

The Lower Siwalik - Basement unconformity in the Sub-Himalaya of eastern Nepal and its significance*

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ABSTRACT

South of the Main Boundary Thrust (MBT), in the Sub-Himalaya of central and eastern Nepal, pre-Siwalik rocks in the form of fault bound slices are known to occur. Recently the present authors have mapped these rocks in the Udayapur district of south eastern Nepal. In the area about 1 km wide pre-Siwalik rocks extend for over 50 km along a NE-SW direction. In the eastern area around Tintale village (near the Tawa Khola-Baijanath Khola confluence), the stromatolitic dolomites of Tintale Formation of the pre-Siwalik Group is overlain by the Lower Siwalik with a prominent unconformity marked by a 4.5 m thick basal conglomerate. Likewise, in the western area along the Manba Khola, the Siwalik Group overlies the pink sandstones and shales of the Manba Formation of the pre-Siwalik Group with an unconformity, again with a conglomerate horizon at the base. It is perhaps the only occurrence where the base of the Siwalik Group is recorded in Nepal. In this part of the Himalaya, the Siwalik sediments directly overlie the Precambrian-Lower Paleozoic (?) basement rocks with an unconformity. The basement rocks along with its Siwalik cover was brought to the surface by thrusting within the Sub-Himalaya.

INTRODUCTION

The study area (Fig. 1) consists of a series of longitudinal ridges and valleys composed mainly of thick sequences of Middle Miocene to Lower Pleistocene molassic sediments. As in other parts of the Sub-Himalayas, the Siwalik Group of Nepal is tectonically bounded by the Main Boundary Thrust (MBT) in the north and Main Frontal Thrust (MFT) in the south.

Stratigraphically, the three-fold subdivision of the Siwalik Group as in other parts of the Himalayas holds true for the present area also. They are Lower Siwalik (LS), Middle Siwalik (MS) and Upper Siwalik (US). However, based on lithology the Middle Siwalik has been further subdivided into Lower Middle Siwalik (MS1) and Upper Middle Siwalik (MS2) (Table 1, Fig. 2). The Lower Siwalik is mainly comprised of grey coloured fine grained, hard sandstones interbedded with purple and grey

shales, mudstones and siltstones. It is gradationally overlain by the Lower Middle Siwalik. The Lower Middle Siwalik dominantly consists of grey medium grained, friable, micaceous sandstones with grey shales and siltstones. The medium grained sandstones exhibit salt and pepper like appearance in fresh outcrops. The Upper Middle Siwalik gradationally overlying the Lower Middle Siwalik dominantly consists of pebble sandstones and medium to coarse sandstones with grey mudstones and siltstones. The Upper Siwalik is comprised of conglomerates with subordinate amount of yellow mudstones, claystones and siltstones with thin beds and lenses of medium to coarse sands. The Upper Siwalik overlies the Upper Middle Siwalik also with a gradational contact.

The Pre-Cambrian and younger metamorphic rocks of the Midland Group of Lesser Himalaya have thrust over the Siwalik Group along the Main Boundary Thrust (MBT). All over the Himalaya the

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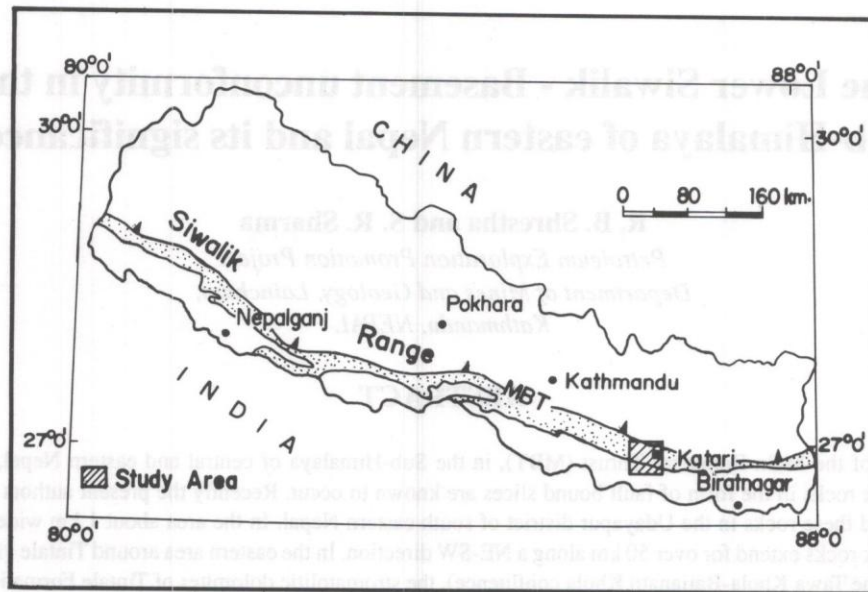


