

**CHARACTERISTICS OF BENIGHAT GROUP  
IN THE CONTEXT OF  
GEOLOGICAL FRAMEWORK OF  
GORKHA - MUGLING AREA & THE SOUTHERN CHURE RANGE**

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**ABSTRACT**

A separate Benighat group is suggested for the Upper Nawakot Group, occupying the core of the Mahabharat syncline in the Gorkha-Mugling area. Lower Nawakot Group is also divided into two lithologically and structurally distinct groups, Dhading & Kunchha.

Benighat Group is an assemblage of alternating calcareous and argillaceous rock units. Six mappable units are distinguished, viz. Hushdi Beds, Dhungre Slates, Jogimara Limestone, Sairling Phyllites, Malekhu Limestone and Robang Phyllites. Basic rocks are found to occur in the upper and middle parts of the Benighat Group.

**INTRODUCTION**

Beneath the Kathmandu Nappe (Hagen, 1969; Stocklin and Bhattarai, 1977) the Lesser Himalayan succession of the central Nepal is divided into the Lower Nawakot Group, comprising the Kuncha Formation at the base overlain in succession by Fagfog Quartzite, Dandagaon Phyllites, Nourpul Formation and Dhading Dolomites of Precambrian to Paleozoic age, and the unconformably overlying Upper Nawakot Group, comprising the Benighat Slates, Malekhu Limestone and Robang Formation of probable Permo-Carboniferous age.

Mitchell et al (1982), however, believe that the black slates lying below the Main Central Thrust together with the Benighat Slates comprise a single major nappe with the Benighat Thrust at the base.

In the central-west Nepal Hirayama et al (1981) and Sakai (1984) reported conformable relation of Benighat equivalent slates over the Dhading equivalent dolomites.

Several authors (Hagen, 1969; Fuchs and Frank, 1977; Stocklin, 1980; Mitchell et al 1982; Sharma et al, 1984) view the discordant relationship between the Dhading equivalent Dolomite and the Benighat equivalent slates. Only Stocklin interpreted this discordance as a disconformity, but for other authors it represented only a thrust plane. Mitchell et al are of the opinion that Benighat Slates originated from a stratigraphic position some where beneath the Kunchha Formation.

Geological mapping carried out by the author in Tansen - Daram Khola and Syangja area (1981, 1983) has revealed that the Benighat slates are underlain by a sequence of Dhading, Nourpul and Dandagaon equivalent rocks.

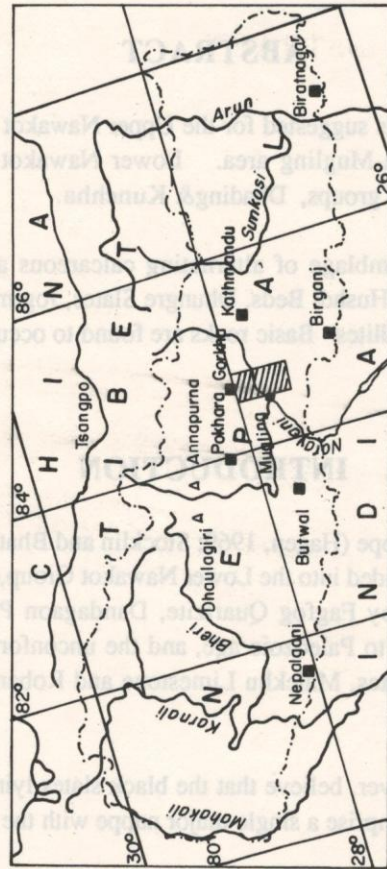
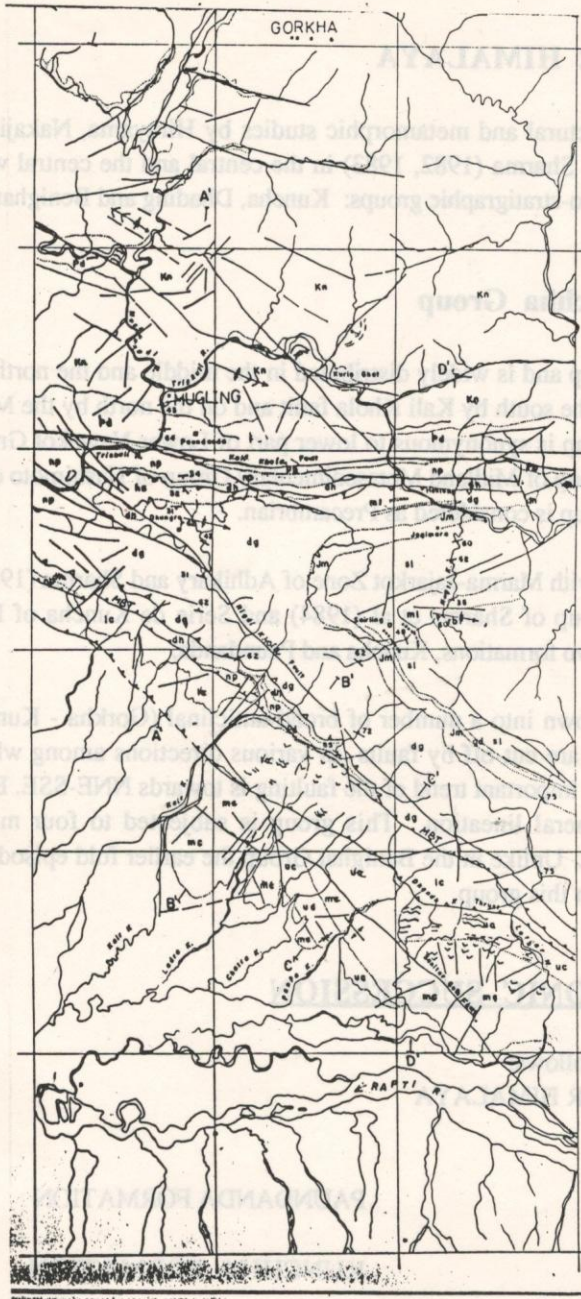


