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Sand Development Pattern Within the Paleocene - Lower Eocene Sediments Along the Shelf Areas of Upper Assam Basin- A Study Incorporating New Sub-Surface Information

Introduction: The Upper Assam Basin, which is a part of Assam Arakan Petroliferous Basin, lies in a syntaxial position which is surrounded on three sides by thrust belts. In the south the Naga Thrust Belt has been developed due to convergence between the Indian plate and the West Burma Block and the syntaxial closure has resulted from the Himalayan collision to the north and northeast. The Basin has developed as a foredeep / foreland basin with respect to Naga Thrust Belt advancement. The foredeep phase was deposited under marine/deltaic conditions and the foreland stage mainly under fluvial environments.

The present thrust for hydrocarbon exploration by Oil India Limited in Upper Assam Basin is on the Paleocene – Lower Eocene shelf sediments along the Basement High trend, running parallel to the River Brahmaputra of Upper Assam, where numbers of oil/gas bearing structures have been identified. Sandstone, deposited in a fluvio-deltaic environment (Langpar Formation) to marginal marine environment (Lakadong & Narpuh Member of Sylhet Formation) acts as the key reservoir facies and major oil accumulations are found in structural traps. Recent exploratory drilling in the deeper and frontier part of the Basin towards east, southeast and northern bank of the river Brahmaputra away from the *Central Basement High* area has revealed interesting information on the reservoir facies development pattern within the Paleocene-Lower Eocene sediments.

Objective: In the early phase of exploration for Paleocene & Lower Eocene prospects, the wells were drilled around the highest part of the Basement High trend around Dikom-Chabua area and encountered very thin sands within Lakaong+Therria (thickness varying from 1 to five metres with total reservoir thickness less than 50m). This led to a belief that the Eocene reservoirs are thin and laterally discontinuous. However extensive exploration in various parts of the Basin during the last 10 years has revealed that there is wide variation in the reservoir facies development pattern and at places, individual sand thickness reaches more than 20 m with good lateral continuity. The objective of this study is to present a regional picture of sand development pattern within the Paleocene-Lower Eocene Formations incorporating new well data.

Methodology: A total of 37 wells which have been drilled through the Paleocene-Lower Eocene sediments (Sylhet and Langpar Formations) within the study area of Upper Assam Basin, has been selected (Figure-1). Three major flooding surfaces near Langpar Top, Lakadong Top and Prang Top have been identified and used for regional correlation. Three subgroups within Lakadong+Therria have been identified based on log-derived lithofacies (Figure-2). Lateral continuity of these units have been studied by well to well correlation along lines parallel and across the basinal strike.

