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Facies Analysis and Depositional Environment of the Bhuban Formation, Sitapahar Anticline, Kaptai, Chittagong Hill Tracts, Bangladesh

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Abstract: *The Bhuban Formation of the Surma Group of rocks is well exposed in the Kaptai to Baraichari road cut section, Sitapahar anticline, Kaptai, Chittagong Hill Tracts, Bangladesh. The main goal of the study is to delineate lithosequences, facies association, depositional model and interpret of different sub environment of the sedimentary deposits of the study area. Litho-stratigraphically the Middle Bhuban Member consists of mainly light gray to black laminated to thinly bedded shale, sandy shale and siltstone and the Upper Bhuban Member of yellowish brown and dark color sandstone, silty shale and black shale. The Lower Bhuban Member is not exposed in the investigated area. Based on texture and sedimentary structures, a total of six lithofacies have been identified such as turbidite sandstone (ST), lenticular laminated sandstone -siltstone-silty shale (Sll), ripple laminated sandstone-siltstone (Sr), wavy laminated sandstone-siltstone-silty shale (Sw), wavy laminated silty shale to shale (Fw), laminated shale (Fl) with subfacies black shale (Flbk). On the basis of genetic aspects, the facies association is grouped into (1) turbidity generated and (2) deep marine basin plain facies association. The turbidity generated facie association consists of ST (complete or incomplete) with or without Sll, Sr, Sw and Flbk. The deep marine basin plain facies association is characterized by Flbk with Sr, Sll, Sw and Fw. The complete ST sequence exhibits channelized forms, since incomplete ones have been identified as channel or interchannel deposits in medial to distal fan. The facies Flbk denotes deep marine environments above and below the carbonate compensation depth, where the lithofacies facies Sr, Sll and Fw were deposited as distal turbidites. The depositional model suggests that the depositional environment of the Upper Bhuban Member and Middle Bhuban Member were in submarine fan environment and deep marine environment where sediments were transported below the continental slope.*

Keywords*: Bhuban formation, Lithofacies, Facies association, Depositional model, Environment of deposition.*

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I. Introduction

The Tertiary and Quaternary sediments are well exposed everywhere throughout Bangladesh but Tertiary rocks including the Surma Group (Surma and Bokabil Formation) are very common in Sylhet and Chittagong and the Chittagong Hill Tracts. The Surma group of rocks is well founded lithostratigraphic unit in the Bengal Basin, the Chittagong Hill Tracts of Bangladesh (Evans,1932; Krishnan,1960; Khan and Mominulla,1988; Wadia,1989; Khan,1991; Kumar,1992; Reiman,1993). The Bhuban and Bokabill Formation of the Surma Group is comprised by the gray to brownish gray massive sandstone-siltstone with black shale, yellowish gray to light yellow medium to fine grained graded-flat bedded-rippled-parallel laminated sandstone with conglomerates and yellowish gray sandstone-siltstone with gray to bluish gray colored mudstone (Khan, 1991; Reimann, 1993; Gani and Alam, 2003; Ahmed and Zaher, 1980; Evans, 1932; Krishnan, 1960; Khan and Muminullah, 1988; Wadia, 1989; Kumar, 1992; Akhter and Bhuiyan, 1998). The deposition of upper Bhuban Member is significantly sub marine fan deposit (Roy et al., 2006; Roy et al., 2007). So, the Tertiary sequence of the Chittagong Hill Tracts and encompassing territories has been broadly studied. But no detailed sedimentological study of the Surma Group of rocks especially Bhuban formation in Sitapahar anticline of Kaptai Upazila has yet done, although sandstone-siltstone in this group form the reservoir rock for the natural gas of the country. So, in the present research work an attempt have been undertaken to study lithofacies and environment of deposition of Kaptai to Baraichari road cut section, Sitapahar anticline, Kaptai Upazila, Chittagong Hill Tracts, Bangladesh.

Geographically the study area lies along the Kaptai-Rangamati-Chittagong metalized road and its adjacent areas around the northern part of the Sitapahar anticline hill range. The Sitapahar anticline is about

70km (N-S) long and 12Km (E-W) wide and bounded within 22°22´N to 22°32´N latitude and 92°05´E to 92°18´E longitude (Fig. 1).

