The International Journal Of Engineering And Science (IJES)
|| Volume || 4 || Issue || 7 || Pages || PP -14-20 || 2015 ||
ISSN (e): 2319 – 1813 ISSN (p): 2319 – 1805

Study on Bedforms and Lithofacies Structres and Interpretation of Depositional Environtment of Brahmaputra River near Nemati, Assam, India.

Ajit Borkotoky
Associate Professor, HOD, Department of Geology, Dimoria College, Assam, India

ABSTRACT

The Brahmaputra river is one of the most important populated river basins of the world. The valley of the Brahmaputra occupies about 750km long depression with comparatively narrow belt having an average width of about 80-90km in Assam, India. . In the braided river like Brahmaputra many structures like bedforms and lithofacies are formed during transportation and deposition. The geological interpretation of various sedimentological structures is very essential for the understanding of depositional environment of the sediments. These interpretations can be done by detail field study of some individual structural feature that provides some clue in environmental interpretation. Lithofacies is a rock unit defined on the basis of its distinctive lithologic features including composition, grain-size, bedding characteristics and sedimentary structures (Miall,1985). Each lithofacies represents an individual depositional event. Lithofacies may be grouped into lithofacies associations or assemblages, which are characteristic of particular depositional environment (Duarah, 1999). In the field investigation the study of shape and size, distribution, vertical and lateral extensions of various sedimentary features are more important.

KEYWORDS *-Brahmaputra river, depositional environment, Lithofacies. Bedforms.*

Date of Submission: 13 July 2015 | Date of Accepted: 30 July 2015

I. INTRODUCTION

The Brahmaputra river is a braided stream and it actively migrates laterally. Because of a high amount of sediment coming during the rainy season, the river builds up channel bars which migrate actively during floods, mainly due to migration of various bedforms. Some of the channel bars and channels are abandoned during the falling stage of the river, because the channel changes its course. Sediment is rather fine grained, the median varying from 0.340 to 0.028 mm (Reineck and Singh, 1980).Coleman (1969) describes about channel bars of the Brahmaputra river. The lower part of the channel bar sequence begins with large-scale cross-bedding due to the migration of giant ripples, over this bedding, lenticular bodies with cross-bedding are present. Most of them are climbing- ripples and sediment deposited at trough of larger bedform, when larger bedforms ceased migration, Above this zone a horizontal bedding with silty clays and silt layers of various colors and compositions. This bedding is formed when suspended sediments is deposited during slack water. In the present investigation surface and subsurface sedimentary structures were observed including all the depositional and erosional features

II. METHODOLOHY

In the surface investigation there are many deposional and erosional features, penecontemporaneous deformation structures, post-depositional structures are observed in different shape, size and geometries. For the subsurface investigation vertical profiles which were cut in L pattern with one direction transverse to the flow direction of the channel and the other parallel. The trenches are up to 1.5 meters depth.

III. OBSERVATIONN AND DISCUSSION

Bedform Features

Ripple marks: In the braided river like Brahmaputra many structures are formed during transportation and deposition. The ripple marks are undulations produced by fluid or wind movement over sediments. The oscillatory currents produces symmetric ripple whereas a well-defined current direction produces asymmetrical ripples. The characteristic features of ripples depend upon water velocity, grain size, current direction and nature of fluid. In the study area current ripple-marks are observed and are produced due to interaction of waves or current on a sediment surface. The current ripple marks are of sinuous, linguoid in shape. The sinuous ripples marks form in the lower-flow regime. The linguoid is nothing but a current ripples or special verity of cuspate ripple that reflects their current origin. They are lobate and convex downstream.

Slump structure: The slump is a erosional features. The term slump bedding is often loosely applied to any sort of contorted bedding whether produced by slumping in the strictest sense or not. According to Reineck and Singh (1980) slump is a deformational structure resulting from movement and displacement of already deposited sediments layers, mainly under the action of gravity. In the investigating area slumping is the main cause backlines erosion as unconsolidated sandy sediments resting on slopes and become unstable due to elevated pore fluid pressure in a layer in the sediment pile. Then the sediments move towards down under gravity as a coherent mass. During recession of flood, when water comes out of the bank material, water exerts a pressure on the bank and causing slumping of the bank materials.

