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Title: Reservoir Rock Quality of the Lakadong Member in the Eastern Part of Upper Assam Basin, India

Key words : Reservoir rock, Lakadong Member, Diagenesis, Porosity, Assam basin

Abstract

The Upper Assam basin is the earliest explored petroliferous basin of India. It represents the northeastern extremity of the Indian subcontinent encompassing an area of about 57000 sq. km. and forms the northeastern part of Assam-Arakan geological province. Tectonically the Upper Assam Basin represents a structurally wrapped foreland basin between two convergent plate margins and came into existence during Early Cretaceous time. The generalized stratigraphy of the Upper Assam Shelf in the study area is given in Table-1. The Lakadong Member (Upper Palaeocene - Lower Eocene) of the Sylhet Formation in Upper Assam is of interest because it contains sandstone reservoirs which are prolific producers of oil and gas. The thickness of this member in the area varies from 60 to 150m. The sandstone beds range in thickness from less than a metre to about 13m. In spite of having lower thickness the productivity from these classic reservoirs are very high. Diagenesis has played a major role in controlling reservoir quality of these reservoir sandstones.

Samples of conventional and sidewall cores along with drill-cuttings and wireline logs of Upper Palaeocene-Lower Eocene age recovered from wells located in different parts of the area have been studied with respect to petrography, diagenesis and lithofacies characteristics. The study of reservoir rocks includes general mineralogy, primary and secondary porosities and the important diagenetic features that control the reservoir quality.

The Upper Palaeocene – Lower Eocene sandstones are basically quartz arenites to sublitharenite and less commonly of lithic wacke type. The general mineralogy of the sandstones includes mainly subrounded to subangular quartz particles (although angular and rounded particle are present), along with feldspar, glauconite, calcite, clay minerals such as kaolinite, chlorite, illite and minor smectite, and heavy minerals. These reservoir sandstones contain generally large secondary pores which are numerous in certain producing horizons. These have developed mainly due to the activity of interstitial solutions. Fracturing and dissolution of quartz, feldspar, rock fragments and the cementing materials are some of the important diagenetic changes that make the reservoir to be highly productive. Moreover, the sorting of the minerals and the presence of micro fractures within the framework grains enhance the porosity and permeability in these sandstones. On the other hand, development of authigenic minerals as well as the overgrowths and presence of clay minerals in the pore spaces, as revealed from scanning electron microscope studies, affects the reservoir quality. Data generated from conventional core and drill-cutting analyses together with wireline log information indicate the presence of three sets of lithofacies within the member. These lithofacies have developed as a result of changing palaeoenvironment condition.

Table 1. Tertiary Succession of Upper Assam Shelf sediments (modified after, Handique *et. al.*, 1989)

Epoch	Lithostratigraphic Units		Thickness (m)	Major Lithological Types
	Group	Formation		
Recent	-	Alluvium		
Pleistocene	Dihing	Dhekiajuli	1300- 2000	Unconsolidated sands with clay and lignitic sands.
-----Unconformity-----				
Pliocene	Dupitila	Namsang Beds	0-1000	Poorly consolidated sandstone with clay and lignitic sands
Miocene				
-----Unconformity-----				
Miocene	Tipam	Girujan Clays	100-2300	Mottled clay with sandstone lenses.
		Tipam Sandstones	{ Upper 300-500	Essentially arenaceous sequence
			{ Middle 100-200	Sand/shale alteration sequence
		{ Lower 100-200	Arenaceous sequence	
	? Surmas	Not subdivided		Sandstone with shale and grit bands
-----Unconformity-----				
Oligocene	Barail	Not subdivided	500-1200	{ Upper Part: Mudstone/sale with sandstone beds and coal bands (Argillaceous sequence) { Lower Part: Sandstone with shale bands (Arenaceous sequence)
Eocene	Jaintia	Kopili alterations	280-500	Splintery shale with sandstone and fine-grained sandstone with coal bands.
		Sylhet Limestone	{ Prang 350-450	Splintery shale with sandstone and limestone bands
			{ Lakadong 60-170	
	Therria			Sandstone, calcareous sandstone and limestone
-----Unconformity-----				
Precambrian granitic basement				