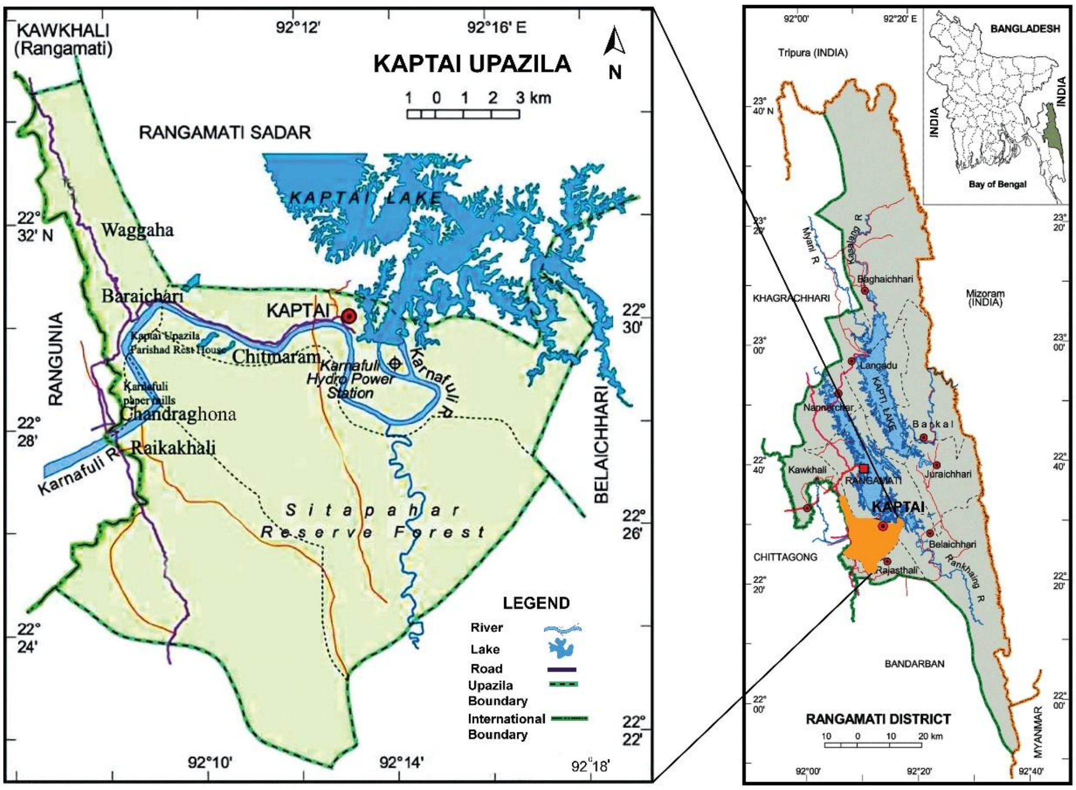

Figure 1: Location map of the study area.

II. Geological Setting And Stratigraphy

The Bengal Basin located at the junction of the three plates Indian plate, Tibetan (Eurasian plate) and the Burmese sub-plate is result of a number of different tectonic activities within the Indian plate that shows variation in the basin fill history within the geotectonic provinces as accounted by Alam et al., 2003. Sitapahar anticline is one of the prominent anticlinal structures in Bengal Basin which is located in the eastern folded belt of the country. It is about 1920 feet elevated (maximum) but from the top towards the study area the elevations are gradually goes down. The anticline is 40km long and its steeper western flank is overturned in some places. It lies between the Ischamati syncline in the west and the Rangamati syncline in the east, while Bandarban anticline is located on the south. The regional strike runs in the NNW-SSE direction. The trend of the axis of the anticline is about N28ºW-S28ºE. The amount of dip of strata varied from 10º-65º towards south-west, occasionally which rises to 82º. The rock sequences of the Bhuban, Bokabill, Tipam Sandstone, Girujan Clay, Dupi Tila, and Dihing Formation are exposed in this anticline (Mominulla, 1978; Reimann, 1993; Kabir, 2006). According to Mondol et al., (2002) two thrust faults are present in the area Chondraghona-kaptai road-cut section in the western flank of the Sitapahar anticline. No major fault was observed in the study but a number of micro fault were found in Silchari and it was situated in (600-700)m north of the road from Silchori Bazar which was dipping towards west. The unconformity was local in nature. But, the unconformity between the Lower Bokabill and the Upper Bhuban formation was not clearly observed. The main channel of the drainage system in the area is Karnafuli River. The coarses of most of the significant tributaries are parallel to the main range in which trending NNW-SSE and appeared to be controlled by structural trend of the area. The geologic map Kaptai-Chandraghona road cut section of the Sitapahar anticline with exposures of the Tertiary sediments is given Figure-2.

Good exposures of the Bhuban Formation were identified along the stream cut valley, road foot path cut section and hill slope of the Silchari-Baraichari section (western and eastern flank). Based on the color, gross lithology, geomorphology and genetic inference, lithostratigraphically Bhuban member can be divided into two members: middle and upper. The Lower Bhuban Member is not exposed in the study area. The Middle Bhuban Member comprises with light gray to black laminated to thinly bedded shale, sandy shale and siltstone and the Upper Bhuban Member with yellowish brown and dark color sandstone, silty shale and black shale. The rock sequences often show lateral and vertical variation, the stratigraphic succession of the area is given in the following Table-1.

Table 1: Stratigraphic succession of the study area of the Sitapahar anticline.

Formation	Member	Lithologic Description
Bokabill		Black or, dark grey colored shale which is highly splintery, is present. Shale are conchoidal in fracture and cementing materials are calcareous. Yellow or, greyish white color sandstone which is medium to fine grained with ripple cross bedded present. Cementing materials of sandstone are calcareous and bidirectional cross bed are also present. Greyish yellow or, greyish white siltstone present with alternated laminated stratified bidirectional paleocurrent present.
Bhuban	***Upper**	Alteration of sandstone silty shale and shale. Dark color medium to fine grain calcareous very hard and compact ripple cross laminated sandstone and turbidity current generated sandstones are present. Bluish to blackish shale with parallel to way lamination. They are non-porous and non-permeable with splintery shale are also present in the unit. Yellow to light yellow siltstone with lenticular to wavy lamination present. Ripple cross lamination of siltstone are also exposed in the studied unit. Rounded to sub-rounded cementing materials argillaceous and calcareous laminated and blackish color silty shale present.
	***Middle**	Mainly shale with subordinate sandstone and siltstone. Black thinly laminated shale with lenses of sandstone and siltstone, which are grayish white. Bluish gray to gray massive and variously stratified sandstone.

