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Lithofacies types and textural properties of channel deposits found in Brahmaputra River towards the southern part of Majuli, Assam, India.

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----------ABSTRACT----------
The Brahmaputra River exhibits braided pattern during its journey through Assam and is marked by the development of various types of structural elements by the process of sediment transportation and deposition. The present study aims to investigate the various bedform features and lithofacies typesformed by the river and their textural properties in the southern part ofMajuli, Assam. The bedform features includes ripples, mega ripples, scour pools, mud cracks, water level cut marks etc. The lithofacies types found areSp, Sh, Sr, St, Sl and Sc. Grain size analysis indicates that mean size(Mz) of the sediments range from fine sand to medium sand(1.68Φ to 2.77Φ).Most of the sediments are well sorted and finely skewed while the frequency polygon curves show leptokurtic curves

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I. Introduction

Braided rivers and their deposits are important components of the Earth's surface, now and in the past.(Bridge et al., 2005). Braided channels are those marked by successive divisions and rejoining's of the flow around alluvial islands. (Coleman. 1969). The dynamics within large braiding rivers include the interplay among bars, branches, islands, and floodplains (Bridge, 1993; Ashworth et al., 2000). The Brahmaputra River flows through the Himalayas and finally debouches its enormous sediment load into the Bay of Bengal. The river displays a braided pattern in its middle part during its journey through Assam with large discharge and heavy sediment load and active lateral migration (Coleman, 1969). Coleman et al., reported presence of mid channel islands and innumerable sand bars which exhibits different bed form features for eg ripples, mega ripples,, sand waves etc. Mega ripples are characterized by 10-200 cm height, 1-4 m wavelength, 10-40 ripple indexes (Reineck et al., 1980). Borkotoky, 2015 reported presence of various bedform features for eg ripple marks, slump structures, scour pool, convolute bedding, mud cracks etc near Nemati, which is located on the opposite bank of the present study area. According to Udden, 1914 size composition of sediment is controlled by hydrodynamic conditions prevailing during deposition of sediment. Hence the present study focuses on the study of internal structures and texture of channel deposits of the Brahmaputra River towards the southern part of Majuli, Assam. The study locations include the channel deposits of Brahmaputra River on the eastern (upstream near Dakhinpat,) and western (downstream near Kamalabari) side towards the southern part of Majuli (Fig 1).

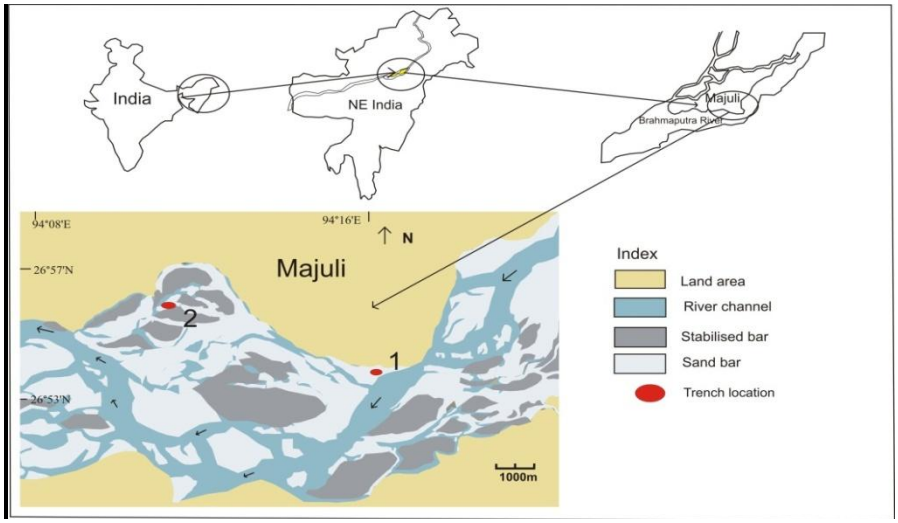

Fig 1: Location map of the study area.

II. Methodology

Field survey as well as laboratory investigations were carried out during the study. The field work was carried out in the post monsoon season to get distinct bed form features as well as distinct internal structures as the exposures are visible in the dry season. The location co- ordinates were measured using a hand held GPS receiver. The characteristics of bed form features were measured and recorded. Trenches were dug in L pattern to study the internal structures, textures and lithofacies types were identified following the lithofacies scheme for fluvial deposits by A.D. Miall, 1978. Representative sediment samples were collected for laboratory investigations by the method of spot sampling and channel sampling. The laboratory investigation involves grain-size analysis and related studiesfor determination of statistical size parameters (Folk and Ward, 1957).Grain-sizedatawere expressed in phi (Φ) scale (Krumbein, 1934) and used to interpret the values of size parameters.