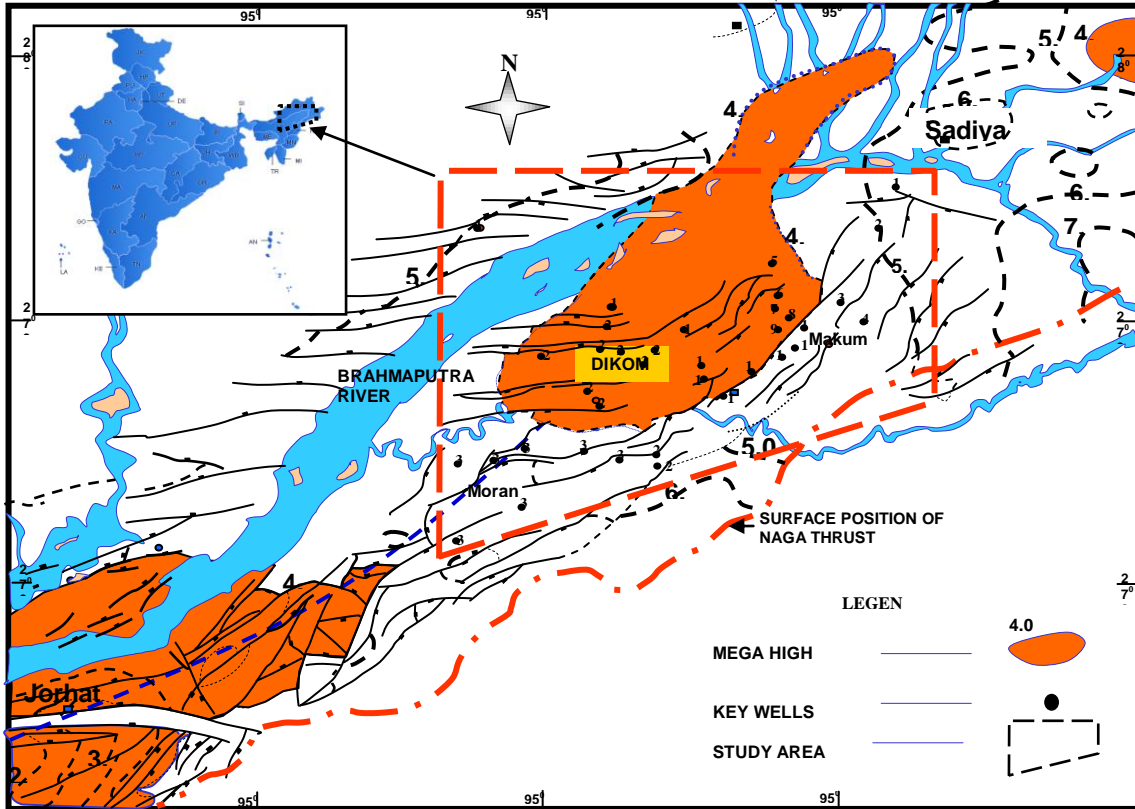


Figure-1 Study area showing Basement High trend and key wells. (Depth contours in KM)

Litho-Model		Formation and Members	
3450 3475 3500 3525 3550 3575 3600 3625 3650 3675 3700	Sy/het Formation Lakadong	Prang	Prang Member consists of limestone bands in alteration with shale, silty shale and siltstone. Poor as reservoir rock
		Narpuh	Narpuh Member is consists of siltstone and shale with occasional thin limestone bands. Becomes sandy towards eastern part. Low porosity reservoir.
		Lakadong	LK1: Consist of thin limestone/ calcareous sandstone, low porosity reservoir.
			LK2: Middle Unit of Lakadong. Thin to thick fine grained sandstone with intervening shale. High in porosity/permeability
			LK3: Bottom unit of Lakadong. Carb. shale, coal zone with thin sand bodies
	Langpar	Thick sands with moderate porosity.	

Figure:2 Paleocene - Lower Eocene sequence of Upper Assam with its subdivisions

For mapping lateral variation of the above litho-units, gross and net sand thickness map were prepared for each and contoured over the study area. A concept based contouring of the properties have been carried out in the areas of limited data control.