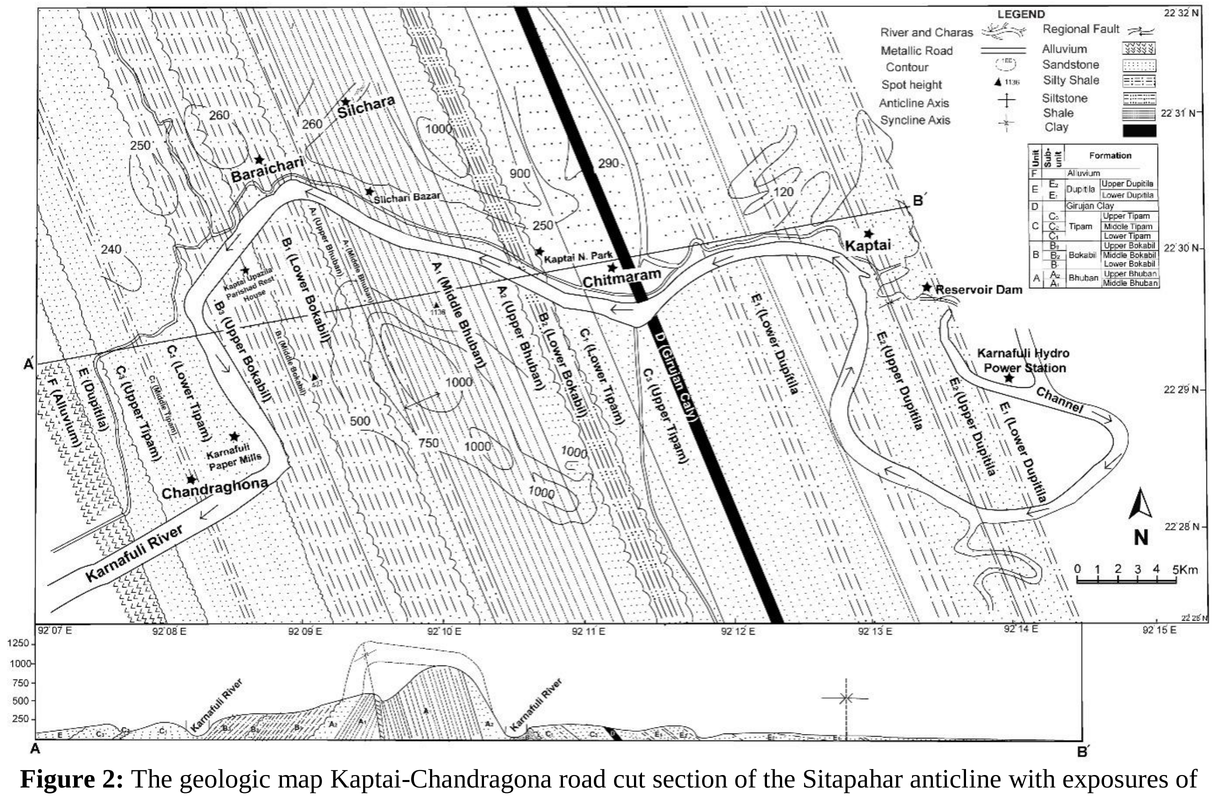

Figure 2: The geologic map Kaptai-Chandragona road cut section of the Sitapahar anticline with exposures of the Tertiary sediments.

III. Material And Methods

A detailed field work was carried out along the Kaptai to Baraichari road cut section and river-tributary section by compass clinometer traverse method. Distinctive type of materials such as base map, measuring tape, knife, clinometers, pocket lens, camera, pen, pencil, eraser, hard board, note book and pickle etc. were utilized to accomplish the research of the investigated area. The thickness and attitude of beds and sedimentary structures are measured by using measuring tape and clinometer. During field session, the investigated area was divided into some section such as Silchari section in western flank and eastern flank. After that the lithologs of various stations were studied well by necked eye, pocket lenses. The cementing materials was observed by using HCl and all the information were clearly noted in the field notebook. Based on color, texture, bedding and different types of sedimentary structures, various types of lithofacies were identified in the study area. Afterwards thethickness of lithofacies were measured and named and coded following the facies classification schemes of Miall (1978) and Rust (1978).

IV. Results And Discussion

4.1 Sedimentary lithofacies

Facies analysis of Bhuban Formation was carried out along the Kaptai to Baraichari road cut section (western and eastern flank) using the modified version of Miall (1978) and Rust (1978) lithofacies classification scheme. A total of six lithofacies have been identified in the investigated area based on color, texture, bedding and different types of sedimentary structures (Table-2). These lithofacies have been genetically group into two facies associations: (1) turbidity generated and (2) deep marine basin plain facies association.

Table 2: Lithofacies scheme observed of the Upper and Middle Bhuban Member along the Silchari to Baraichari road cut section, Sitapahar anticline, Kaptai, Chittagong Hill Tracts, Bangladesh.

Facies code	Sub facies code	Lithofacies	Texture	Sedimentary feature	contact	occurrence	Interpretation
Fl	**F_{lbk}**	Black shale	Clay with few very fine silt	massive	sharp	In both below and above CCD and abyssal plain.	Deep marine environment.
Fw		Very fine silty shale to shale	Clay with silt	Massive with occasionally	Sharp	Shallow marine to tidal flat and/or deep marine.	Inter tidal to shallow marine environment overlapping lenses or ripples.
Sll		Lenticular laminated sandstone-siltstone- shale	Very fine sand to silt within clay	Lenticular lamination	Sharp	Starved ripple in mud dominant environment and/or marine.	Product of ripple movement alternating with mud deposition tidal flat environment.
Sw		Wavy laminated sandstone siltstone silty shale	Very fine sand, silt to silty shale	Wavy lamination	Sharp	Tidal flat	Product of ripple movement in lower flow regime with slack water condition.
Sr		Ripple cross-laminated sandstone-siltstone	Fine sand to silt	Ripple lamination current or wave generated	Sharp	Small scale 2D and 3D ripple.	In abandoned part of channel, shallow and crevasse channel, tidal flat at shallow water environment.
ST		Turbidite sandstone	Medium to fine sand	Graded- flat -ripple-parallel bedding/ lamination, complete or incomplete	Gradational to erosive and sharp	Channel fill, shallow scour fill and flat based turbidites	Complete or incomplete turbidite of Bouma sequence, mostly in distributary channel fill in submarine fan.