Observation and Interpretation:

The field locations in this study are located in the channel deposits of the Brahmaputra River towards the southern part of Majuli. The bedform features identified aremegaripples, water level cut marks, scour pools, dessicationcracks. The location near Dakhinpat was characterized by shallow ridges and depressions. The depression marks the location of the trough. Near Kamalabari the bedform features identified are Megaripples, wind generated small ripples, scours etc. Both the trenches were dug within the channel deposits in L pattern both along and across the river.

Fig 2: Figure showing (a) Measurement of amplitude of a mega ripple (b) water level cut marks (c) Climbing Ripple type 1. (d) Covolutionsin planar cross stratified sand

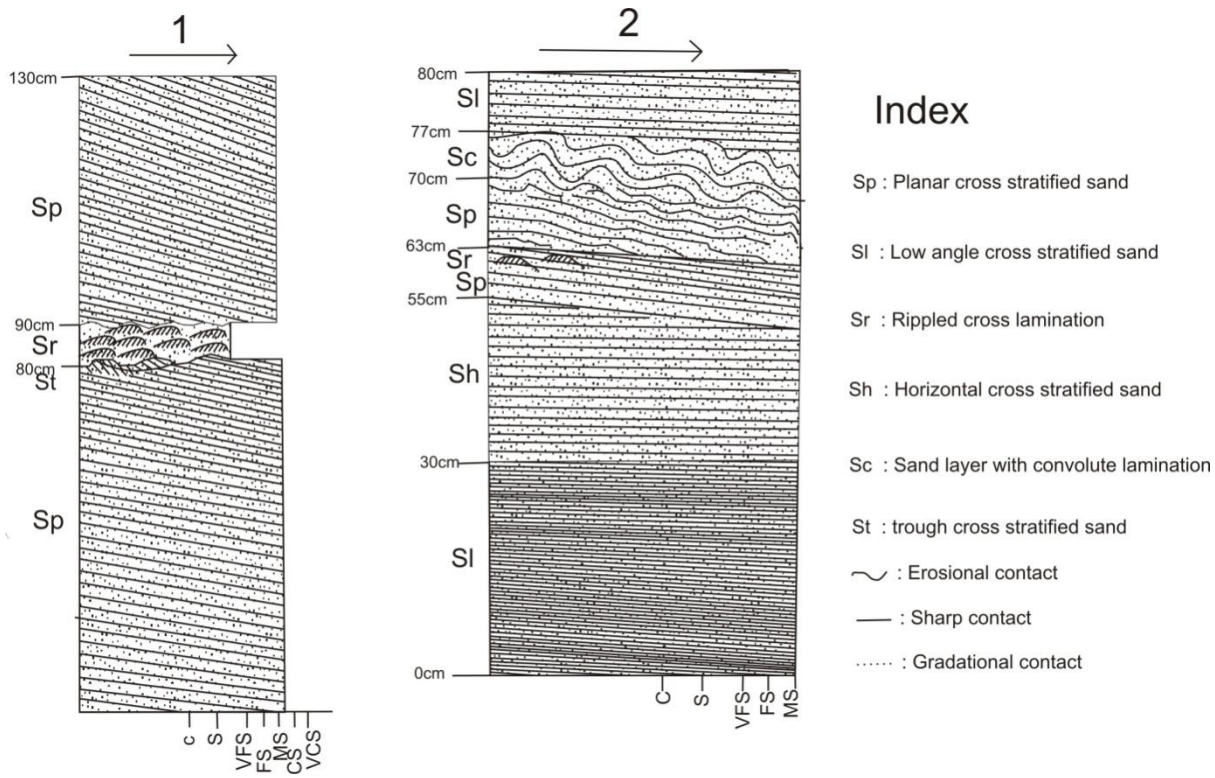

Fig 3: Lithofacies types and their associations of within channel deposits at two locations of the study area.