Fig. 1 : INDEX MAP, Scale : 1 : 6,000,000

GORKHA - MUGLING AREA & THE SOUTHERN CHURE RANGES  
 GEOLOGICAL FRAMEWORK OF  
 IN THE CONTEXT OF  
 CHARACTERISTICS OF BENIGHAT GROUP

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The present work is based upon the actual photo interpretation of the whole area and upon the geological traverses of the Mustang - Kail Khol - Dhangre - Uparang Gauri - Kail Khol, the Kail Khol - Hugi Khol, and the Kail Khol - Lohar Nashi confluence - Lohar Nashi downstream sections.



**LEGEND**

- Quaternary Deposits**
- Recent And Ancient Alluvial Deposits, Dun Valley Deposits
- CHURE GROUP ( Neogene )**
- uc Upper Chure Formation - Conglomerates with irregular bands of sandstones and mudstones
  - mc Middle Chure Formation - Sandstones, siltstones, mudstones, shales with coal lenses, pseudo conglomerates
  - lc Lower Chure Formation - Fine grained hard sandstones with purple and variegated shales, mudstones, siltstones
- DHADING GROUP ( Paleozoic ? )**
- dh Dhading Dolomite - Light blue-gray dense dolomitic limestone, in places stromatolitic
  - np Nourpua Formation - Alternating layers of phyllites and calcareous quartzites/dolomites showing colour banding
  - pb Purbast quartzite member - ortho quartzite
- BENIGHAT GROUP ( Paleozoic ? )**
- rb 6 Robang phyllites (rb)
  - ml 5 Maleshu limestone (ml)
  - sl 4 Sairing slates (sl) with boulder beds (bb) and amphibolites (gd)
  - jm 3 Jagimara limestone (jm)
  - dg 2 Dhangre slates (dg) with Carbonate base (lm)
  - hs 1 Hushdi beds (hs)
- KUNCHHA GROUP (Upper Precambrian)**
- pd Paundanda formation - White orthoquartzite ripple marked with slates/phyllites
  - kn Kuncho formation - Dark gray to light green gray slates, phyllites occasionally calcareous, sandstones calc, gritty, conglomerates, rare amphibolites
- STRUCTURES**
- Formation boundary
  - Bedding trace
  - VVV Flat iron
  - Fault
  - Major thrust
  - Thrust
  - Anticlinal axis
  - Anticlinal axis with plunge
  - Synclinal axis
  - Synclinal axis with plunge
  - Strike and dip
  - Foliation
  - Joint
  - Trace of section
  - Drainage
- OTHER SYMBOLS**
- 5772 Elevation in feet
  - Terrace escarpment
- |  |                |       |
|--|----------------|-------|
| DEPARTMENT OF MINES AND GEOLOGY                                |                |       |
| GEOLOGICAL MAP OF GORKHA-MUGLING AND THE SOUTHERN CHURIA RANGE |                |       |
| Author - T. P. Adhikari  | Checked by:    |       |
| Drawn by P. B. Hada  | Date: 2046/5/4 |       |
| Ref No. 48/52  | Report No.     | Scale |

DHADING DOLOMITES  
NOURPUL FORMATION

DHADING GROUP

The present work is based upon the aerial photo interpretation of the whole area and upon the geological traverses of the Mugling - Kali Khola - Dhungre - Upardang Garhi- Kair Khola, the Kair Khola - Hugti Khola, and the Kali Khola - Lothar Nadi confluence - Lothar Nadi downstream sections.

