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Palynological study of pre-Siwalik sediments in Sub-Himalaya of central Nepal

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ABSTRACT

The pre-Siwalik sediments are exposed in the inner Terai valley of central Nepal. The sediments occur within the Lower Siwalik and lie to the north of Marin Thrust. Slices of pre-Siwalik sediment might have brought up by thrusts. Since no fossils have been reported from these pre-Siwalik rocks, their age is referred to range from Gondawana to Miocene.

In this paper, an attempt is made to determine the stratigraphic position and age based on the palynological study. A number of spores and pollen are recorded from the samples. However, the palynomorph assemblages in the samples include only stratigraphically long-ranging taxa (Eocene to Quaternary). The identified Compositae type along with *Aabiespollenites, Caryapollenities, Psilamonocolpites, Retitricopites* etc are found belonging to Miocene or younger. *Zoncostites ramonae* (mangrove) is assigned to be Late Eocene or younger age where as the Dinocyst *Lingulodinium machaerophorum* suggests the sample belonging to Tertiary or younger. Besides the pre-Siwalik outcrops are lithologically correlable with the red beds of Murree of India and Pakistan that are assigned as Oligocene-Miocene age. Hence, considering the palynomorph assemblages, its recommended age and paleo-environment including the lithological correlation, the pre-Siwalik sediments of the present area must have deposited in Tertiary time and probably may range from Oligocene to Miocene.

INTRODUCTION

The pre-Siwalik rocks are exposed within the Siwalik rocks of central Nepal. The area is located north of Bakiya Khola valley, in the Bagmati River section and also in the northern parts of Marin Khola valley. The sediments occur within the Lower Siwaliks and to the north of Marin Thrust (Fig. 1).

A few research works have been carried out on the pre-Siwaliks and basic volcanics that occur in the Bagmati River and Marin Khola area of central Nepal (Adhikary and Rimal 1996). No fossils have been reported so far from this area. Therefore, these sediments are correlated with different formation ranging from Gondawana equivalent to the Lower Siwaliks (Pradhan and Sharma 1999).

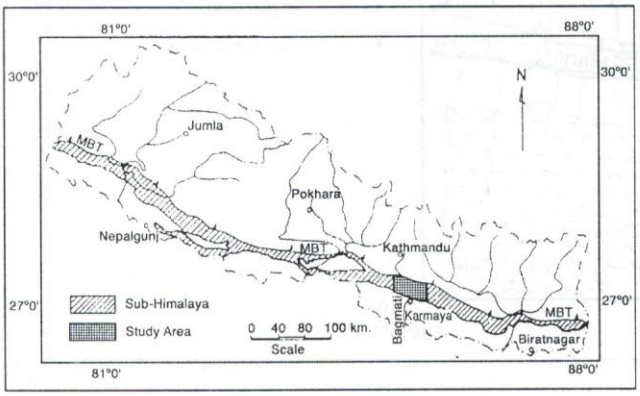

Fig. 1: Location map of the study area

Herail et al. (1986) described the occurrence of "substratum outcrops" in the Dowar Khola, Sindhuli District. They inferred Gondwana age for the rocks in the lower section of the Dowar Khola, while the lowest sedimentary rock sequence consisting mainly of sandstone and the overlying red beds in the upper section were equated to the Dharamshala-Muree beds. They have also reported the occurrence of volcanic rocks in both the lower and upper sections inter-layered with the red sediments. Subedi and Sharma (1991) observed basic intrusives within the Lower Siwaliks which are exposed in some streams, east of Bagmati River. They did not recognise the pre-Siwalik rocks. Kaphle and Einfalt (1992) studied the doleritic volcanic rocks occurring within the Lower Siwaliks (host rock) exposed in Dowar Khola, a tributary of the Marin Khola in central Nepal. They have inferred a very young i.e. post mid-Miocene volcanic activity within the Siwaliks in this area. Gautam et al. (1995) carried out the paleomagnetic study and petrochemistry of the doleritic volcanic rocks and the red beds, exposed in Dowar Khola and Dhanmana Khola of east central Nepal. Considering the best defined remnant direction, they have assigned the age for the deposition of the red beds and the emplacement of volcanic rocks, sometimes between the Eocene and Early Oligocene times.

GEOLGICAL SETTING

The study area basically comprises the rocks of Siwalik Group and exposed repeatedly due to thrusts. The Main Boundary Thrust separates the Siwaliks from the overlying

Lesser Himalaya. Pre-Siwalik rocks are exposed to north of Marin Thrust within the Lower Siwalik (Fig. 2). They extend for about 50 km in a east-west direction.

The sandstones are mainly red coloured and fine grained, occasionally medium grained and rarely gritty. The altered sandstones exhibit red and white bands. Pre-Siwalik sandstones are hard, indurated and more stratified than the Siwalik sandstones. Intraclast shales are present in the medium grained to gritty sandstones. Shales are mostly observed in the middle and upper sections.

