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Study of lithofacies from Barail group of rocks in and around Sonapur, South Jaintia Hills district, Meghalaya

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Abstract

The different types of lithofacies have been studied from Barail Group of rocks occurring in and around Sonapur, South Jaintia Hills District, Meghalaya.

The overall generalised litholog of the area has been constructed after detailed investigation. The lithofacies consists of Sm, Sh, St, Sr, Fl Fm etc. The lithofacies successions are characterised by the presence of a couple of fining upward sedimentation cycles.

The present study gives a picture of the distribution of various facies as well as the water level conditions throughout the area. A hypothetical sedimentation model constructed for the generalised sedimentary sequences suggest rapid sedimentation and high energy conditions for the basal-stratification, through cross-strata, rippled strata, finely laminated silts, muds etc. indicating deposition in the wanning stages of a flood.

Facies observations indicate that majority of the sequences towards the base may be a product of braided river condition. The abundance of massive and horizontally stratified sands suggest the presence of an upper flow regime. The laminated fine sands along with muddy layers may also be interpreted as sediments filling abandoned chute channels. These chute channels are active only at the flood stage and these were the sediments deposited mainly from suspension mainly as overbank facies.

The sedimentary characteristics and presence of both wave and current formed structures like ripple-marks and current beddings and suggestive of intertidal sandflat origin, where bedload transport under tidal action dominated over slack water (suspension) depositions.

Key words : Lithofacies, Barail Group, Sonapur, Jaintia Hills District, Meghalaya.

Introduction

The study area constitutes approximately 25 sq. kms. (Toposheet no. 83C/8). In the scale of 1 : 50000, it is bounded by the geographical parameters of $25°09^{/}19^{//}$N - $25°11^{/}03^{//}$N and $92°26^{/}20^{//}$E - $92°27^{/}09^{//}$E. Spread out at a distance of one and half hours from Silchar towards north-west wards along National Highway no. 44, the present study area is a part of the greater Barail Range of hills and as such it exhibits a very undulating topography. (Fig. - 1).

The present area of study falls in the early Tertiary geosynclinal margin running along the southern extension of the Shillong Plateau. The rock exposures are predominantly arenaceous with alternations of small to moderate shale bands with occasional development of carbonaceous shale and coal streaks.

The sandstones show both massive, and well laminated character. The individual beds are 5-30 cm thick, comprising friable to massive, fine to medium grained, grey to brownish grey coloured. Thin internal laminations, sinous and straight crested ripple marks, are observed at places along with planar to trough cross stratifications. The general strike trends of the lithoassociations are NE-SW with moderate to high dips (30°-41°) towards SE. The sandstone layers show blocky as well as slabby bedded features are fining upward character towards the shaly contact. The sandstone - shale alternations towards the base grade upward into bedded sandstones with thin shaly interbeds near the top. Overall, it is also seen that the coarseness of the sands increase south easterly. Overall, the fining upwards characteristics of the lithoassociations look to be seasonal increments. It is also seen that the blocky bedded character of the arenaceous rocks prevail wherever the organic content is less or nil. The fine units are mostly thin and slow pinching and swelling character in patches hosting fine grained sandstones. Such zones show discrete sedimentary structures like cross-laminations, ripple marks and convolutions. Carbonaceous shales can be distinguished from the shaly bands by their darker colour and pyritiferous specks. Sproradic coaly specks with lower earthy lustre suggest coalification activity in patches. Fossillic contents are very sparse or rare[3].

The generalised lithostratigraphic succession of the study are is as follows :

AGE	GROUP	FORMATION	
Recent		Soil / Alluvium	
- - - - - - - - - - - - - - - - -	Unconformity	- - - - - - - - - - - - - - - - - - -	
Miocene	Surma	Bhuban	(south)
- - - - - - - - - - - - - - - - -	Unconformity	- - - - - - - - - - - - - - - - - - -	↑
Oligocene	Barail	Laisong	
Eocene	Jaintia	Kopili	(north)

Lithofacies :

A sedimentary rock is not only a product a specific transport history but it is also a product of the environment of deposition. The sole task is to decode these imprints from the clasts. There have been many ways devised for reading and understanding the 'clasts' history and , lithofacies analyses is one of them is one amongst them. A sedimentary facies is mass of sedimentary rock which can be defined and distinguished from others by its geometry, lithology, sedimentary structures, palaeocurrents patterns, fossils etc. A sedimentary facies is the product of a depositional environment. The key to the interpretation of facies is to combine observations made on the spatial relations and internal characteristics-lithology and sedimentary structures. A genetical explanation for an ancient phenomenon is always made by an analogy with that of the modern happenings.

