstone	1.60	
Coal	2.00	S/E <sub>23</sub>
Ferruginous sandstone	0.75	
Coal	2.90	S/E <sub>22</sub> Top S/E <sub>21</sub> Bot
Sandstone	2.43	
<i>Middle Section</i>		
Bright coal	1.50	S/E <sub>20</sub>
Coal with carbonaceous shale	2.00	S/E <sub>19</sub>
Sandstone	1.00	
Coal with carbonaceous shale	1.62	S/E <sub>18</sub>
Bright coal	1.31	S/E <sub>17</sub>
Coarse-grained grey colour sandstone	1.65	
Bright coal	1.78	S/E <sub>16</sub>
Coal with carbonaceous shale	0.60	S/E <sub>15</sub>
Ferruginous sandstone	2.63	
<i>Bottom Section</i>		
Coal	1.46	S/E <sub>14</sub>
Thin bright Coal	0.50	S/E <sub>13</sub>
Ferruginous sandstone	1.90	
Bright coal	2.00	S/E <sub>12</sub> Top S/E <sub>11</sub> Bot
Shale	0.75	S/E <sub>10</sub>
Coal	2.30	S/E <sub>9</sub> Bot
Carbonaceous shale	0.75	S/E <sub>8</sub>
Bright coal	1.20	S/E <sub>7</sub>
Sandstone	3.19	
Coal	0.75	S/E <sub>6</sub>
Coal with carbonaceous shale	1.81	S/E <sub>5</sub>
Coal	2.30	S/E <sub>4</sub>
Sandstone/Arkose	3.25	
Bright coal	1.63	S/E <sub>3</sub>
Ferruginous sandstone	1.30	
Bright coal	0.75	S/E <sub>2</sub>
Calcareous sandstone	1.50	S/E <sub>1</sub>
	exposed thickness	



Histogram 1—Showing palynofloral composition of the Permian sediments investigated around Elephant area in West Kameng District, Arunachal Pradesh.

monosaccate pollen grains occur up to 36 per cent. Disaccate and other group of pollen are poor in representation.

The present palynological assemblage from West Kameng area is closely comparable with the Lower Karharbari palynoflora known from Korba and Giridih Coalfields (Bharadwaj & Srivastava, 1973 ; Srivastava, 1973) in view of the characteristic association of *Parasaccites* + *Callumispora*. However, the latter two assemblages contain further association of *Brevitriletes* which is very rare in Kameng.

Lele and Makada (1974) also described a Lower Karharbari miospore assemblage from Jayanti Coalfield which compares with the present assemblage in view of the dominance of *Callumispora*.

In the lowermost coal facies of Paradol-Chirimiri railway cutting of Chirimiri Coalfield (Srivastava, 1980) also similar dominance of *Callumispora* has been observed but the same contains greater amounts of *Microbaculispora* and *Jayantisporites*. Among the latter two genera, the former is present in Kameng also but in low amounts. The Lower Karharbari palynoflora has been recently reported from Umaria and Johilla coalfields in South Rewa Gondwana Basin (Srivastava & Anand-Prakash, 1984; Anand-Prakash & Srivastava, 1984, respectively). In both the coalfields *Callumispora* is associated with *Jayantisporites* but in Kameng area the latter genus has not been recorded.

Thus, the *Callumispora* + *Parasaccites* dominant assemblage has been observed to be associated with the lowermost coal-bearing sediments overlying the Talchir sediments in a conformable sequences in Lower Gondwana of India and they represent the Lower Karharbari palynoflora.

The above comparisons of known palynofloras from various basins of Peninsular Lower Gondwana suggest that the West Kameng palynoflora investigated here could be equated with the Lower Karharbari palynoflora.

Srivastava and Dutta (1977) have studied the palynology of the Gondwana sediments of Garu-Gensi Road section in western part of Siang District of Arunachal Pradesh. They have indicated the occurrence of two distinct palynofloral zones; the older being rich in radial monosaccates while the younger plynzone contained the association of *Parasaccites* and *Callumispora*. Singh (1979) has also studied the above section in Siang District and has classified that the Bomte Member of the Garu Formation in Siang District contains *Callumispora* followed by *Parasaccites*. The above studies have shown that palynofloral Zone II of Srivastava and Dutta (1977) and that of Bomte Member by Singh (1979) are same except that monosaccates are slightly more in latter studies.