Gully: Gully is a erosional feature caused by running water with distinctly develop channel of temporary drainage with steep banks. In the study area the gully are formed towards the downstream.

Scour pit and scour pool: This erosional sedimentary structure are mainly developed due to whirling or turbulent action of the river. In the study area the scour pit were observed over unconsolidated sedimentary surface in the active portion of the bar. These structures are produced within channel with their longer axis running parallel to the flow direction. When the scour bear with water body they know as score pool.

Convolute bedding: Penecontemporaneous deformation structures are observed in channel bar of the river. Convolute bedding is a structure showing marked crumpling or complicated folding of the laminate of a rather well- defined sedimentation unit (Kuenenn, 1953 Potter and Pettijohn, 1963;). The convolute bedding is well developed in fine- grained non-cohsive sediments, such as fine sand or silty fine sand (Reineck and Singh 1980).The convolute structure is actually slump features some time it also known as ball and pillow and pillow structure (Picard and High, 1973). In the investigating area convolute structure are found along the bank where sediment are fine sand with longer slopes. According to Coleman (1969) convolute bedding may be produced from increased shear stress due to an increase in current velocity as a result of a sudden rise in turbulence. This zone may represent a transition from deposits of the lower flow regime to overlying upper flow regime beds.

Mud cracks: In the study area mud cracks are seen in the low-lying area where thick muddy layer are deposited. According to Picard and High (1973) this structure are deposited due to reduction in volume as fine-grained sediment dried when exposed in air. Both orthogonal and polygonal mud cracks are present in the study area. Orthogonal mud cracks show both curvilinear and straight boundaries.

Lithofacies: The subsurface depositional unit with their internal structure and physical properties are described as lithofacies. The lithofcies unit may develop either due to variation of energy condition of depositional environment with a supply of sediments of constant grain size, or due to variation of grain size of the available material for sedimentation in a constant energy condition (Fritz and Moore, 1988). In the study area several lithofacies have been recognized based on their sedimentary structures and grain size.

Convolute laminated fine sand /silt (Fc): The fine grain convolute facies is observed in the area which is overlain by massive mud. They are asymmetrical in nature.

Massive mud (Fm): These sheets like structure is developed at the top the cycles of sedimentation mainly composed of clay-sized particles without any apparent internal structures.

Horizontal laminated sand (Sh): This lithofacies shows little inclination (3˚ to 5˚) towards down current direction and are very prominent due to the mica content. Though the laminations are continuous sometime it shows irregular undulation due to the deformation with the loose sediment.

Parallel lamination sand (Sl): This facies is commonly observed with Sh facies. The parallel lamination facies shows dark and light colored alternating fine band of mica and quartz mineral.

Planner cross-bedded sand (Sp): The planner cross-bedded sand lithofacies (Sp) occupies in single and by multiple sets. The sand are coarse to medium grains, with and thickness of individual beds are not uniform.

Trough cross-bedded sand (St): This facies is widely developed in cosets but some in single sets. The trough cross-bedding is geometrically linguoid type mega ripples.

Ripple-drift cross-lamination (Fr): This lithofacies consist of fine grained sand silt with cross-lamination. This facies is formed is the upper part of sedimentation cycle.

Massive sand (Sm): It consists of mainly sand without any distinct bedding plan extending few meters across the bars.

IV. RESULTS

The various lithofacies successions are controlled by the variation of sediment grain size, sorting and composition, sediment load, discharge, width, depth, flow velocity, flood duration etc. Flow velocity is the most important factors in directly producing the wide verity of common sedimentary features. With the exception of post-depositional structures, most of the other types of structures and bedding are primarily controlled by this parameter. Flow velocity affects the sediment in several ways, including balance between erosion and deposition and mode of transportation (Picard and High, 1973). The horizontal (Sh) lamination is deposited during deposition of upper flow regime condition. The lower regime condition is short-lived and only thin horizontal lamination is formed. According to Miall (1978) horizontal lamination can develop under two controlling condition, in shallow water and during flooding. The planer and trough cross-bedded (St) sandy facieses may be attributed to the migration of straight-crested and lunate sand waves. They form in response to condition of low intensity current in the lower flow regime.