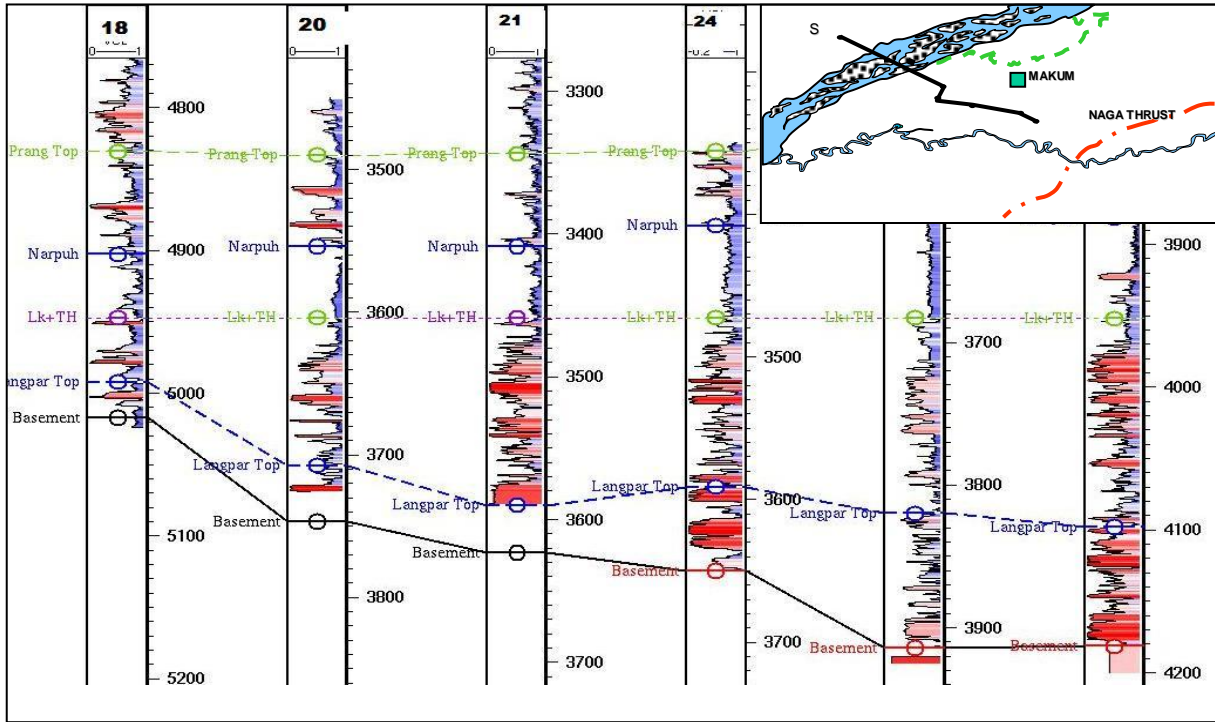


Figure-3 NW-SE correlation of Paleocene-Lower Eocene formations

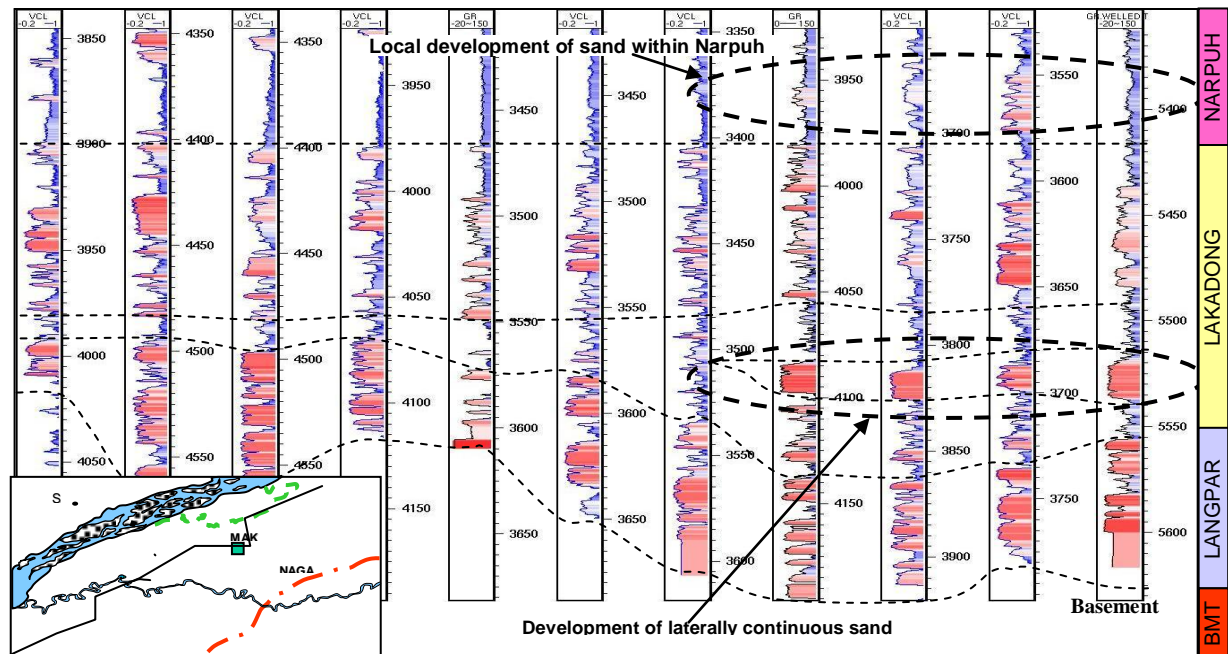


Figure-4 WSW-ENE regional correlation of Paleocene-Lower Eocene formations

Discussion: Isopach maps show that gross thickness of each unit increases towards south-east to east. Two regional correlations, one in NW-SE direction (figure-3) and one in WSW-ENE direction (Figure-4) exhibit the development of each units and as well as basin configuration at the time of deposition of Langpar and Lakadong sediments.

The Langpar Formation is thin /absent towards the north bank of the River Brahmaputra. Net sand thickness increases from about 40m around the present Basement High area to more than 50m towards south of Nahorkatiya. Porosity is low within the deeper part of the Basin (10-12%) in the SE direction, while in the northeastern side of the study area (NE of Makum), good porosity development is observed even at greater depth (about 18% at 5610m TVD).