The palynoflora investigated from Elephant Flat in West Kameng Area in the present investigation shows greater similarity in having the dominance of *Callumispora* + *Parasaccites*. Almost all the genera encountered in Siang District have been observed in West Kameng District also except a slight decrease in the percentage of *Plicatipollenites* and *Potonieisporites*. Thus, the sediments of the Bhareli Formation from Kameng Area studied here seems palynologically to be coeval to those of West Siang District, Arunachal Pradesh.

Banerjee et al., (1977) have studied both mega- and microfossils from the Gondwana sediments around Hallidayganj (former Singrimari, 25°44'N : 89°55'R) north-west of Tura, Shillong Plateau. They recorded the following genera : *Leiotriletes*, *Calamospora*, *Punctatisporites*, *Cyclobaculisporites*, *Acanthotriletes*, *Horriditriletes*, *Microfoveolatispora*, *Scheuringipollenites*, *Platysaccus*, *Lahirites* and *Striatites*.

They also recorded the following megafossils from the same sediments :

*Glossopteris communis*, *G. browniana*, *G. stricta*, *G. parallela*, *Vertebraria indica* and *Schizoneura gondwanensis*.

On the basis of a large number of nonstriate disaccate genus *Scheuringipollenites* the authors suggested that the Lower Gondwana sediments of Hallidayganj area corresponds to Lower Barakar palynoflora of Peninsular India. The palynoflora of Kameng area does not compare with that of Hallidayganj in view of having the dominance of *Callumispora* and *Parasaccites* which are present in rare amounts in Hallidayganj Area.

Gupta and Vischer (1980) have described few monosaccate pollen grains from Bijni Tectonic Unit of Garhwal Himalaya. These genera are present in West Kameng sediments under investigation but the former sediments are stratigraphically older and thus the comparison is only apparent.

Ghosh (1983) has recently described the palynofossils from the Rongtong Unit of the Darjeeling Area, West Bengal. The Lower Unit contains high percentage of striate disaccate pollen grains but they decrease abruptly in the upper unit. The author has considered the Lower Unit to be equivalent to Upper Barakar and the Upper Unit to be equivalent to Raniganj palynoflora known from Peninsular Gondwana Basins. The palynoassemblage of Kameng District does not compare in any respect with those of the Darjeeling area which are comparatively much younger palynologically.

### Age of Bhareli Formation

Brown as early as in 1912 referred Permian sediments of Siang District as Gondwana on the basis of their lithological similarities with those of the Peninsular Gondwanas. Kumar and Singh (1974) on the basis of palaeontological evidence concluded that atleast a part of this succession represents the Middle Carboniferous. Acharyya *et al.* (1975) opined the sediments of Siang District essentially as Lower Permian because of their closer faunistic resemblances with those of the marine intercalations within the Talchir Formation of Peninsular Gondwanas.

Jacob and Banerjee (1954) reported the occurrence of plant fossils in Gondwana rocks of Kameng District. They reported fronds of *Schizoneura* and *Phyllothea*. Das *et al.* (1975) reported *Glossopteris*, *Vertebraria*, *Phyllothea*, *Noeggerathiopsis* etc., and equisetals and placed those sediments in Damuda Group. Krishnan (1968) considered them as Barakars. Acharyya *et al.* (1975) recorded plant fossils from the Bhareli Formation: *Glossopteris communis* var. *stenoneura* Feistmantel, *G. angustifolia* Bong., *Dictyopteridium* sp., *Vertebraria indica* Royle, *Phyllothea* sp., *P. griesbachi* Zeiller, *Schizoneura gondwanensis* Feistmantel and *Samaropsis* sp. On the basis of dominance of *Glossopteris* spp. and near absence of *Gangamopteris* Bhareli Formation was considered equivalent to Raniganj Formation of Peninsular India.

The foregoing evidences have suggested a wide range of age to the Bhareli Formation of Kameng District. The present palynological evidences, however, bring a different picture. The sediments studied in the present investigation are dominated by *Callumispora* in association with radial monosaccate pollen grains and compare with Lower Karharbari palynoflora known from the Peninsular Lower Gondwana basins. A detailed comparison of the present palynoflora has also shown that these sediments are coeval with the Bomte Member of the Garu Formation in Siang District. The sediments of Hallidayganj in Meghalaya and Rongtong Unit in Darjeeling areas are younger than the Kameng sediments. Thus, the present investigation concludes that a part of Bhareli Formation around Elephant Flat in Kameng District is equivalent to Lower Karharbari (Lower Permian).