The planer cross bedded (Sp) and ripple drift (Fr) cross lamination are deposited to the lower part of lower flow regime. Generally during low water stage the river water recedes from the bar, only a thin sheet of water having very fine sediment particles as suspended load flows at very low velocity depositing mainly from muddy sediments. The convolute laminated sandy facies is developed due to the rapid rise and fall of the river level, slope steeping and heavily laden water currents. Liquefication of sediments is also major causes for the development of convolute bedding (Lindholm, 1987).

The parallel laminated sand (Sl) facies is a fine bands of dark and light colored bedding commonly associated with the horizontal lamination. The massive mud (Fm) is found at the top of the bedding which indicates low-stage discharges. The lithofacies units shows that they are mostly composed of sand and silt. The SP facies shows prevailing of high energy current which drives sand waves of large size. The trough cross-stratification indicates scouring action of the deposited sediments as well as 3D migration of the sand waves as a result of turbulent discharge. Trough cross-stratification is a dominant sedimentary structure of the bank materials indicating that the materials were deposited by turbulent current. Ripple lamination and ripple-drift lamination are indicator of low energy flow in shallow environment. Mud facies are deposited in a relatively calm and quite environment. The lithofacies of the bank sections indicate that the river bank was also once a part of the fluvial deposition, which was abandoned later on by some mechanism of deflection of the river channel from the present bank area. The convolute bedding (Photo-.10) sequence in the bank sections indicate slumping due to high pore pressure in the bank after the recession of high flood.

V. CONCLUSION

The lithofacies of the bank sections indicate that the river bank was also once a part of the fluvial deposition, which was abandoned later on by some mechanism of deflection of the river channel from the present bank area. The lithofacies of the river bank shows similarity with the active bar sections of the Brahmaputra (Das *et.al.* 2003). Now the river is reoccupying its old course position by eroding its bank. It appears that the river is playing within its belt of jurisdiction.

Photo-1: A view of the Brahmaputra river bank with scattered trees. Foreground is a sand bar.

Photo- 2: Water level marks in the Brahmaputra river bank.

Photo-3: Scour pool near the bank of the Brahmaputra.

Photo- 4: Scouring of the river bed by the turbulent current generated by the partially exposed flood drifted debris. Current direction is towards lower right corner of the photograph.

Photo- 5: Dessication cracks / mud cracks in the Brahmaputra river channel bars near study area

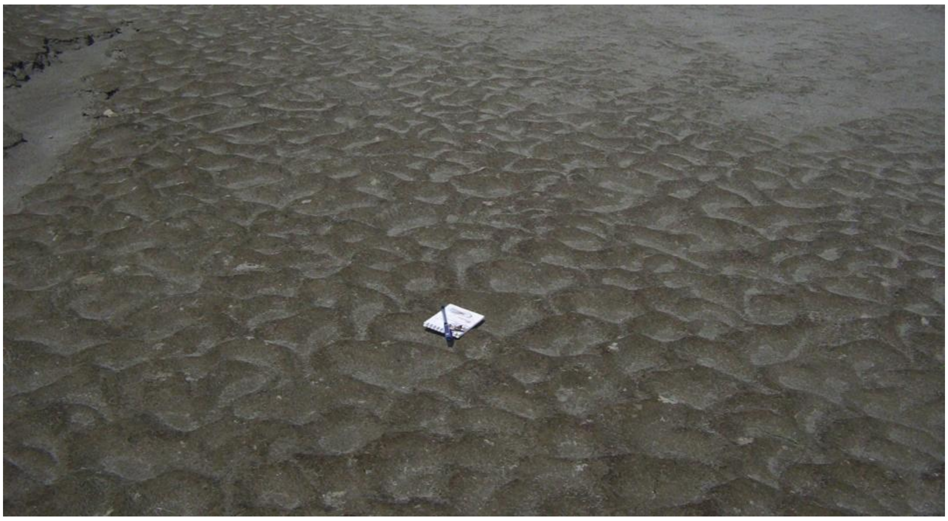

Photo- 6: Linguoid ripple marks in the Brahmaputra river bed.