Methods of Study :

At each exposure, individual lithounits were identified based on gross lithology, sediment texture (grain size) and, sedimentary structures in detail. On the basis of observational physical characteristics, each bed was given a facies name and a symbol following the lithofacies code scheme of Miall[9] with inputs also from Walker[16].

The overall generalised litholog (Fig. 2) of the area has been conducted after detailed investigation and correlation of a number of vertical sections dispersed in the area of investigation.

lithofacies Description :

Considering the genetical implications, even the smaller discernible lithounit characteristics are enlisted below -

I. Massive Sandy facies (Sm) :

The lithofacies consists of sand without any distinct bedded features or stratification. Composed of fine grained sands, these are seen as thicker units (thickness seen upto 20 metres) and also as small lenses within the shaly layers.

These may be interpreted as a product of sediment transportation in planar sheets under very high energy conditions or deposited as seasonal loads[4,5]. The possible causes of the massiveness are water draining during compaction, rapid sedimentation, strong generation of gas bubble and grain flow.

II. Horizontal stratified sandy facies (Sh):

The horizontal stratified sandy facies is developed both in the lower and upper parts of the exposed litho-logs. Laminations show some irregular undulations due to parri-passu sediment deformation. Number of dark lamina are less than that of the light laminae. Beds of this facies are usually continuous across the width of the outcrop and they commonly overlie and underlie the facies Sp and St. They show the maximum thickness of 28 metres which is highest amongst all the other lithofacies units of the present area.

Horizontal stratified facies can develop under two contrasting conditions - in shallow water and during the flood[9]. Horizontal stratified units with fine sands in the lower part of the bed may be interpreted as sands transported in planar under high energy conditions[4,13].

III. Planar cross stratified sandy facies (Sp):

Planar cross strata occur in small scales. They are commonly associated with through cross stratification and horizontal stratification. The top and bottom contact are sharp and, these cross sets occur as single sets or cosets. The sets are usually laterally extensive. Thickness of the whole sets are on an average 25 to 30 cms whereas, the whole lithofacies unit extend on thickness upto 8 metres. Certain sets of facies Sp develop on a flat surface that truncate facies St. This unit may be thought of as a product of lower flow regime of sedimentation probably associated with ripple migration. The Sp facies shows widespread development in braided river deposits (Cant and Walker, 1976). The forests were covered by gradually waning flood events[10].

IV. Trough cross stratified sandy facies (St):

Facies St is composed of apparently massive to poorly defined cross bedded sandstones with depth of trough ranging upto a maximum of 3.5 cms. Trough cross stratification occur as cosets with the trough being regularly stacked. Composed of moderately to poorly sorted medium to fine grained sands, the cross strata are truncated to the top set and are at an angle with the bottomset. In certain patches, the top portion looks erosional. The stratification is poorly defined in many cases due to poor sorting as well as lack of fine material needed to show up the cross strata. Scattered granules and pebbles, occur at the base of some troughs. They show a maximum thickness of 3 metres.

The trough cross strata is mainly the result of scouring of channels due to sediment laden flood water that filled them as flood power decreased[5]. The small scale trough cross stratification may be the result of infilling of circular or elliptical shaped scours connected with migration of tongue shaped lingoid current ripples. (Beck and Koster, 1972). Overall, they are a product of lower flow regime.

V. Ripple laminated sandstone (Sr) :

This lithofacies consists of both planar and cross laminated beds. The facies usually occurs on top of facies Sp and alternate with parallel - laminated sandstone (Sh). Rarely climbing ripple lamination is attached with facies Sr and wherever they are, these beds show Type-I (both lee and stoss sides being well preserved). and Type-II (only lee side is preserved) characteristics[14] (Lindholm, 1987). Transition from one type to the other cannot be worked out. Certain patches show convolution too. Thickness of this unit which depicts a low flow regime is upto a maximum of about 3 metres.

VI. Parallel laminated fine sand, silt and clay facies (FI) :

In the parallel laminated facies each lamina is parallel to the lower set of boundary. The laminations show variation in colour and are comprised of fine sand, silt, and clay.

The lamination in silt and clay are developed under suspension, in waning stages of flood[10]. This facies was developed when the flow energy was sufficient to distribute the finer sediments[11].