The lithofacies types found in the channel deposits are Sp(planar cross stratified sand), St(trough cross stratified sand), Sr (rippled laminated sand), Sl (Low angle cross stratified sand), Sh (Sand showing horizontal stratification), Sc(sand layer showing convolutions) . The presence of Sp, Sr and St indicates lower flow regime condition whereas formation of Sh indicates transition from lower flow regime to upper flow regime energy condition (Miall, 1978).The presence of climbing ripple lamination in the trench is the result of migration and simultaneous upward growth of ripples produced by currents (Reineck et al., 1980). In some locations lithofacies Sp shows development of convolutions (Sc).Convolution 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). They may be produced from increased shear stress due to an increase in current velocity as a result of a sudden rise in turbulence (Coleman 1969).

The textural studies of the sediments collected from each layer of the trenches were undertaken in the laboratory and the statistical parameters were calculated. From the grain size analysis frequency polygon curves for each sample were drawn (fig 4a,b).Frequency curves are smooth curves which show variation of weight percentage as a continuous function of grain size (Lindholm, 1987). It was found that in trench 1 the mean size varies from 1.68Φ to 2.41Φ which indicates that sediments are consist of fine to medium sand. From the standard deviation values (.38Φ to .789Φ), it was found that the sediments range from well sorted to moderately well sorted.The values of skewness ranges from -.032 to .378 indicating symmetrical to finely skewed sediments. It thus means that in most of the sediments there is an excess amount of fine material. Values of Kurtosis ranges from .822Φ(platykurtic) to 1.86(very leptokurtic). The platykurtic sediments indicate that the range of distribution of the sediment sizes is narrow and very leptokurtic means that the size of the sediments was distributed widely.In trench no 2 the mean size of the sediments ranges from 2.71Φto 2.77Φ. Almost all of the sediments are composed of fine sand. The value of standard deviations ranges from .25Φ to .289Φ which indicates that all of sediments are very well sorted. Skewness values ranges from -.005Φ to .210Φ. Some samples are symmetrically skewed means equal amount of coarse and fine materials are present. The positive skewnessvalues indicate that more amount of fine material is present in the sediments than coarse material. Values of kurtosis range from 1.24Φ to 1.43Φ indicating leptokurtic curves, which means that the size of the sediments are distributed widely.