Description of different types of lithofacies

4.1.1Turbidite sandstone facies (ST)

Turbidite sandstone facies is well exposed in the investigated area. The lower contact of this facies is erosive to sharp yet Upper contact is sharp to gradational. The sandstone bodies happen alternately with black shale. Locally Upper contact is observed gradational with steel gray shale. This facies is characterized by complete as well as incomplete turbidite sequence, formed of graded bedded sandstone (Ta), flat laminated sandstone (Tb), ripple cross laminated sandstone (Tc) and sand-silt alteration with faint parallel lamination (Td).

This facies is generally gray to grayish brown having medium to very fine grain sandstone with occasional siltstone (Fig. 3a and 3c). In shale dominant middle part, sandstone and shale are monotonously interbedded where sandstone beds are flat top and bottom with little scouring. Sandstone beds have sharp base and tend to grade upward into finer sandstone, siltstone and shale.

Interpretation

Generally sandstone bodies structured by graded bedding, flat lamination and ripple cross laminations which graded upto fine grained sandstone, siltstone and shale have been reported in classical turbidite of Bouma sequence (Bouma, 1962). The Upper Bhuban Member is characterized by more incomplete Bouma sequence than one complete. The facies displays a deposition by turbidite current in marine condition underneath the continental slope. When there is a higher amount of deposition from suspension during rippling, climbing ripple cross lamination will form (Reineck and Singh, 1980).

4.1.2 Ripple laminated sandstone-siltstone facies (Sr)

Ripple and ripple cross laminated sandstone-siltstone lithofacies comprises of grayish white to yellow color fine grained sandstone (Fig. 3a, 3b, 3e and 3f). This facies is likewise a predominant lithofacies in the investigated area. Ripples are asymmetric in profiles and sinuous crested, mostly lingued and lunate in nature. Current or wave generated ripple lamination are also found in the study area.

Interpretation

Ripple laminated sandstone-siltstone facies formed because of migration of small scale 2D and 3D ripples in lower flow regime (Jopling and Walker 1968). It happens shallower part of the thalweg of the small channel. This type of facies deposited in abandoned part of channel, shallow and crevasse channel of turbidity current origin in marine environment.

4.1.3 Wavy laminated very fine sandstone-siltstone- silty shale facies (Sw)

In this facies shale and sand-silt layer alternate and form consistent layers. The predominant color of this facies is grayish white, light yellow and yellowish brown of medium to fine grained sandstone and siltstone (Fig. 3b). The observed color of shale is bluish gray to dark gray in the study area. Vertical accretion of sand, silt and clay of this facies may sometimes able to be named as vertical accreted sequence.

Interpretation

The rhythmically wavy laminated facies might be the product of tidal flux (Reineck, 1968) which is more precisely characterized as tidal bedding or lamination. However, starved ripples were also found within shale. The occasional bidirectionality is due to reversible flow of deep sea current. The very fine sand, silt, laminae were deposited either by strong current and shale laminae were the result of suspension followed in deep marine environment, which is domain of shale deposition. The main environment of this facies are subtidal zones and intertidal zones (Reineck et al., 1968).

4.1.4 Lenticular laminated sandstone-siltstone-silty shale facies (Sll)

The Facies is comprised by very fine sandstone to siltstone embedded within shale or layers and yellowish gray to grayish white in color. Generally these lenses are ripples, but mostly current generated where lenses are few mm to few cm thick and shale layers encompass these lenses (Fig. 3e). Notwithstanding, some are wave generated. This facies is consisted of sand lenses within the black shale alternating with mud layers repeatedly over a longer distance in space and time. This kinds of facies is sometimes highly bioturbated.

Interpretation

This facies is deposited by slack water condition while mud is deposited. Foreset laminae of current ripple or wavy ripple made the sand silt layer. It also demonstrates the absence of abundant supply of coarser clastic to generate continuous lamination. Therefore, the environment of the formation of this facies comprises of subtidal to deep environment (Reineck and Wunderlich, 1968) and also deep sea (Jenkyns, 1986; Shanmugam, 2000). This type of facies likewise exhibits distal turbidite deposits within anoxic pelagic environment.

4.1.5 Wavy laminated very silty shale to shale (Fw)

This facies is formed by shale having wavy laminated sedimentary structure which is dark gray to blackish gray in color (Fig. 3c). The bed contact of this facies is more or less sharp which normally overlies lenticularlaminatedsandstone-siltstone facies.

Interpretation

Wavy laminations are produced by the draping of the underlying ripples or lenses (Reineck and Sigh 1980; Reading and Collinson 1996). This facies shows calm and quiet condition. Mud can also deposit along with sand and silt, which is commonly observed in shallow marine environments (Boggs, 2001).