## **LESSER HIMALAYA**

Based on the detailed lithological, structural and metamorphic studies by Hirayama, Nakajima, Shrestha and Adhikary, (1981), and Adhikary & Sharma (1982, 1983) in the central and the central west Nepal, the study area can be divided into three litho-stratigraphic groups: Kuncha, Dhading and Benighat.

### **Kunchha Group**

The Kuncha Group forms the lowermost group and is widely distributed in the middle and the northern parts of the Lesser Himalaya. It is delimited on the south by Kali Khola fault and on the north by the Main Central Thrust (beyond the study area). This group is synonymous to lower part of Lower Nawakot Group of Stocklin (1980), and Lower arenaceous Sub-group of Midland Metasedimentary Group of Hashimoto et al (1973) and Arita et al (1982). The age of this group is considered as Precambrian.

The Kuncha Group can be correlated with Marma-Jajarkot Zone of Adhikary and Sharma (1982), Chails of Fuchs and Frank (1970), Kuncha Group of Sharma et al (1984) and Serie de Kuncha of Kali Gandaki section of Bordet (1961). It consists of two formations, Kuncha and Paundanda.

Structurally rocks of this group are thrown into a number of broad anticlinal (Gorkha - Kuncha anticlinorium) and synclinal folds. These folds are cut-off by faults in various directions among which WNW-ESE trending faults predominate. Another important trend of the faulting is towards NNE-SSE. Both the formations in this group exhibit NNE mineral lineation. This group is subjected to four major deformational episodes as in the Benighat Group. Unlike in the Benighat Group the earlier fold episode of NNE-SSW to NE-SW orientations is pervasive in this group.

## **LITHO-TECTONIC SUCCESSION**

The litho-tectonic section in the study area is as follows:

LESSER HIMALAYA	
<b>KUNCHHA GROUP</b>	PAUNDANDA FORMATION
	KUNCHHA FORMATION

-----Kali Khola Fault-----

**DHADING GROUP**

DHADING DOLOMITES

NOURPUL FORMATION

-----Benighat Thrust-----

ROBANG PHYLLITES

MALEKHU LIMESTONE

SAIRLING PHYLLITES

JOGIMARA LIMESTONE

DHUNGRE SLATES

HUSHDI BEDS

-----Main Boundary Thrust-----

SUB - HIMALAYA

UPPER CHURE FORMATION

MIDDLE CHURE FORMATION

LOWER CHURE FORMATION

CHURE GROUP  
(SIWALIK)

Kuncha Formation

This formation is an assemblage of alternating pale green to greenish gray phyllites, gray to dark gray slates, fine grained to gritty sandstones, quartzites, gritstones and minor conglomerates. The phyllites vary in composition from argillaceous to arenaceous. The slates and sandstones are in places calcareous. The almond shaped semi-transparent quartz grits in phyllites are quite characteristic. Few metres thick layers of basic rocks, meta-gabbros, epidiorites, amphibolites (Sharma, 1973) are found interbedded in this formation. Sericite and chlorite are the common metamorphic minerals found in the phyllites. This formation is more than 3000 m thick.

Paundanda Formation

The name of this formation is derived from Paundanda village situated on the south-east of Mugling. It conformably overlies the Kuncha Formation. It is an assemblage of thin to thick alternating bands of quartzites and slates/phyllites. Along the Trishuli River, just south of Mugling, this formation shows at least four thick (150-350m) bands of fine to coarse grained, white ortho-quartzites with occasional reddish and pale orange tints. Quartzites are thick bedded to massive, show ripple marks and graded bedding. The basal quartzite member of about 350 m thick was designated by Stocklin and Bhattarai (1977) as Fagfog quartzite, which is observed as overlying the dark gray ferruginous slates of the Kuncha Formation at the northern flank of Mahabharat syncline. The slates and phyllites of this formation are dark gray to greenish gray and occasionally laminated. Thin alternating layers (few cms) of ferruginous dark gray, silty slates and fine grained dark brown sandstones are also marked. The thickness of Paundanda Formation is about 1350 m.