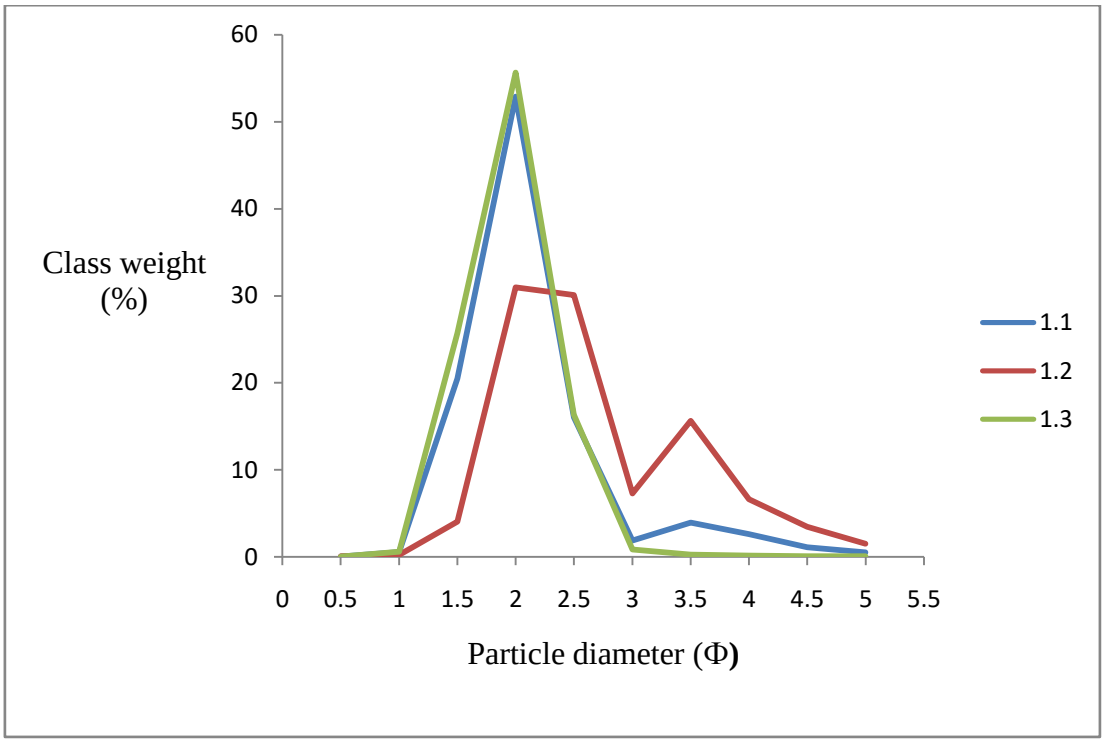

Fig4(a): Frequency curves of various samples for trench no 1

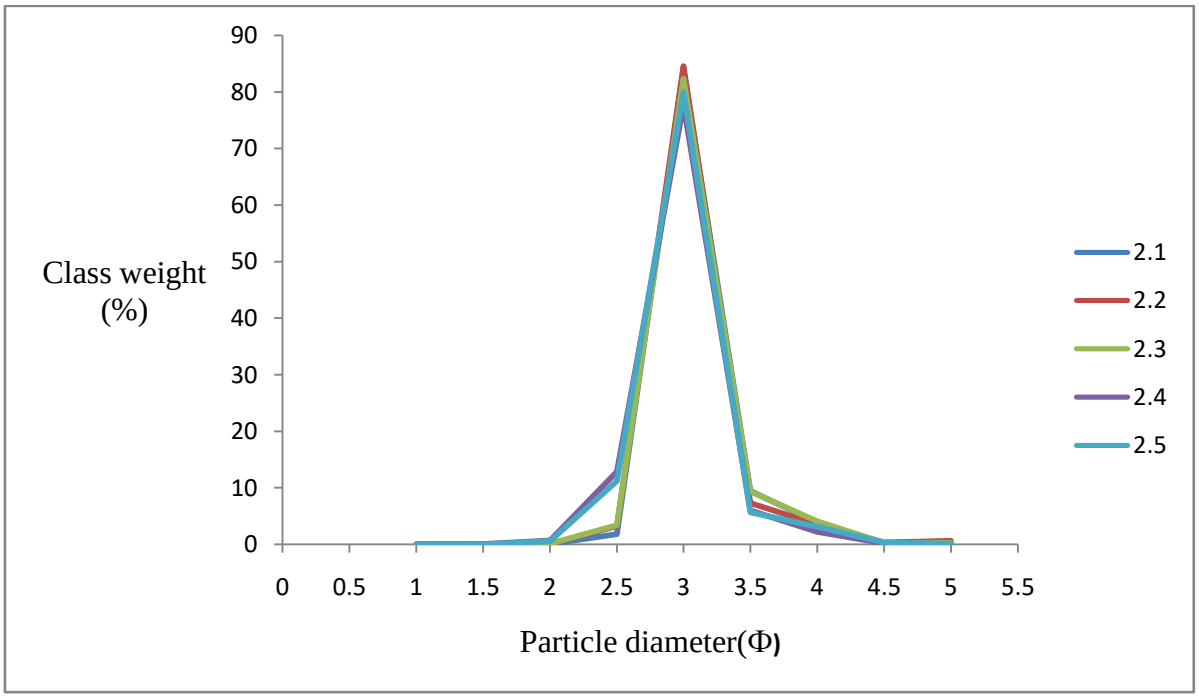

Fig4(b): Frequency curves of various samples for trench no 2

Trench No	Sample No	Statistical Size Parameters							
		Mean Size (Mz) In Φ	Interpretation	Inclusive Graphic Standard Deviation (s_i) in Φ	Interpretation	Inclusive Graphic Skewness (Sk_i) In Φ	Interpretation	Graphic Kurtosis (K_G) in Φ	Interpretation
1	1.1	1.81	Medium sand	.576	Moderately well sorted	.276	Fine skewed	1.86	Very Leptokurtic
	1.2	2.41	Fine sand	.789	Moderately sorted	.378	Very fine skewed	.822	Platykurtic
	1.3	1.68	Medium sand	.384	Well sorted	-.032	Symmetrical	1.12	Leptokurtic
2	2.1	2.77	Fine sand	.25	Very well sorted	.205	Fine skewed	1.24	Leptokurtic
	2.2	2.76	Fine sand	.252	Very well sorted	.210	Fine skewed	1.27	Leptokurtic
	2.3	2.77	Fine sand	.256	Very well sorted	.205	Fine skewed	1.25	Leptokurtic
	2.4	2.71	Fine sand	.284	Very well sorted	-.005	Symmetrical	1.35	Leptokurtic
	2.5	2.72	Fine sand	.289	Very well sorted	.035	Symmetrical	1.43	Leptokurtic

Table 1: Table showing results of statistical size parameters and their interpretation

For the classification of the sediment types ternary diagrams showing percentage of sand, clay and silt ratio were constructed (Folk 1980). From the ternary diagram it was found that in trench no 1 the size of the sediments comes under the sand type (Fig 5a). However there is little variation in amount of silt content. In the ternary diagram of trench no 2 the points also comes under the sand field (Fig 5b). All the points overlap in this diagram.