4.1.6 Laminated shale facie (Fl)

This facies includes black shale sub facies (Flbk). The Black shale facies is described below-

Black Shale Facies (Flbk)

Black shale facies (Flbk) is exposed most abundantly and covers around 80 percent of the middle Bhuban Member (Fig. 3e, 3d and 3f). Inside this facies a few number of shallow preserved channels of 2 to 4 m wide and 0.05 to 2m deep have been noted. These scale scours are occupied by very fine grained sandstone to siltstone. Calcareous concretionary bodies are locally present, and most of which are spheroidal, ellipsoidal, disc shaped. In the study are most of the shale are slightly calcareous to non-calcareous. The thickness of shale zone ranges from few centimeters to several meters.

Interpretation

In the study area,black shale which shows calcareous as well as non-calcareous nature, recommend that it was deposited both above and below the carbonate composition depth (CCD), a depth below in which carbonates are fully dissolved (Hesse, 1975). The appearance of graywacke nature of interbedded sandstones, dolomite and chert, glauconite, and black to dark color of shales indicates the shales are pelagic and hemipelagic type. These types of shales were deposited in deep marine environment, especially in bathyal and abyssal plain (Bouma, 1962; Mutti, 1977; Hesse, 1975; Jenkyns, 1986). Again, the alteration of course (interbedded with fine grain sand facies as Sll, Sw) and fine (shale as Fl facies) over a considerable vertical distance is the characteristic features of fine grain turbidite and hemipelagite-pelagite sequence (Stow, 1986; Rayhan and Mostafa, 1999).