Fig. 1: Location map of the study area.

older rocks of the Lesser Himalaya are restricted only to the north of the Main Boundary Thrust. However, in eastern Nepal including the present study area, the pre-Siwalik rocks also outcrop south of the MBT within the Siwalik Zone (Herail et al., 1986; Bashyal et al., 1989; Shrestha and Sharma, 1994; Gautam et al., 1995). These older suite of rocks found to the south of the MBT and lithologically similar to those of the Midland Group of the Lesser Himalaya, has been collectively named as pre-Siwalik Group. The main rock types of this group are grey cherty dolomites, grey shales, purple and green shales, pink sandstones, white quartzites and green shaly phyllites. The dolomites are best exposed around Tintale Village located at the confluence of Tawa Khola and Baijnath Khola (downstream of the confluence the stream is called Kamla River). It has a thickness of over 200 m and is informally named as the Tintale Formation. Similarly, pink sandstones with purple shales exposed in the western part of the area has been named as the Manba Formation after the Manba Khola (a tributary of the Thakur khola) where these rock types are well exposed.

STRATIGRAPHY AND TECTONICS

In the southern part, the Lower Siwalik gradually passes into the Middle Siwalik which in turn is

overlain gradationally by the Upper Siwalik. The Lower Siwalik is repeated three times by thrusting along the N-S section (Fig. 2). The Lower Siwalik rocks and the Upper Siwalik conglomerates are brought together by the Main Dun Thrust (MDT). In the Baijnath valley, the Midland Group rocks are brought to the surface by the Main Dun Thrust and associated thrusts (Bashyal et al., 1989). Along the Kamala River-Baijnath Khola axis which lies about 10 kms south of the MBT, the pre-Siwalik Group is exposed continuously for over a distance of 50 km running almost parallel to the MBT (Fig. 2).

Lower Siwalik-Basement Unconformity

Within the fault bounded packages of pre-Siwalik rocks the base of the Lower Siwaliks has been found. Just to the south of Tintale village at the confluence of Tawa Khola and Baijnath Khola, the stromatolitic dolomite consisting of thin layers of dark grey chert and grey shale partings is overlain by a 4.5 m thick basal conglomerate with brick red mudstone and shale and banded chert layer (Fig. 3, 4). The basal conglomerate consists of sub-rounded to rounded pebbles of grey white dolomites, banded white grey quartzites, dark grey to black cherts, purple and grey shales derived from the underlying rock units of the pre-Siwalik Group cemented by the calcareous sandy

Table 1: Lithostratigraphic sub-divisions of the Pre-Siwalik and Siwalik Groups

Age	Group	Formation	Lithology
Middle Miocene To Lower Pleistocene	Siwalik Group	Upper Siwalik	Conglomerates, clay with minor Sandstones
		Upper Middle Siwalik	Pebbly sandstones, medium to coarse grained grey sandstones, grey mudstones, siltstones
		Lower Middle Siwalik	Medium grained, arkosic micaceous grey, bluish grey sandstones, grey shales, mudstones and siltstones
		Lower Siwalik	Fine grained, grey, hard and compact sandstones, purple shale, clay, with purple mottled grey siltstones
Upper Precambrian To Lower Paleozoic(?)	Pre-Siwalik Group	Unconformity	
		Tintale Formation	Grey, white grey stromatolitic dolomites with dark grey shale partings and minor chert layers
		Manba Formation	Pink sandstones and quartzitic sandstones with purple shales

matrix. The subrounded to rounded dolomite pebbles in the basal conglomerate resemble the dolomite of the underlying Tintale Formation. The conglomerate unit is overlain by the fine grained, hard and compact grey sandstone and purple shales with grey purplish mudstone and siltstone of the Lower Siwalik. The Lower Siwalik thus clearly overlies the Tintale Formation of pre-Siwalik Group with an unconformity.

Similarly, in the western part of the study area along the upper reaches of the Manba Khola, the Siwalik Group is found to overlie the pre-Siwalik Group with an unconformity. Here, fine to medium grained sandstones with grey shales of the Siwalik Group unconformably overlies the pink sandstones of the Manba Formation of pre-Siwalik Group (Fig. 5, 6). The pre-Siwalik rocks of the Manba Khola area, however, is brought out by a different thrust lying further to the north of the Kamla-Tawa Thrust. Here a 1.4 m thick basal conglomerate consisting of sub-rounded to rounded pebbles of pink sandstones, purple shales, green grey shales, white

and pink quartzites forms the base of the undifferentiated Siwaliks. The upper half meter of the basal conglomerate unit is well cemented by grey sandy matrix while the matrix in the lower part of the conglomerate is more pinkish.