Lakadong Member show wide variations in sand development in terms of thickness and lateral continuity. In the Basement High area around Dikom, individual sands bodies are thin with limited lateral extent and are primarily a mainly mixture of coastal plain and tidal channel deposit. Southeast of Dikom, stacked bar sands give rise to higher NTG but lateral continuity continues to be poor. In contrast, in the north eastern part of the basin (Makum onwards) along the Basement High trend, best sand development within Lakadong is observed (Figure-5). In this area sand bodies extends sheet like with lateral continuity over 3 to 4 kilometers. The top Calcareous unit of Lakadong (LK1) grades into sandy facies here and depositional environment appears to be fluvio-deltaic with abundance of sediment supply in this area.

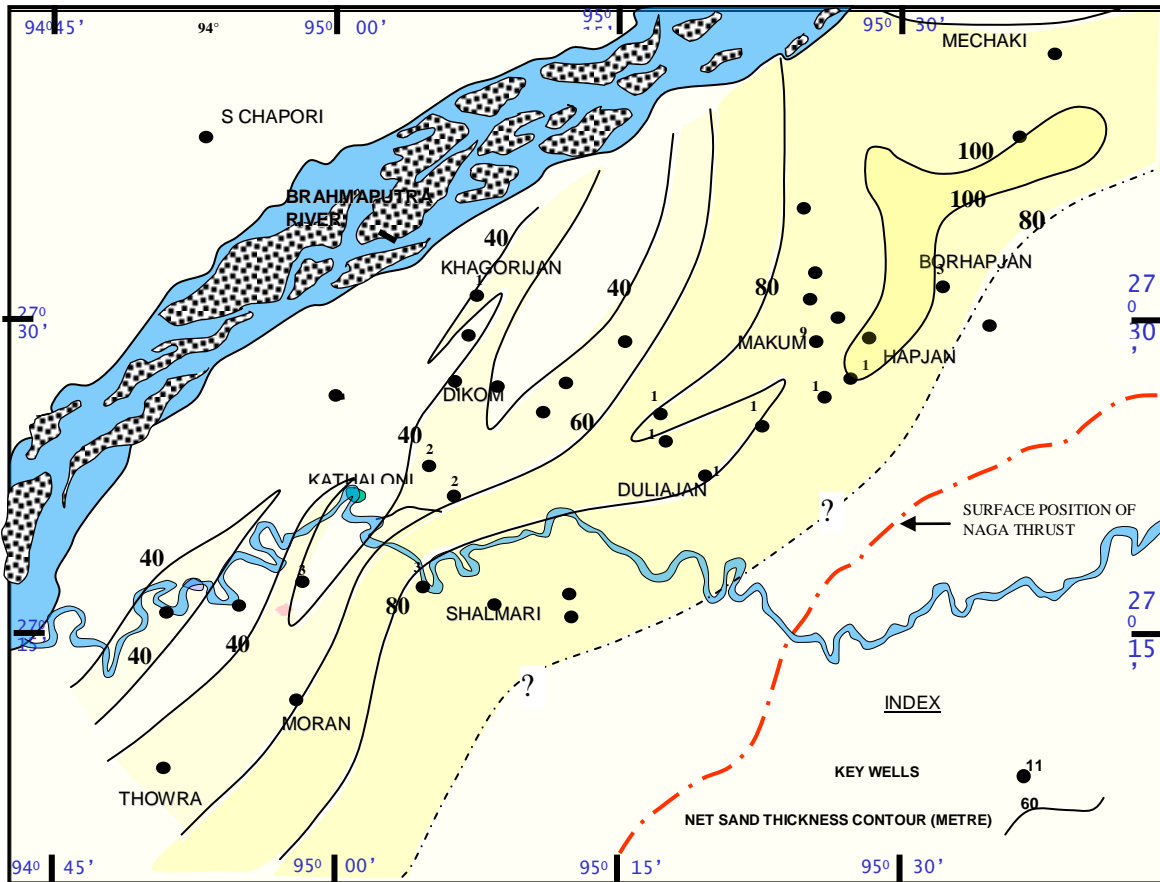


Figure:-5 Net thickness map showing sand development trend within Lakadong.