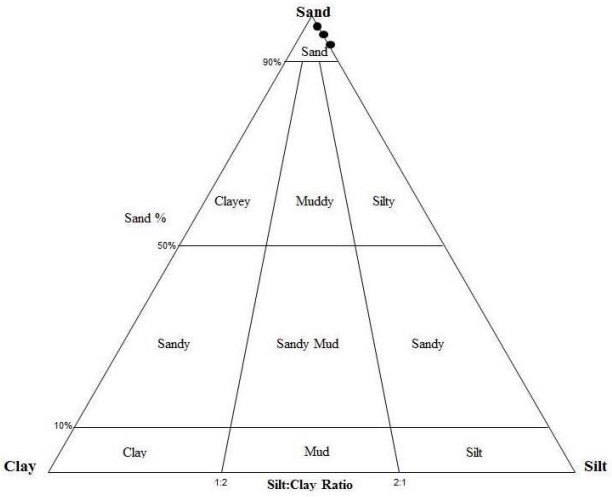

Fig 5(a): Ternary diagram showing prportions of sand, silt and clay.All the samples from trench 1 occupies the sand field.

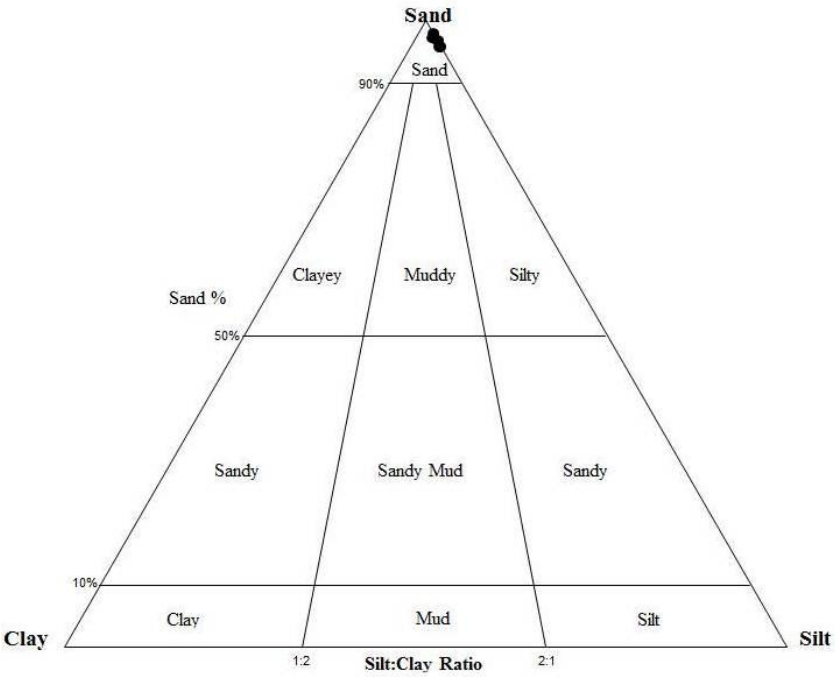

Fig 5(b): Ternary diagram showing prportions of sand, silt and clay.All the samples from trench 2 occupies the sand field.

III. Conclusion

The within channel deposits of the Brahmaputra River in this area is composed of fineto medium sand(Mz 1.68Φ to 2.77Φ). From the values of standard deviation(.25Φ to .78Φ), we can conclude that the the sediments are ranges from well sorted to very well sorted. The skewness values (-.032Φ to .378Φ) implies that in most of the sediments there is an excess amount of fine sand than coarse sand. The values of kurtosis(.822Φ to 1.86Φ) show that in most of the sediments range of size distribution is wide. The lithofacies types found are Sh, Sp, Sr, St., Sl etc. and hence indicating different hydrodynamic condition at the formation of these deposits

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