Lithologically, grey, white grey stromatolitic dolomites of the Tintale Formation and pink sandstones and purple shales of the Manba Formation can be compared with the Midland Group lying to the north of the MBT. Based on the lithology, the Tintale Formation appears similar to the Gawar Formation of the Lakharpata Group (Upper Proterozoic to Upper Paleozoic?) of the Lesser Himalaya to the north of Dang valley (Friedenreich et al., 1994). The stromatolitic dolomites of the Tintale Formation can also be compared with the Dhading Dolomite of the Lower Nawakot Group in central Nepal (Stocklin and Bhattarai, 1981). Similarly, pink sandstones and purple shale of the Manba Formation may be compared with the Ramkot Formation of the Lakharpata Group of the Dang area (Friedenreich et al., 1994). Occurrence of red and green sandstones along with dolerites in

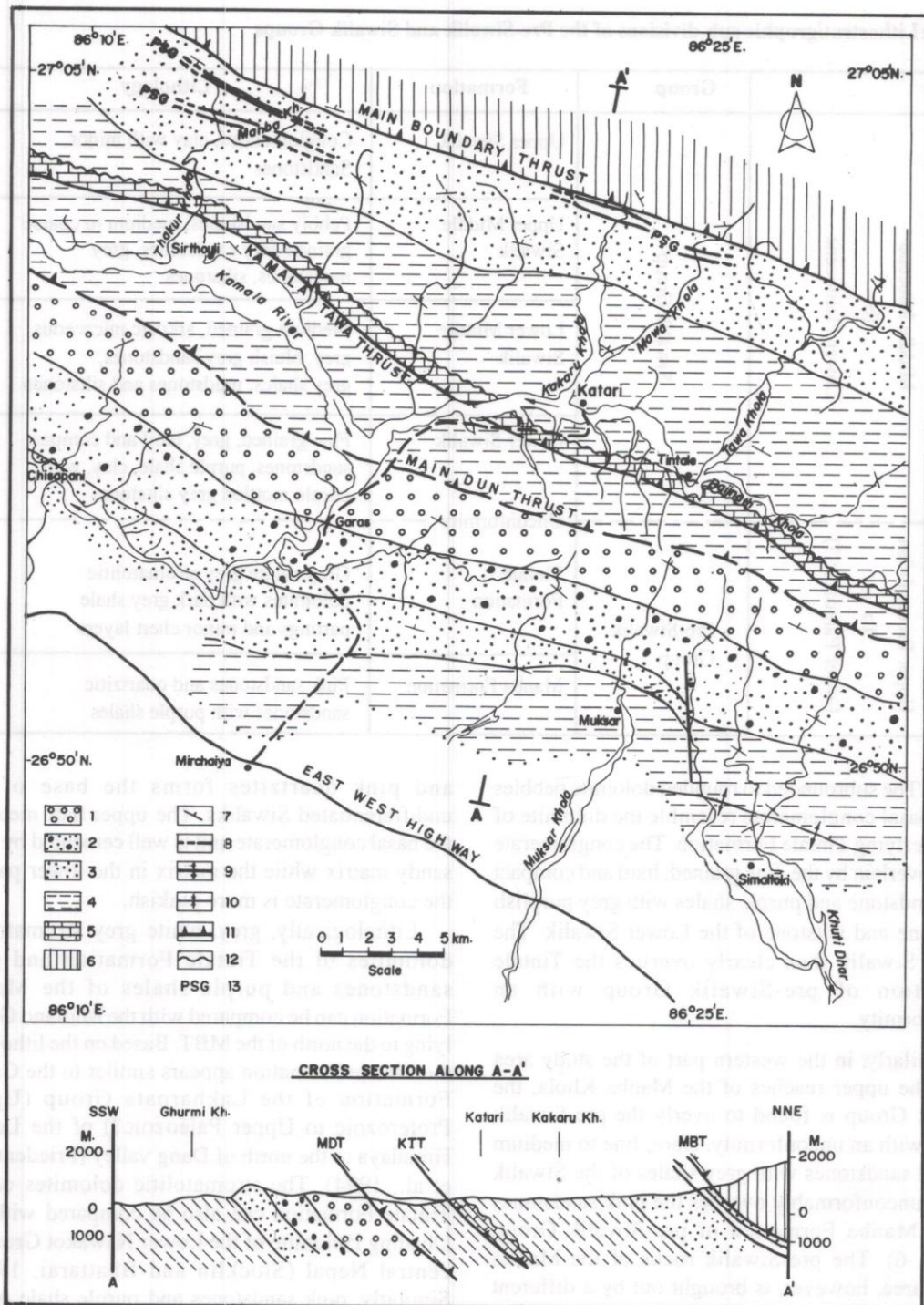


Fig. 2: Geological map of the Katari area, Udaypur district, eastern Nepal. Legend: 1. Upper Siwalik; 2. Middle Siwalik (MS₁); 3. Middle Siwalik (MS₂); 4. Lower Siwalik; 5. Pre-Siwalik; 6. Midland Group; 7. Dip and strike; 8. Fault; 9. Anticline; 10. Syncline; 11. Thrust; 12. Unconformity; 13. PSG: Pre-Siwalik Group. KTT: Kamala-Tawa Thrust; MDT: Main Dun Thrust; MBT: Main Boundary Thrust.

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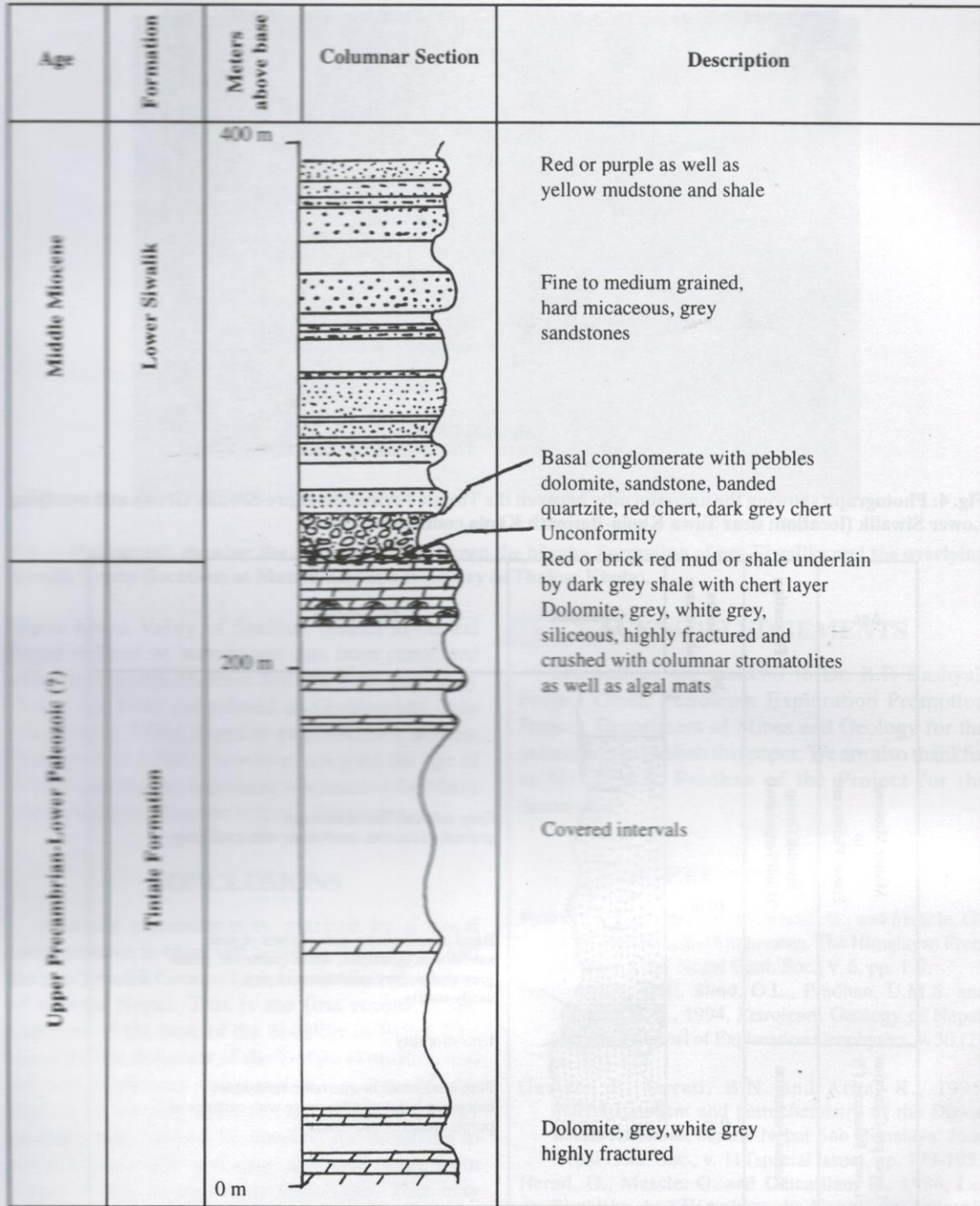


Fig. 3: Columnar section showing the unconformity between the Lower Siwalik and Tintale Formation (pre-Siwalik) in Tawa Khola, Katari Area.