This formation shows lateral and vertical facies changes. In its type locality quartzites are dominating. Along the Trishuli River north of Heklung Khola it shows the appearance of thin bands of calc-phyllites.

## Dhading Group

This group occurs in both the flanks of the Mahabharat syncline and is underlain by the Benighat Group rocks. In the northern flank of the syncline the Dhading Group comes in tectonic contact (Kali Khola Fault) with the Kuncha Group whereas in the southern flank the basal part of the group is cut-off by the Main Boundary Thrust. This group is synonymous to the upper part of the Lower Nawakot Group of Stocklin (1980). It is correlated to upper part of Daram khola complex of Adhikary and Sharma (1982), Nawakot Group of Sharma et al (1984) and Hirayama et al (1981). In the study area the Dhading Group consists of two formations, Nourpul Formation and Dhading Dolomite. The names of these two formations have been retained from Stocklin's (1980) litho-stratigraphy.

The main structural element in the Dhading Group is the Mahabharat Syncline. The closure of the syncline is also recognizable in the Dhading Dolomites and Nourpul Formation, both occurring at the bank of Trishuli River. The Rigdi Khola thrust fault has brought the Nourpul Formation in direct contact with the Dhungre slates of Benighat Group at the lower and the middle courses of the Rigdi khola.

This group is subjected to three major deformational episodes. The earlier fold episode of NNE-SSW trend does not exist in this group.

### Nourpul Formation

This formation starts with gray, white to pink, strongly ripple marked Purebesi Quartzite at the base followed upwards by dark gray to pale green phyllites with variable amount of quartzite and calcareous intercalations exhibiting colour banding. The upper part of the formation shows white to pink, thin to thick bedded dolomitic quartzites/siliceous dolomites. In the Kair Khola area also Purebesi Quartzite member is observed in Nourpul Formation occurring north of the MBT. The total thickness is about 800 m. The contact with the overlying Dhading dolomite is gradational and is characterised by two or three alternations of a few metres thick white to pink siliceous dolomites and light bluish gray dolomites.

### Dhading Dolomite

The Dhading dolomite is massive to well bedded, dense to fine crystalline and light to bluish gray coloured. It contains stromatolites at several levels. The upper part is characterised by a few alternating beds of light bluish gray dolomites and dark gray slates. The average exposed thickness is about 800 m.

## Benighat Group

The Benighat Group occurs in the outermost part of the Lesser Himalaya and occupies the core of the Mahabharat syncline. It overlies the Dhading dolomites on both the flanks of the syncline with a tectonic contact.

This group is synonymous to Upper Nawakot Group (Upper Paleozoic) of Stocklin (1980), and Benighat Nappe of Mitchell et al (1982). It is also correlatable to Galyang slate of Hirayama et al (1981),

Simla Slate of Fuchs and Frank (1970), Tal Khola Formation of Adhikary and Sharma (1982), Hatiya Formation of Sharma et al (1984) and Andhi Khola Formation of Sakai (1986).

Valdiya (1984 pers. comm.) is inclined to correlate this group with the Mandhali Formation (Upper Riphean to early Vindhian) in the Kumaon Himalayas. However, Stocklin (1980) has pointed out to the possibility of its correlation with Permo- carboniferous Blaini/Infra Krol Unit of the Krol belt.

In broad consideration Benighat Group is an assemblage of alternating calcareous and argillaceous rock units. The rocks are either unmetamorphosed or are very less metamorphosed. This group is lithologically very distinct from the underlying Dhading and Kuncha Groups. It has been divided into six mappable units. They are Hushdi Beds, Dhungre Slates, Jogimara Limestone, Sairling Phyllites, Malekhu Limestone and Robang Phyllites. Among them Dhungre Slates, Jogimara Limestone and Sairling Phyllites, all combined together are equivalent to Benighat Slates of Stocklin, (1980). These units are described below, as observed in the Hugti Khola section.

The closure of the Mahabharat synclinorium which is reduced to a single syncline of WNW-ESE trend in the study area is very well reflected by the bendings of limestone bands (Jogimara Limestone, Malekhu Limestone) in the Benighat Group. The southern flank of the syncline has been dissected by the Rigdi Khola fault and the Kali Khola fault of regional WNW-ESE trend. In the axial part of the syncline, the beds are dipping moderately to steeply (40 -65 ) in Dhungre and the Hugti Khola area NNE-SSW to NE-SW mineral lineation is quite common.