The Narpuh Member of the Basin was earlier believed to be dominantly argillaceous with minor silty layers. However, wells drilled in northeastern part of the Basin have encountered considerable thickness of sand facies within the Narpuh. This Narpuh sand development area overlies the best sand development area of Lakadong which indicate continued sediment supply in that area till Narpuh deposition time. The overlying Prang Member is made up of three major limestone bands with intervening shale layers. Individual limestone bands thicken towards southwest, but are practically devoid of any effective porosity.

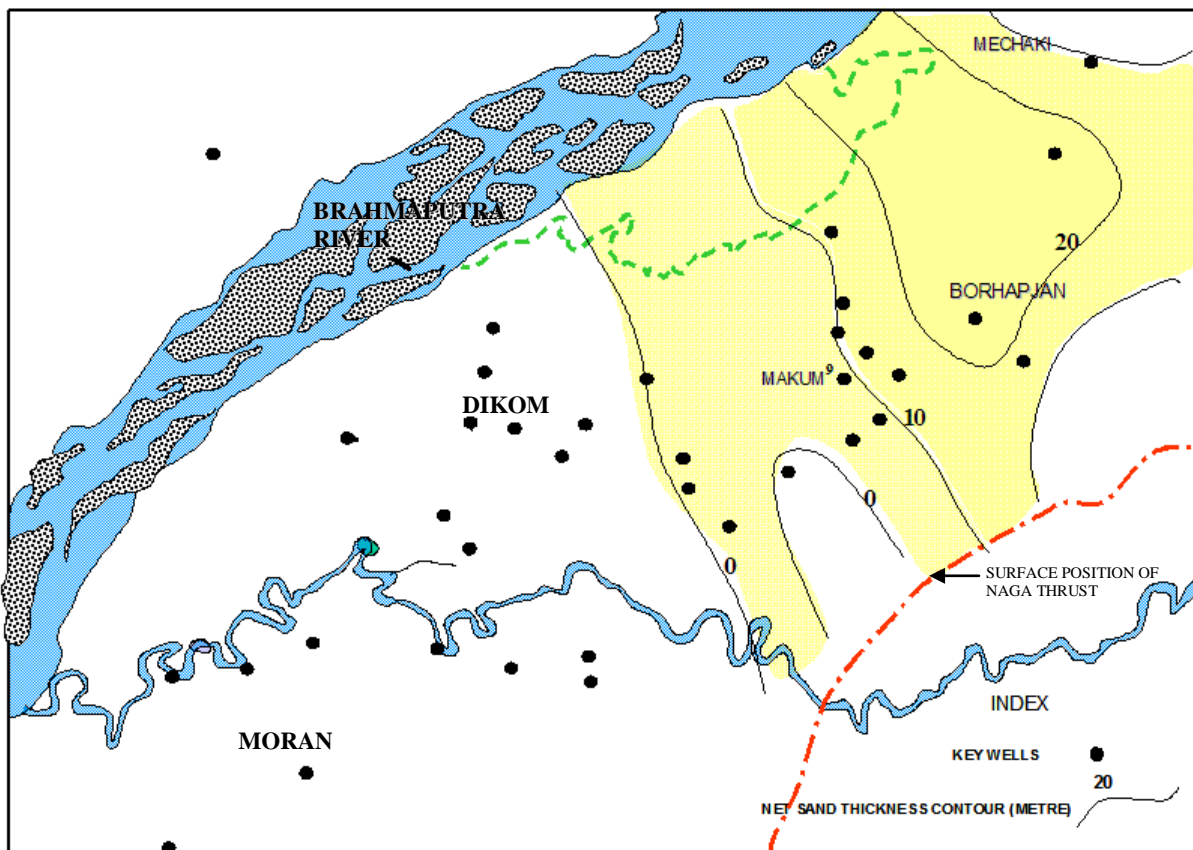


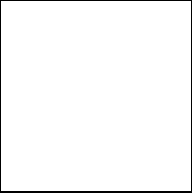
Figure:-6 Net thickness map showing sand development pattern within Narpuh

Conclusion: The sedimentation rate varies widely in different parts of the Basin. The northeastern part of the Basin which today host a number of new oilfields, has been a loci for prolific and continued sand deposition through the entire Paleocene-Lower Eocene times. Gross as well as net thickness of each unit decreases towards northwest, north of Basement high trend due to limited accommodation space over there during Lower Eocene and the area experienced marine transgression during deposition of top part of Lakadong only.

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