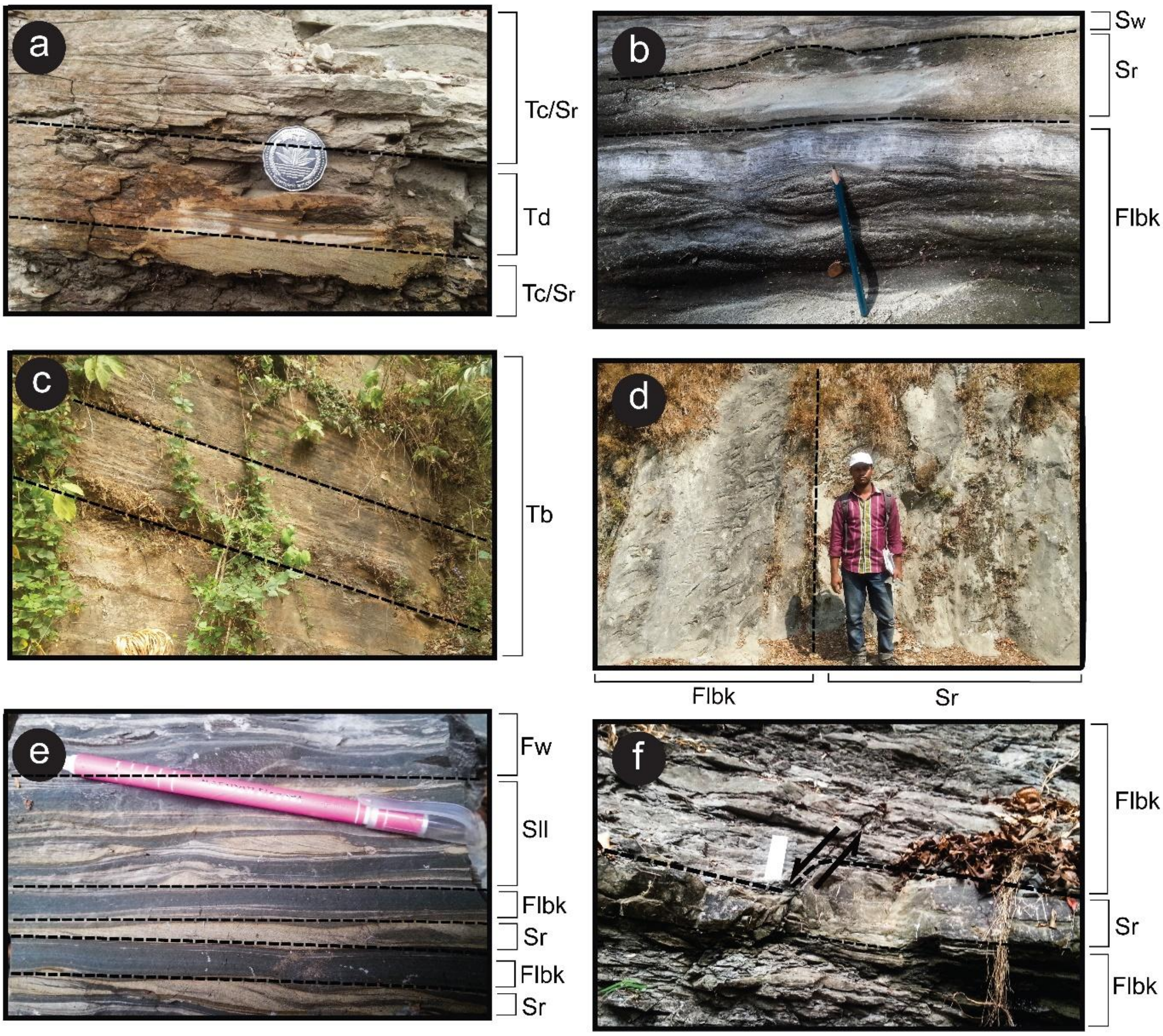

Figure 3: The field photographs show different types of sedimentary facies. (a) A turbidite channel filled by ripple laminated white to yellow color fine grained sandstone (Tc) and parallel laminated gray to light yellow sandstone (Td) of the Upper Bhuban Member, Kaptai-Rangamati road cut section, Kaptai, Rangamati Hill District. (b) An alternating zone consisting of wavy laminated very fine sandstone-siltstone-silty shale facies (Sw), ripple laminated sandstone -siltstone facies (Sr) and laminated black shale facies (Flbk) of the Middle Bhuban Member (western flank) at Silchori river bed section, Kaptai. (c) A series of flat bedded yellowish gray sandstone (Tb) channelized body of the Upper Bhuban Member, Chitmaram, Kaptai. (d) Dark color, calcareous very hard and compact Ripple cross laminated sandstone facies (Sr) and black shale facies (Flbk) of the Upper Bhuban Member (western flank) along the opposite side of Zoom Restaurant, Kaptai. (e) Wavy laminated silty shale to shale facies (Fw), lenticular laminated sandstone-siltstone-silty shale facies (Sll), black shale facies (Flbk) and ripple laminated sandstone-siltstone facies (Sr) of the Middle Bhuban Member (eastern flank) along (600-700)m north of road from Silchori Bazar, Kaptai. (f) The photograph shows micro fault, ripple laminated sandstone-siltstone facies (Sr) and black shale facies (Flbk) of the Middle Bhuban Member along (600-700)m north of the road from Silchori Bazer, Kaptai, Rangamati Hill District.

4.2 Facies association

Facies association is a combination of facies which happens together. Generally it is considered to be genetically or environmentally related and as a result of making more information than a facies in isolation from neighbors (Walther, 1894; Reading, 1986; Blatt et al., 1980; Reading, 1986; Miall, 1988). Therefore, the facies analysis is the most essential to all environmental interpretations as well as paleogeographic reconstruction (Miall, 1985, 1990 and Boggs, 2001). On the basis of color, texture, bedding and different types of sedimentary structures, the facies can be classified as two facies association which are described as follow:

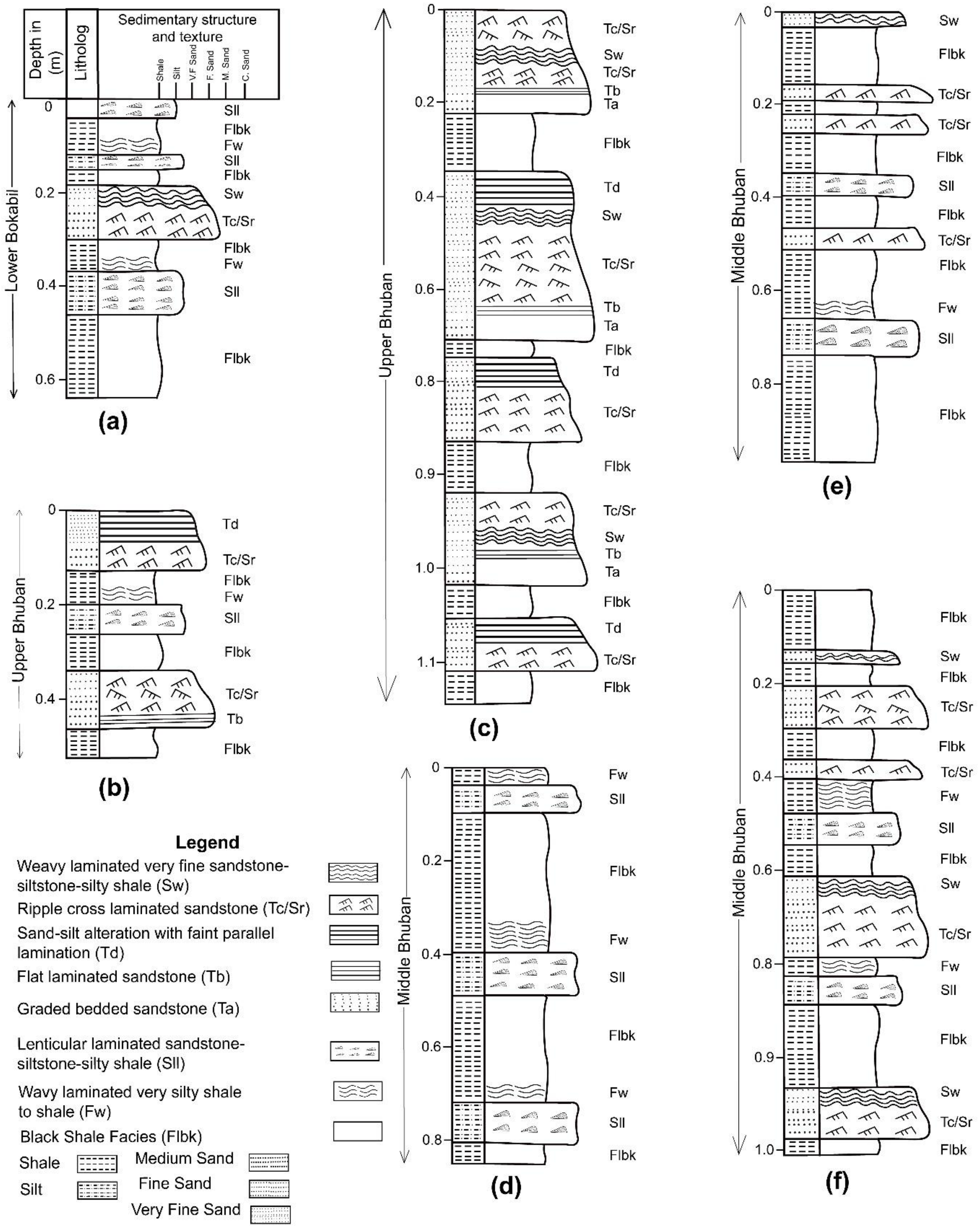

Figure 4: Vertical Lithosuccession of Exposed Rock Sequence of Bhuban Formation of the Silchari to Baraichari road cut section (western flank-a, b, c and eastern flank-d, e, f), Sitapahar anticline, Kaptai, Chittagong Hill Tracts, Bangladesh.