VII. Carbonaceous shale, Coal facies (C) :

This facies type is very rare in exposure. It is a composite of high organic matter plus mud films. A product of swampy like environment, the coaly are of low grade nature - mostly peat type.

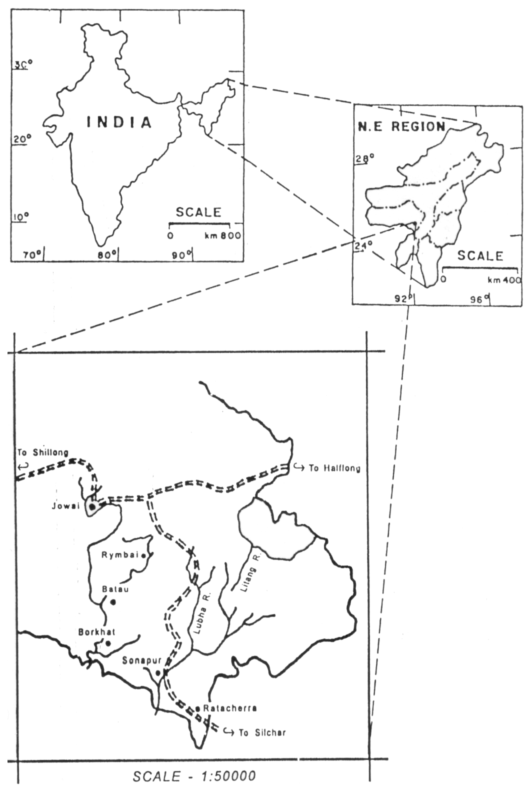
VIII. Massive to poorly laminated shale / Mudstone (Fm) :

The facies consists of apparently massive to poorly laminated shale and mudstone. Commonly alternates with facies FI, this unit is a part of the top of sequence. it contains burrows, rootlets and dessication cracks. This facies may be formed by finer sedimentation in high magnitudes in the waning flood stage.

Lithofacies Relationships, Their Implications:

The lithofacies successions are characterised by the presence of a couple of fining upward sedimentation cycles. However, a typical cycle is rarely developed. Variation in grain sizes in the different lithounits is not so sharp. Beginning of a new cycle is marked by massive to horizontal bedded sands while the top portion is covered by massive mud with organic influence.

Finning upward cycles have been projected mostly as a product of fluvial influence[2,14,10]. The basal massive sands along with the horizontal strata are products of the upper flow regime with high to moderate velocity currents of plane bed phase[6,12]. Going by the thickness of the massive and horizontally stratified sand, it appears that the upper flow regime prevailed for the longer extent of time. Cross bedded sand are believed to be formed by downstream migration of mega current ripples[1,8] under a stream flow of high intensity in the lower flow regime. Planar type is formed by down current migration of 2-dimensional ripples while 3-dimensional ones (dunes) are responsible for the trough cross stratifications. Genetically the trough cross stratification is related to lingoid type mega ripples. Harms and Fahnestock[6] points out that this morphotype in indicative of low intensity current in the low flow regime. The rippled unit is also indicative of a lower flow regime. Typically during low water stage, the river water receeds and, only a thin sheet of water with high sediment input of finer nature gets deposited. Bedform undulations in the strength of the depositional media etc. leads to the