The basic rocks are exposed in several places inter bedding with the red beds and show concordant relation with the host rocks (Kaphle and Eeinfalt 1992). These basic rocks are identified as dolerite volcanics and as basalt and also termed as volcanites. Its exposed thickness varies from 3 m to 60 m or more. The rocks are fine to medium grained and reddish brown, green and dark grey in colour. The basic intrusives are usually having vesicular structures filled up with carbonate and chlorite. Some volcanic bodies show amygdaloidal structures (Pradhan and Sharma 1999).

The Siwalik and pre-Siwalik rocks show thrust contact. Along the lower boundary, the contact is concealed and the exposed pre-Siwaliks are usually brecciated. In the upper section of the pre-Siwalik, sharp contact can be seen in some streams where the overlying Siwaliks are found in contact with underlying brecciated rocks. These are the clear evidences of tectonic contact between the Siwaliks and pre-Siwalik rocks.

PALYNOLOGICAL STUDY

The pre-Siwalik sediments are devoid of fossils. As the fossils are not found, the palynological study could be useful to determine and the age of the pre-Siwalik sediments.

A few samples from the study area were sent to the Palynological Laboratory of Texas, USA through Texana Resources Company, an oil company in Houston. The results show that most of the pollen and spores reported have common age. The palynofossils having common and relevant age have been listed here along with its age and palaeo-environment Table 1.

INTERPRETATION

The palynofossils analysed from the samples show wide range of geological age. These palynomorphs show mostly Miocene or younger age but Tertiary or younger age is also

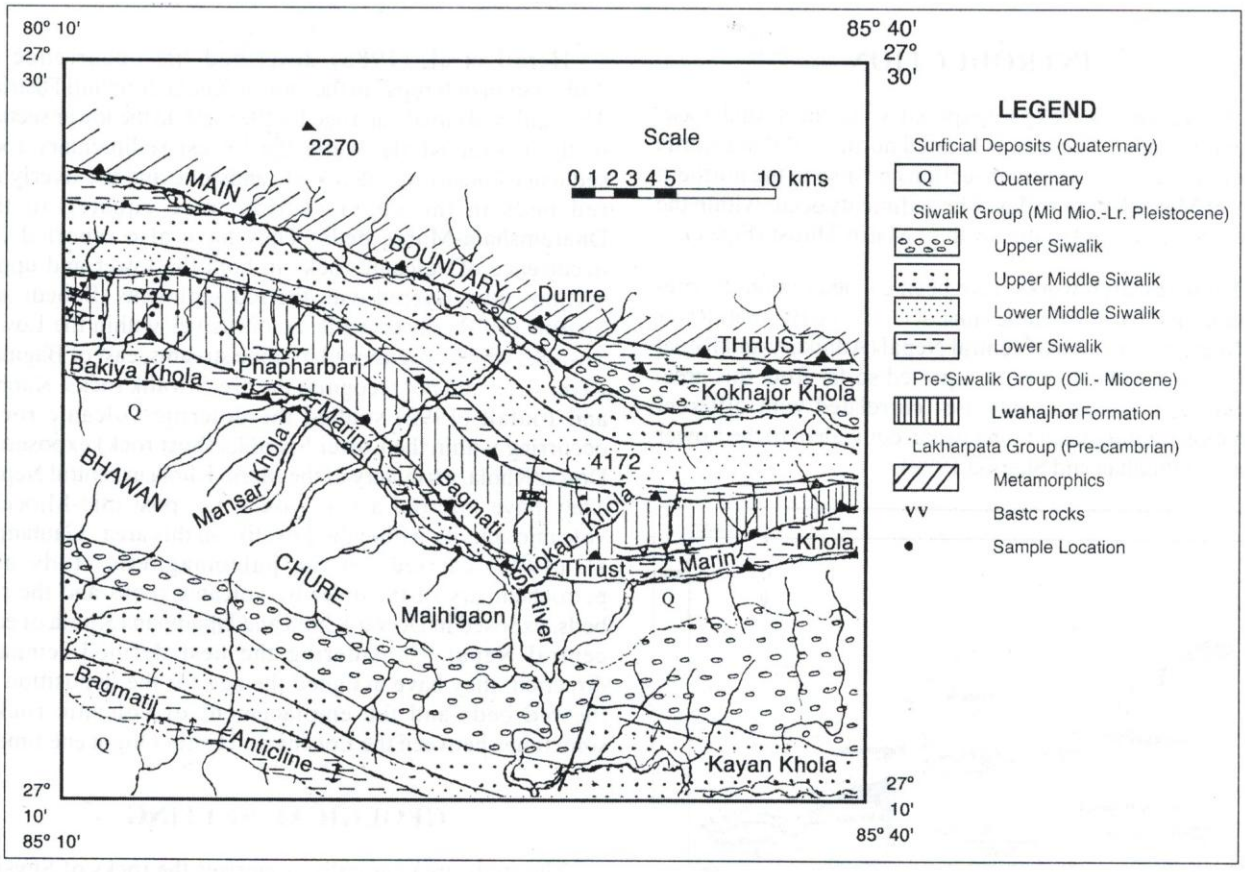

Fig. 2: Geological map of Siwalik and Pre-Siwalik sediments exposed around central part of Southern Nepal