Four deformational episodes were observed in the Benighat Group. The earlier two fold episodes comprise fairly tight isoclinal to reclined folds of NE-SW and NW-SE orientations. The age relationship between these two types was not known in course of the present study. The fold episode of NW-SE orientation is highly pervasive. This deformational episode has given rise to the axial plane cleavage.

The open regional folds of WNW-ESE and ENE-WSW orientation are superimposed over the earlier two generations of folds. These have produced wide spread puckers, crenulations and minor open folds of the same trend.

The last or the fourth fold episode of NNE-SSW to NNW-SSE orientation has been superimposed over the earlier folds. They are represented by gentler undulations and micropuckers.

#### Hushdi Beds

This is the lowermost unit of Benighat Group and is distinguished locally near the closure of the Mahabharat Syncline. The thin dark gray slates occurring at the top of the Dhading dolomite is overlain by the ash gray weathering siliceous phyllites, phyllitic quartzites, calc-quartzites and sandy dolomites. These rocks are designated as Hushdi Beds.

#### Dhungre Slates

These are dark argillaceous slates or phyllites containing frequent intercalations of black carbonaceous slates. In addition, this unit contains several lentiform carbonate beds (few cms to few tens of metres in length) and calc-phyllites. The slates or phyllites vary in composition from argillaceous to arenaceous. The argillaceous varieties show more of quartz lenses and vienlets. The slates are in places laminated showing distinct banding due to colour and compositional variations.





### Jogimara Limestone

This forms a distinct marker horizon. The dark gray phyllites of Dhungre Slates are directly overlain by white siliceous limestone (600 m) with a sharp contact. This limestone is bedded to foliated with alternate bands of green tinted, thin to moderately bedded and foliated and siliceous limestones. These limestones show thin films of sericite and chlorite. The upper part shows thin to moderately bedded light bluish gray dolomitic limestone (200 m). Actually Jogimara Limestone is equivalent to one of the thick carbonate beds (second from top) of Stocklin (1980).

### Sairling Phyllites

This unit is named after the village Sairling at the upper course of Hugti Khola. It is composed dominantly of phyllites and slates of dark gray colour. Besides phyllites and slates white to gray quartzites, calc-quartzites and light bluish gray foliated, siliceous dolomitic limestones and green phyllites are present in subordinate amount. The dark gray to green slates or phyllites vary in composition from pelitic to arenaceous and contain numerous quartz lenses and veinlets. At places they are highly pyretiferous and laminated and show cross beddings, fine gradations as well as limonite stains along the cleavage partings. In the upper course of Hugti Khola about 200 m thick exposure of dull green foliated basic rock containing specks of magnetite and occasional lenses and veinlets of quartz occurs at the base of this unit overlying Jogimara Limestone. Two conglomerate beds occur, one at the lower and the other at the upper parts of the unit. These conglomerate beds consist of unsorted quartzitic pebbles and cobbles with quartz, mica and chlorite matrix. The upper part of the unit shows alternations of dark gray slaty phyllites and pale green pelitic to siliceous phyllites. The highly quartzose gray to green siliceous phyllites show traces of copper.

### Malekhu Limestone

This is another distinct marker horizon in the Benighat Group. Its name is retained from that of Stocklin (1980). It starts with yellowish white fine grained dense siliceous limestone with pale green sericitic partings followed up by tens of metres thick bluish gray, dark gray and grayish white, massive and dense quartzite containing 0.75 m thick conglomerate layer with stretched quartz pebbles. The upper part shows regular alternations of white siliceous limestones and light bluish gray dolomites with minor intercalations of sericite chlorite- phyllites, quartzose phyllites and ferruginous black slates.

### Robang Phyllites

Robang Phyllites is the uppermost unit of the Benighat Group being exposed at the core of the Mahabharat syncline in Hugti Khola. It is dominantly made up of gray to dark gray slaty phyllites and siliceous phyllites with subordinate amount of green quartzose phyllites and quartzites. The dark gray to black phyllites are ferruginous and contain numerous quartz lenses and veinlets. Basic rocks (Stocklin 1980) are found in the upper part.