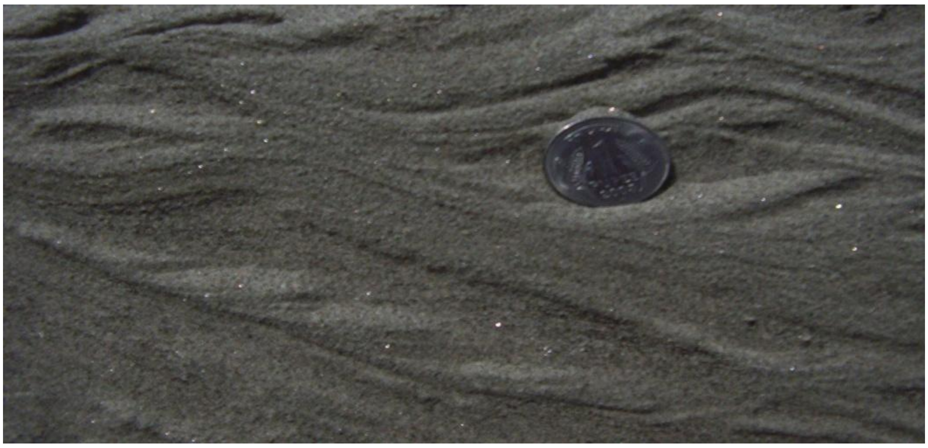

Photo - 7: Ripple drift laminated fine sand in vertical profile of the Brahmaputra river bank.

Photo- 8a: Vertical profile of the river bank of the Brahmaputra showing planar cross-stratification (SP) below and ripple laminated sand (Sr) above.

Photo - 8b: Vertical profile of the river bank of the Brahmaputra showing planar cross-stratification (SP) below and ripple laminated sand (Sr) above.
The truncated top and tangential bottom of SP are distinctly visible.

Photo- 9: Vertical profile of the river bank of the Brahmaputra showing trough cross-stratification (St) in the central part of the photograph.

Photo.10: Vertical profile of the river bank of the Brahmaputra showing convolute structure.

REFERENCES

[1]. Coleman, j. m. (1969): Brahmaputra river channel process and sedimentation. Sediment. Geol., 3 pp.129-239.
[2]. Das, P.K.; Sarma, K.P. and Duarah, B.P. (2003): Fluvial facies model of the Brahmaputra river sediments, India; Proc. IVth South Asian Geological Congress, GEOSAS-IV, New Delhi, March, 2003; pp.146-153.
[3]. Duarah, B.P.; Das, P.K. and Goswami, D.C. (1999a): Grain size analysis and textural parameters of the Puthimari river sediments near Puthimari village, Kamrup district, Assam; Jour. Indian Assoc. Sedimentologists; Vol.18, No.2. pp.231-248.
[4]. Duarah, B.P.; Das,P.K. and Goswami, D.C. (1999b): pabble analysis of the Puthimari river bed in its upper reach near Nagrijuli, Kamrup district, Assam; Proc. Annual Technical Session, Assam Science Society, Guwahati; Vol.1; pp.54-63.
[5]. Fritz, W.J. and Moore, Inc J.N. (1988): Basics of Physical Stratigraphy and Sedimentology; John Wiley & Sons.
[6]. Kuenen, Ph. H. (1953): Significant features of graded bedding; Bull. Amer. Assoc, Petrol. Geologists; Vol. 37; pp1044-1066
[7]. Lindholm, Roy (1987): A Practical Approach to Sedimentology; Allen and University Inc.; 285p.
[8]. Miall, A.D. (1985): Architectural element analysis: A New Method of Facies Analysis Applied to Fluvial Deposits; Earth Sci. Rev.; Vol. 22; pp.261-308
[9]. Miall, A.D. (1978): Lithofacies Types and Vertical Profile Models in Braided River - A summary. In: Fluvial Sedimentology, A.D. Miall (Ed.). Canadian Soc. Petrol. Geol; Memoir 5; pp.597-604.
[10]. Picard, M.D. and High(Jr) I.R. (1973) : Sedimentary Structures of Ephemeral Streams ;Elsevier Scientific Publ. Co. ;223p
[11]. Potter, P. E. and Pettijohn (1967): Palaeocurrents and Basin Analysis; Berlin-Botingen-Heidel-berg, Springer;296 p
[12]. Reineck, H.E. and Singh, I.B. (1980): Depositional Sedimentary Environments; Springer- Verlag, New york; 549p