4.2.1 Turbidity generated facies association

This facies association is well exposed in all the studied litho-succession of the Upper Bhuban Member. This facies association is formed by the facies ST, Sll, Fw and Flbk. The lower contact of this facies is erosive, on the other hand upper contact is gradational with gray shale. This facies association isordinarily constituted from bottom to top by graded bedding (Ta), flat laminated sandstone (Tb) ripple cross lamination (Tc), faint parallel lamination (Td), black shale (Flbk), lenticular laminated siltstone-sandstone (Sll) and wavy laminated shale (Fw). Grain size varies from medium grain sandstone to siltstone and the color of the facies association is normally bluish gray to brownish gray.

4.2.2 Deep marine basin plain facies association

The constituent facies of this association are predominantly black shale (Flbk) with ripple laminated sandstone-siltstone facies (Sr/Tc), lenticular laminated siltstone-sandstone facies (Sll), wavy laminated very fine grain sandstone- silty shale facies (Sw) and wavy laminated shale (Fw). Monotonous shale with a regular arrangement of hemi-pelagic sediments indicates deep marine sedimentation and pelagic shale with some silty stringers indicates the submarine basin plain facies association. The shale are mostly suspension fall out in submarine basin plain as hemipelagic and pelagic sediments.

4.3 Facies model

Facies model is an ideal norm or figure remains all the common character of local example wherever we studied the facies sequence. In the lithosuccession, facies is classified into two facies association for gaining more information on paleoenvironmental condition. It also assists to reconstruct two types of facies model in the studied Upper Bhuban Member and Middle Bhuban Member which are repeated the whole lithosuccessions. Firstly, the facies model is consisted of fine to medium grained sandstone and siltstone which is comprised of complete or incomplete turbidity generated facies sequence with little amount of black shale and gray shale (Fig. 5a). Secondly, the facies model is deep marine basin plain sediments interbedded with some distal turbidites and where black shale is pelagite and hemipelagite types (Fig. 5b). This is pretty much similarity persevering with the turbidite dominated facies model in the Upper Bhuban Member in the study area. It demonstrates that the coarse and fine alternation of the turbidity generated and deep marine basin facies association are repeated throughout during the life span of the deposition of the member. It also exhibits progradation and receeding phases of submarine fan development within the deep marine basin plain environment because of instability of the basin floor and relative sea level change (Posamentier et al., 1988). The paleogeography was occupied by distal fan and deep marine basin plain repeat and randomly occur one upon suggesting slope instability along basin margin formed probably by faulting along Dauki in Meghalaya-Sylhet border and adjoining area accompanied by sea level fluctuation (Fig. 6).

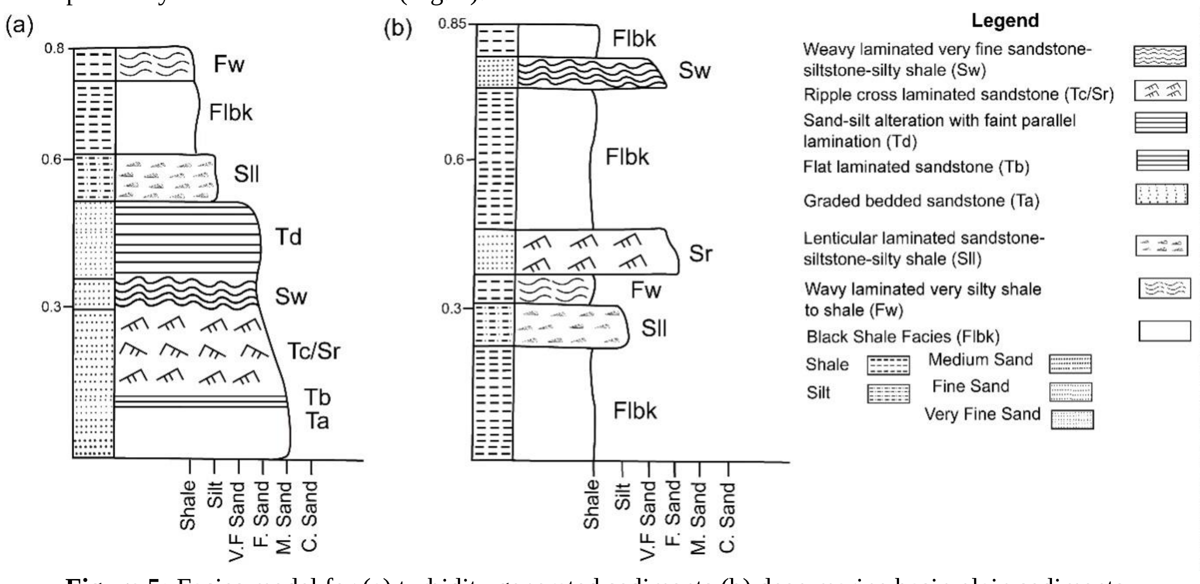

Figure 5: Facies model for (a) turbidity generated sediments (b) deep marine basin plain sediments.