Map : 1 (Fig. 1) Location map of sonapur

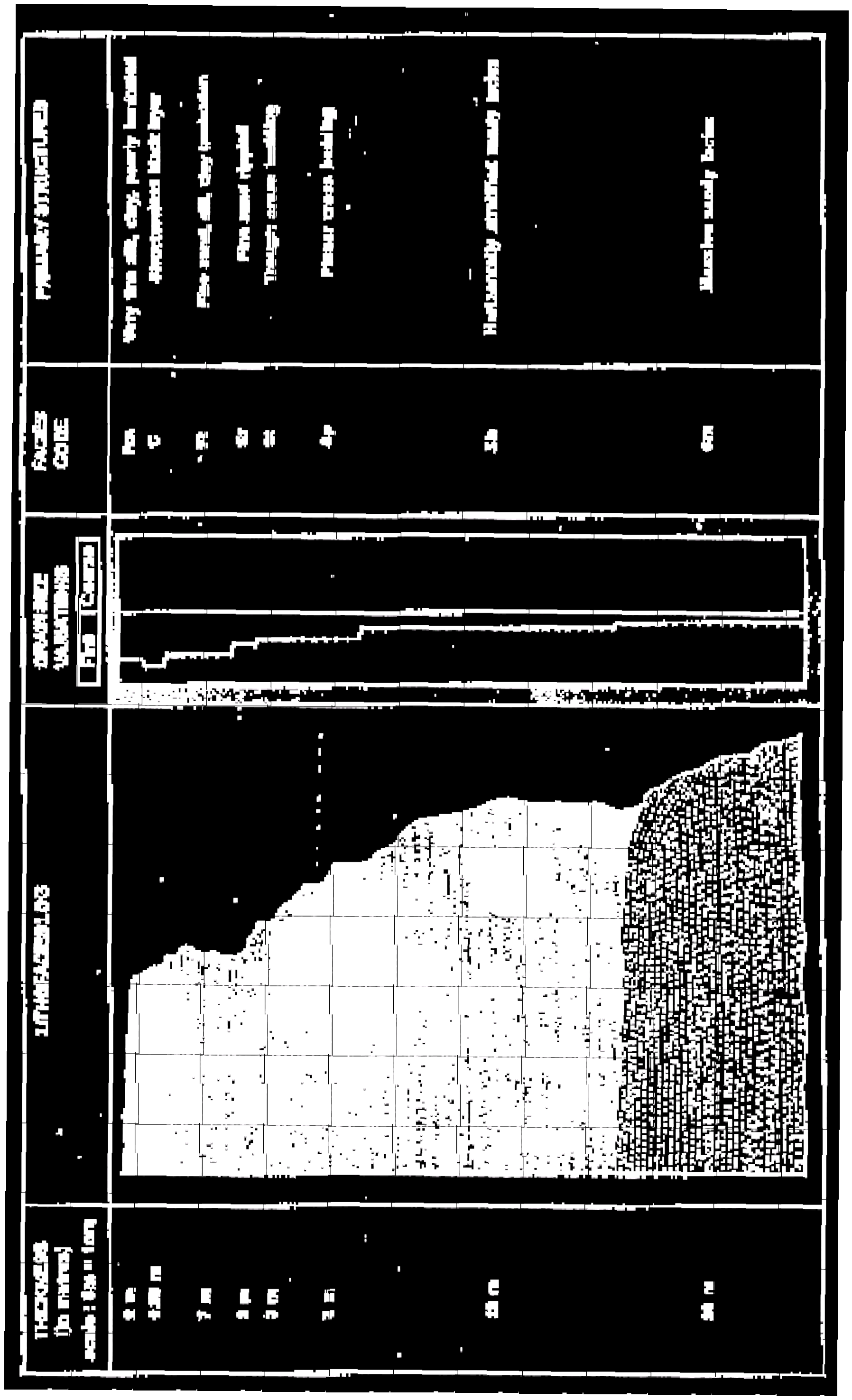


Fig. 2
LITHOFACIES COLUMN OF THE SEDIMENTARY ROCKS EXPOSED IN AND AROUND SONAPUR

deposition of the same. Massive mud layers along with very fine grained laminated sand, silt and organic materials are products of deposition in the waning stages of flood cycle mostly by vertical accretion. These layers mark the end of a flood cycle. Rare occurrences organic materials, their concentrations may be attributed to a transitory stage in the flow regime.

Localised shift of flow direction of the media lead to a swampy condition wherein high concentration of organic materials may take place. Such materials may in due course of time become a victim of the processes of coalification. In the present case, the process of coalification was incomplete and hence, only the poorest variety, *i.e.* peat type layer could be formed.

The present study gives a picture of the distribution of various facies as well as the water level conditions throughout the area. A hypothetical sedimentation model constructed for the generalised sedimentary sequences suggest rapid sedimentation and high energy conditions for the basal-stratification, through cross-strata, rippled strata, finely laminated silts, muds et. indicating deposition in the wanning stages of a flood.

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A gradual decline in the size of successive trough and planar forests in vertical order implies progressive decline in current bars, a characteristic feature of stream deposits[17,15]. The migration of small scale ripple in shallow water have produced ripple cross laminations in the sandstone. The thin occurrence of associated shale lithofacies is suggestive of rapid shifting of channel bars through space and time.

The sedimentary characteristics and presence of both wave and current formed structures like ripple-marks and current beddings and suggestive of intertidal sandflat origin, where bedload transport under tidal action dominated over slack water (suspension) depositions.

However, considering the nature of the finding of this study the present litholog of the area may also be considered to have an influence of a distributary network of channels.

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