## **SUB - HIMALAYA**

### **Chure Group**

The rocks of this group cover the Sub-Himalayan range, south of the Main Boundary Thrust. In the study area, it occurs north of the Rapti Dun Valley. The Chure range of Nepal is an eastern

continuation of Siwalik Range of India (Hardwar). The rocks of this group are as a whole synonymous to rocks of Siwalik Group of India.

The Chure Group comprises terrestrial sediments of Mid- Miocene to early Pleistocene age. Lithologically it can be divided into three formations, lower, middle and upper. However, the paleontologically based three fold division of Indian Siwaliks can be applied in Nepal with cautions. Regional consideration shows that the rocks related to this group exhibit substantial lateral facies variations (West & Munthe 1981). Therefore, the lithologically recognisable and mappable units may not represent the same time every where. In absence of the reliable fossil evidences I prefer the name, Lower Chure Formation, Middle Chure Formation and Upper Chure Formation.

The structure of Chure Group is marked by a series of folds, longitudinal thrusts and faults of NW-SE to WNW-ESE orientations. Dhandh khola thrust has brought the Lower Chure Formation over the Upper Chure Formation. A normal fault of NW-SE trend passes in oblique relation with the strike of hanging wall rocks. Apart from these, there are a number of transverse faults of NNE-SSW and NNW-SSE trends. The formations are generally moderately inclined.

#### Lower Chure Formation

This formation consists of irregularly alternating beds of fine-grained, hard calcareous sandstones and siltstones. Purple and variegated shales and mudstones are intercalated frequently. Sole marks, ripple marks and cross beddings are frequently observed. The base of the formation is not exposed. Its thickness is more than 2500 m.

#### Middle Chure Formation

The lower limit of this formation is marked at that place where the sandstone becomes thick bedded, massive, medium to coarse grained and arkosic. This sandstone contains thin alternating beds of siltstones, mudstones, shales and pseudo- conglomerates in subordinate amount. Some coal lenses and seams are encountered in the black sandstones and shales. The upper part of the formation shows pebbly sandstones gradually changing into upper Chure conglomerates. The thickness of this formation attains more than 2000 m.

#### Upper Chure Formation

This formation is represented by pebble to boulder conglomerates with occasional lenticular bands of sandstones and mudstones. The rock fragments are mainly composed of quartzites. The thickness is expected to be more than 600 m.

### CONCLUDING REMARKS

Present study in the Gorkha-Mugling area and the Chure range leads to the following conclusions:

The Benighat Group is an assemblage of alternating argillaceous and calcareous rock units with subordinate amounts of basic and siliceous materials. Jogimara Limestone is equally a mappable horizon as Malekhu Limestone.

The amphibolites and quartzites are found not only in Robang phyllites as reported earlier by Stocklin (1980), but also found in the area of Sairling Phyllites of the Benighat Group lying stratigraphically below the Malekhu Limestone.

The beds of Benighat Group in the axial part of Mahabharat syncline are dipping moderately to steeply (40 -65 ).

The Benighat Group actually exhibits two fold episodes comprising fairly tight isoclinal to reclined folds of NE-SW and NW-SE orientations. The age relationship between these two episodes is not known in the course of present study. The fold of NW-SE orientation is highly pervasive.

Geological investigation in the study area as well as beyond the area show that nowhere does the Kuncha Group come in normal contact with the overlying Dhading Group. Metamorphic as well as structural character of these groups possibly point to the considerable time gap between the former and the later. Moreover, one episode of the earliest deformation of NNE-SSW trend is observed in this group, which is not seen in the overlying Dhading Group. This clearly implies a question over Stocklin's assertion of no stratigraphic break in his Lower Nawakot Group.

The Dandagaon Phyllites of Lower Nawakot Group of Stocklin (1980) can not be recognised in the study area. What he had mapped as the Dandagaon phyllites is nothing but the upper part of his Fagfog Quartzite, which I designated as the Paundanda Formation. Thus it is obvious that he had extended the Dandagaon Phyllites from the type locality to westward.

The Kali Khola Fault at the base of Nourpul Formation in contact with the Kuncha Formation has been recognised. It is characterised by a few tens of cms to few metres thick crushed black carbonaceous zone.

The older fold episode present in the Benighat Group, the sharp contact between the Benighat Group and the underlying Dhading Group and the strong variation in thickness of the Benighat Group together with the findings of a sequence of Dhading, Nourpul, Dandagaon, Benighat equivalent rocks in the central west Nepal point not only to the tectonic nature of the contact between the Dhading and Benighat Groups, but also to the older age of the Benighat Group.

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