4.4 Environment of deposition

The facies association of the Upper Bhuban Member is turbidity generated which is interbedded with medium to fine grain sandstone (ST) and with or without Sl, Sr and or Sll/Fw facies. The complete Bouma sequences demonstrate channelized forms of sandstone, when incomplete sequences have been distinguished as channel or interchannel sandstone such as levee deposit. Some channels show shallowing nature which indicate their origin from overtopping and crevassing of the close by levee. The bed thickness of sandstone, grain size and erosive features decline from distal fan to deep marine basin plain. The facies ST (complete or incomplete) along with Sr indicate their deposition by turbidity current in more distant medial to distal fan environment

(Stow, 1986; Shanmugam, 1980; Alam et al., 2003; Roy et al., 2006). Moreover, the depositional model also suggests that Upper Bhuban Member was deposited in sub marine fan environment.

The Middle Bhuban Member is constituted mainly by black shale (Flbk) interbedded with Sw, Sr, Sll, and Fw facies. The less distinct facies like Tc, Td, Sll, Sw and Fw in shale dominated marine basin plain facies association indicates turbidity generated rhythms in the marine environment (Shanmugam, 1980). Again the shales show calcareous as well as non-calcareous nature which may be comprised of dolomite and chert, glauconite, Illite, mica and feldspar indicating their deposition in deep marine environment, particularly in bathyal and abyssal plain (Bouma, 1962; Mutti, 1977; Hesse, 1975; Jenkyns, 1986). Moreover, the thin paper like laminated shale demonstrates calm and quite environment and deposited in deep marine environment (Roy et al., 2006; Haque 2001, Stow 1986). So, on the basis of all information, the depositional environment of the Middle Bhuban Member in the study area was deep marine with progradation and reseeding phases of submarine fan development underneath the continental slope, and that are alternated by shale predominated deep marine basin plain deposits because of sea level change and tectonic activity with short temporal and spatial sense.

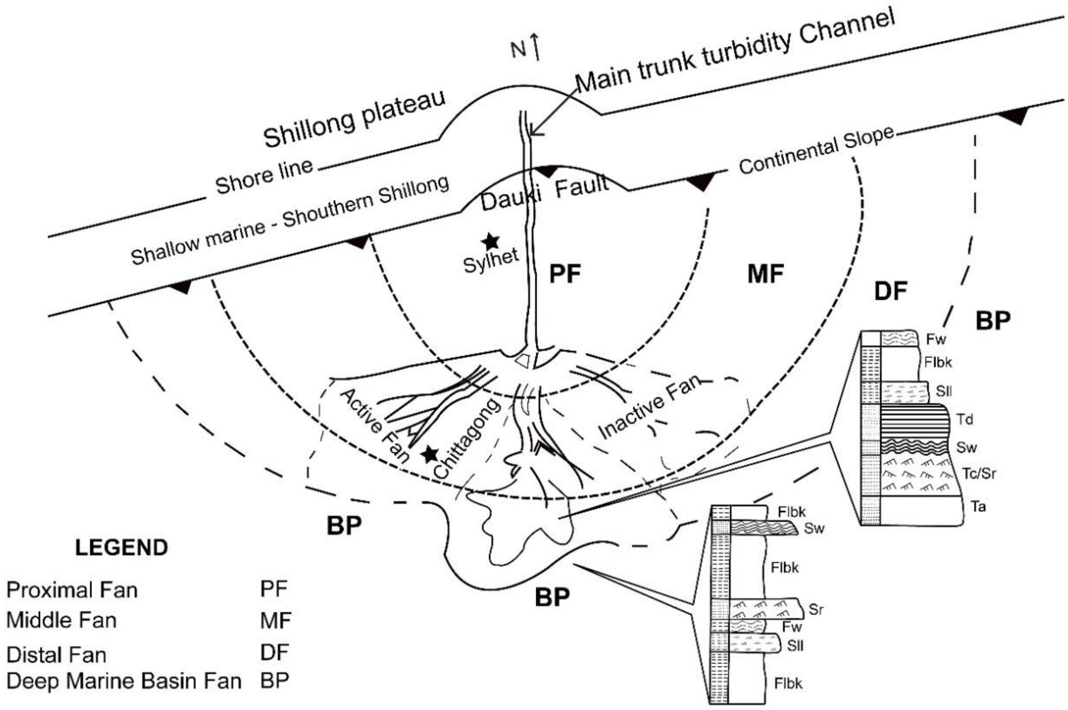

Figure 6: Schematic depositional model of the Bhuban Formation of Sitapahar anticline, Kaptai, Chittagong Hill Tracts, Bangladesh.

V. Conclusions

The Bhuban Member of rocks are well exposed in the Sitapahar Anticline, Kaptai Rangamati Hill District, Chittagong Hill tracts. Structurally the study area is an asymmetric plunging anticline with steeply dipping western flank and gently dipping eastern flank which has trend of NNE-SSW. Lithofacies analysis of the Bhuban Member of rocks are carried out to interpret its depositional environments. Based on the lithology, texture, internal sedimentary structures, boundary conditions, six major lithofacies are identified in the study area which are ST, Sr, Sw, Sll, Fw and Fl with subfacies Flbk. Genetically these facies are group into two facies association which are turbidity generated facies association and deep marine basin plain facies association. The turbidite generated facies association comprises mainly turbidite sandstone facies (ST) along with Sll, Sr, Sw, Fw and Flbk facies indicating medial to distal submarine fan environment. The deep marine basin plain facies association consists of mainly black shale facies (Flbk) with Sw, Sr, Sll and Fw facies suggesting deep marine environment. The facies sequence comprising of medial to distal fan and deep marine basin plain were done repeatedly and set side by side randomly one upon other, which is seemed to be formed because of slope instability along basin margin formed presumably by faulting along Dauki and adjacent area accompanied by the fluctuation of sea level.

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