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### References

- ACHARYYA, S. K., GHOSH, S. C. & GHOSH, R. N. (1974). New fossil finds from Arunachal Pradesh. *News, Geol. Surv. India*, 5(5) : 16.
- ACHARYYA, S. K., GHOSH, S. C., GHOSH, R. N. & SHAH, S. C. (1975). The continental Gondwana Group and associated marine sequences of Arunachal Pradesh (NEFA), Eastern Himalayas. *Him. Geol.*, 5 : 60-89.
- ANAND-PRAKASH & SRIVASTAVA, S. C. (1984). Miofloral studies of the Lower Gondwana sediments in Johilla Coalfield, Madhya Pradesh, India. *Palaeobotanist*, 32(3) : 243-252.
- BANERJEE, S. (1973). A note on the geology of Arunachal Pradesh. *Jl Mines Metals Fuels*, 21(8) : 225-229.
- BANERJEE, M. P. & CHAKRABARTY, D. K. (1977). Occurrence of Lower Gondwana rocks in western Garo Hills, India. *IV int. Gondw. Symp., Calcutta*, 1 : 71-79.
- BHARADWAJ, D. C. & SRIVASTAVA, S. C. (1973). Subsurface palynological succession in Korba coalfield, M. P., India. *Palaeobotanist*, 20(2) : 137-151.
- BROWN, I. C. (1912). A geological reconnaissance through the Dihang Valley being the result on the Abor Expedition 1911-1912. *Rec. geol. Surv. India*, 42(4) : 231-253.



- DAS, A. K., BAKLIWAL, P. C. & DHOUNDIAL, D. P. (1975). A brief outline of the geology of parts of Kameng District. *Geol. Surv. India, Misc. Publ.*, **24**(1) : 115-127.
- GHOSH, T. K. (1983). Palynostratigraphy of the Lower Gondwana rocks of Darjeeling, Eastern Himalayas, India. *J. geol. Soc. India*, **24**(7) : 356-362.
- GUPTA, V. J. & VISCHER, H. (1980). Early Permian palynomorphs from the Bijni Tectonic Unit of Garhwal Himalaya. *Bull. Indian Geol. Assoc.*, **13**(1) : 63-65.
- JACOB, K. & BANERJEE, T. (1954). The occurrence of *Glossopteris* fronds in the N. E. Frontier tracts. *Proc. natn. Inst. Sci. India*, **20**(1) : 53-61.
- JAIN, A. K., THAKUR, V. C. & TANDON, S. K. (1974). Stratigraphy and structure of the Siang District, Arunachal (NEFA) Himalaya. *Him. Geol.*, **4** : 28-60.
- KRISHNAN, M. S. (1968). *Geology of India and Burma, Madras*.
- KUMAR, S. & SINGH, T. (1974). Lithostratigraphy of the southern parts of Siang District, Arunachal Pradesh. *Him. Geol.*, **4** : 648-656.
- LA TOUCHE (1885). Notes on the geology of the Aka Hills. *Rec. geol. Surv. India*, **16**(2) : 121-124.
- LELE, K. M. & MAKADA, R. (1974). Palaeobotanical evidences on the age of the coal-bearing Lower Gondwana Formation in Jayanti Coalfield, Bihar. *Palaeobotanist*, **21**(1) : 81-106.
- SINGH, T. (1979). Palynostratigraphy of the Permian rocks of Siang District, Arunachal Pradesh. *IV : Metamorphic Rock Sequences of Eastern Himalaya*, P. K. Verma (Ed.), pp. 100-113.
- SRIVASTAVA, S. C. (1973). Palynostratigraphy of the Giridih Coalfield. *Geophytology*, **3**(2) : 184-194.
- SRIVASTAVA, S. C. (1980). Palynostratigraphy of the Lower Gondwana sediments in Chirmiri Coalfield, M. P., India. *Geophytology*, **10**(1) : 62-71.
- SRIVASTAVA, S. C. & DUTTA, S. K. (1977). A note on the palynology of the Gondwana of Siang District. *Geophytology*, **7** : 281-283.
- VERMA, P. K. & TANDON, S. K. (1976). Geological observation in a part of the Kameng District, Arunachal Pradesh. *Him. Geol.*, **6** : 259-286.