not uncommon. A few specimens show Cenomanian, Lower Eocene and even younger age. Some palynofossils such as *Zoncosites* and *Compositae etc.* are found in both long ranging taxa. *Compositae* type, are though having long ranging age (Miocene or younger) its earliest stratigraphic occurrences are in sediments of Early Miocene age. But it is also found associated with the other specimen like *Abiespollenites* spp., *Caryapollenites* sp., *Inaperturopollenites* spp., *Psilsmonocopites* sp., *Pinuspollenites, Retitricopites* sp. *etc.,* which are again having wide range of age from Tertiary or younger (Mathur 1984). Presence of *Tasmanites* in the sample, which has brackish to shallow marine water environment, indicates the transitional zone of the basin, which could be an indication of Oligocene age. Hence, the Tertiary age is found more acceptable to the pre-Siwalik sediments though it is a very broad age. As some palynofossil (Tasmanites) has indication of Oligocene beds and some (Compositae) are specifically identified from Early Miocene, the present sediments could range in age from Oligocene to Miocene.

Evaluating the average occurrences of palynofossils and their relevant paleo-environment, the pre-Siwaliks may have deposited in a non-marine environment and not in marine or paralic to shallow marine environment. The dominance of nonmarine character indicates its deposition in non-marine environment, i.e. younger than marine Eocene rocks. Hence, the pre-Siwalik sediments must be older than Siwaliks.

The pre-Siwalik outcrops are further lithologically correlable with the red beds of Dharamsala- Murree beds of India and Pakistan that are assigned as Oligocene to Miocene age (Herail et.al.1986). Gautam et.al. (1995) have assigned them an age between Eocene to Early Oligocene.

CONCLUSION

The preliminary palynological study of the pre-Siwaliks has revealed some pollens and spores of stratigraphically long ranging taxa broadly including Tertiary age. The pollens and spores such as Tasmanites and Compositae indicate Oligocene and Miocene age. As the sediments are sliced up between the Siwaliks and some of the sediments show paralic environment also, there is possibility of existence of older marine sediments intermixing with the present pre-Siwaliks. However, the average specimens show deposition in non-marine to paralic environments.

Considering the present result of palynological study, the paleomagnetic study of rocks of Dowar Khola area and the regional lithological correlation, it may be concluded that the pre-Siwalik sediments of the present study area were deposited in the Tertiary time and the age could be from Oligocene to Miocene.

Table 1: Palynofossils with their age and palaeo-environment

SN.	Polymorph assembles	Age	Paleo- environment
1	*Zonocostites ramonae ?*	Late Eocene or younger	Non-marine to paralic ?
2	*Momipites spp. ?*	Cenomanian or younger	,,
3	*Compositae type*	Miocene or younger	,,
4	*Proxapertites sp. ?*	Miocene or younger	,,
5	*Betulaceae type ?*	Miocene or younger	,,
6	*Abiespollenites spp.*	Miocene or younger	,,
7	*Monoporites annulatus*	Miocene or younger	,,
8	*Psilatricolporites spp.*	Tertiary or younger	,,
9	*Psilamonocolpites sp.*	Miocene or younger	,,
10	*Retitricolpites sp.*	Tertiary or younger	Paralic to Shallow marine ?
11	*Retitricolporites sp.*	Tertiary or younger	,,
12	*Inaperturopollenites sp.*	Tertiary or younger	,,
13	*Taxodiaceaepollenites hiatipites*	Miocene or younger	Paralic to Non-marine ?
14	*Dictyophyllidites sp.*	Miocene or younger	,,
15	*Piceapollenites spp.*	Miocene or younger	,,
16	*Pinuspollenites spp.*	Miocene or younger	,,
17	*Chorate dinocyst*	Tertiary or Younger	Paralic to near shore marine shallow environment
18.	*Lingulodinium machaerophorun?*	Early Eocene to Quaternary	Paralic or near shore shallow marine environment
19	*Tasmanites sp. ?*	Tertiary or younger	Brackish to shallow marine ?
20.	*Rigidusporonites spp.*	Late Eocene or younger	Non-marine to paralic ?
21.	*Inapertisporites spp.*	Miocene or younger	,,
22.	*Hypoxylonites sp.*	Tertiary or younger	,,

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