Fig. 4: Photograph showing the unconformity between the Tintale Formation of pre-Siwalik Group and overlying Lower Siwalik (location: near Tawa Khola-Bajjnath Khola confluence).

Age	Formation	Meters above base	Columnar Section	Description
Middle Miocene to Lower Pleistocene	Siwalik Group (Undifferentiated)	20 m		Grey colored, fine to medium grained micaceous sandstones with coal lenses
Upper pre-Cambrian to Lower Paleozoic (?)	Manba Formation	0 m		Basal conglomerate with pebbles of pink sandstones, quartzites, white quartzites, green grey shales, grey sandstones in pink sandy matrix. Unconformity Pink sandstones or quartzitic sandstones below the basal conglomerate with partings of purple shales of pre-Siwalik

Fig. 5: Columnar section showing the unconformable relationship between the pre-Siwalik and Siwalik Group as evidenced by basal conglomerate, Manba Khola.



Fig. 6: Photograph showing the unconformity between the Manba Formation of pre-Siwaliks and the overlying Siwalik Group (location: at Manba Khola, a tributary to Thakur Khola).

Marin Khola Valley of Sindhuli district in central Nepal defined as 'substratum' has been correlated with Dharamsala-Murrees and the dark grey slaty shales has been considered as Gondwana beds (Herail et al., 1986). Based on paleomagnetic studies, Gautam et al. (1995), however, assigned the age of the red beds and the associated volcanics of the Marin Khola Valley as Eocene to Early Oligocene.

CONCLUSIONS

A clear unconformity marked by a basal conglomerate is observed between the Siwalik and the pre-Siwalik Groups found in the Sub-Himalaya of eastern Nepal. This is the first record of the exposure of the base of the Siwaliks in Nepal. The stromatolitic dolomite of the Tintale Formation and the pink sandstones and purple shales of the Manba Formation forming the basement of Siwaliks may be compared with the Midland Group occurring to north of the MBT and their age may range from Upper Precambrian-Lower Paleozoic. This may indicate that the Siwaliks of this part of Nepal were unconformably deposited over a Precambrian-Upper Paleozoic basement.

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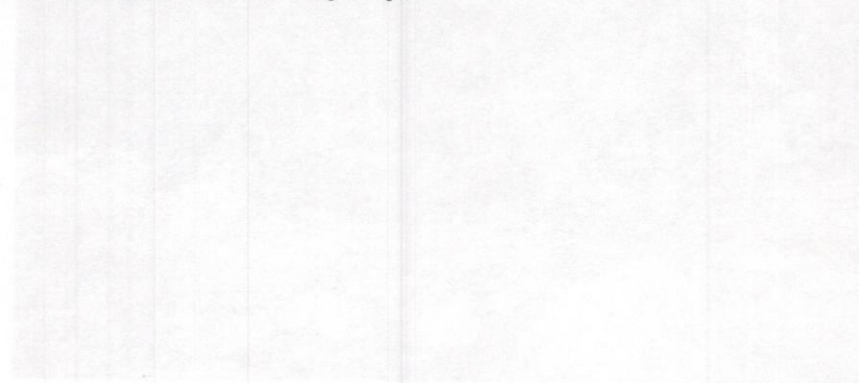


Fig. 6. Photograph showing the stratigraphic relationship between the Siwalik and the pre-Siwalik Group (lower part of the Arung Khola) in the Arung Khola area.

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CONCLUSIONS

A clear unconformity marked by a basal conglomerate is observed between the Siwalik and the pre-Siwalik Group in the Sub-Himalaya of eastern Nepal. This is the first record of the exposure of the base of the Siwalik in Nepal. The stratigraphic relationship of the Tertiary Formation and the pre-Siwalik Group in the Mahabharat Range is similar to that of the Siwalik and the pre-Siwalik Group in the Sub-Himalaya. The Siwalik Group is deposited over a Precambrian Upper Palaeozoic basement.