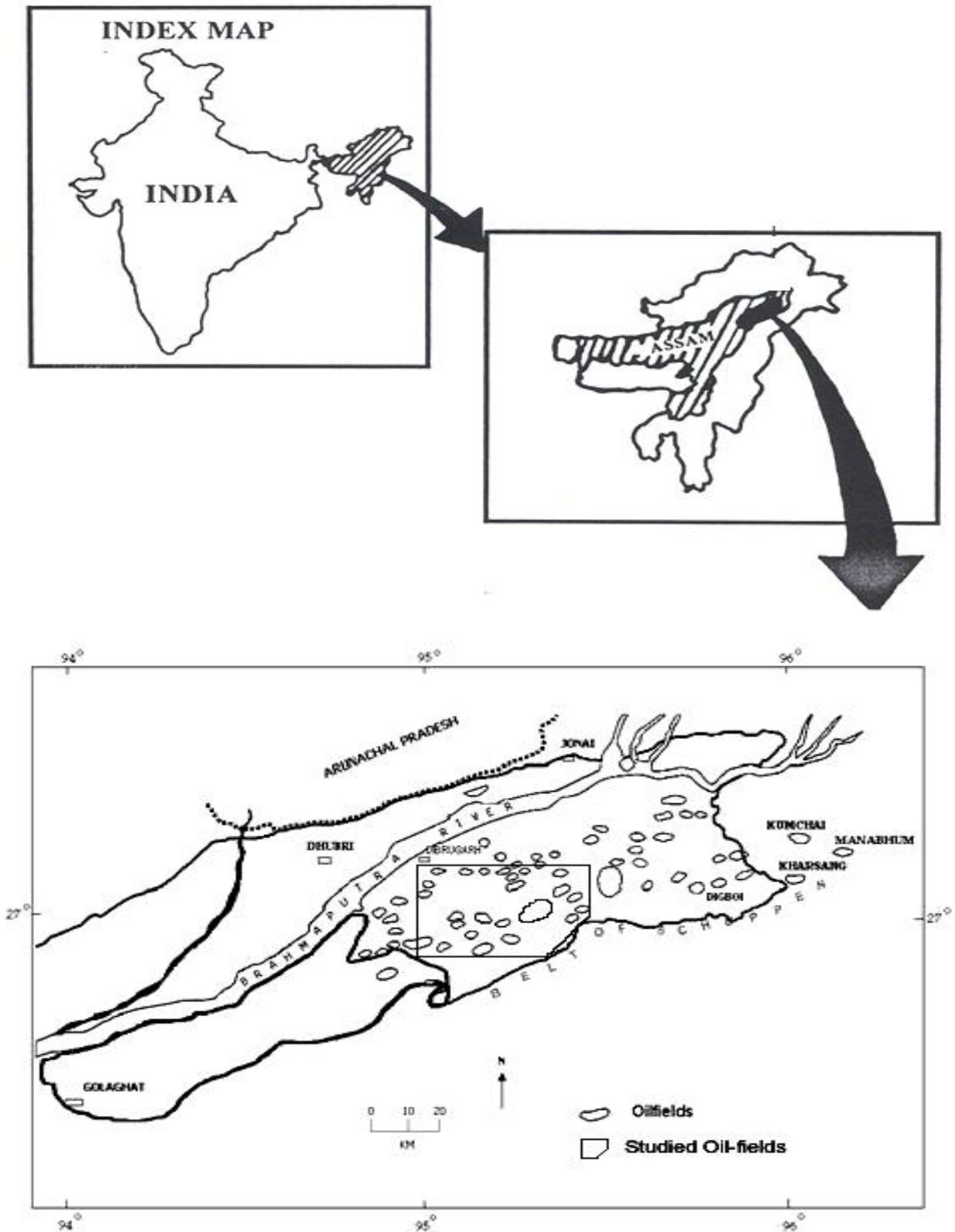


Figure 1: Location map of the study area

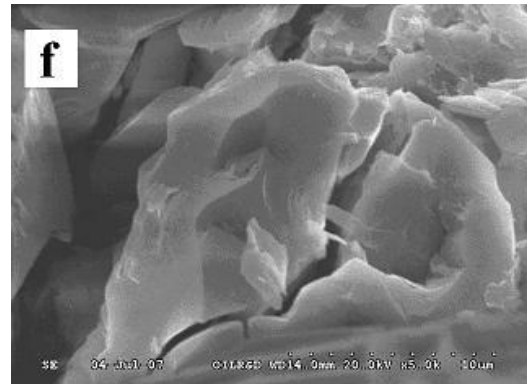
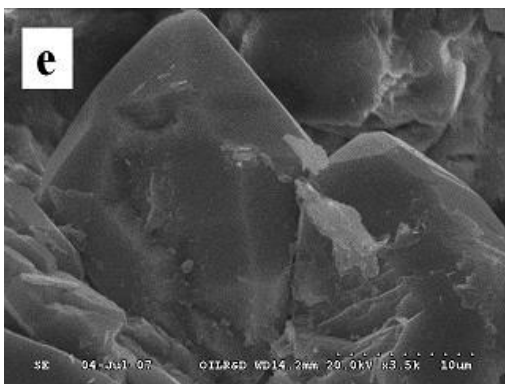
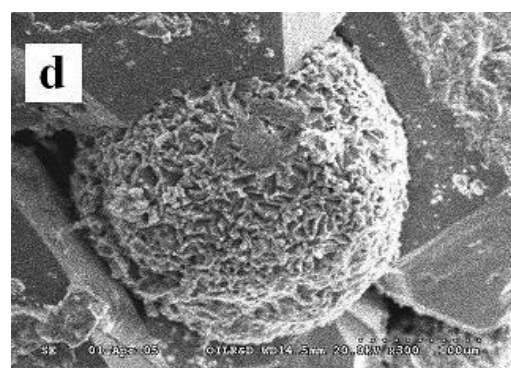
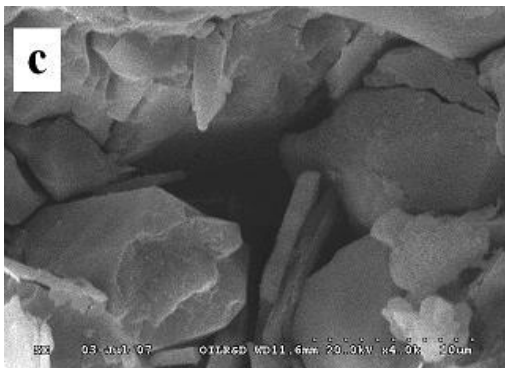
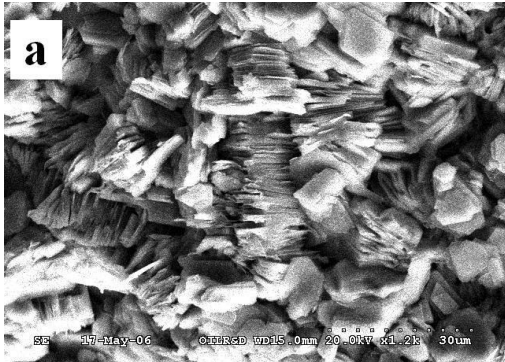


Figure 2. SEM photomicrographs of Lakadong reservoir sandstones. *a*, Kaolinite books. *b*, Gypsum crystals. *c*, Intergranular pore. *d*, Glauconite developed in pore space. *e*, Quartz overgrowth. *f*, Microfracture in framework quartz.

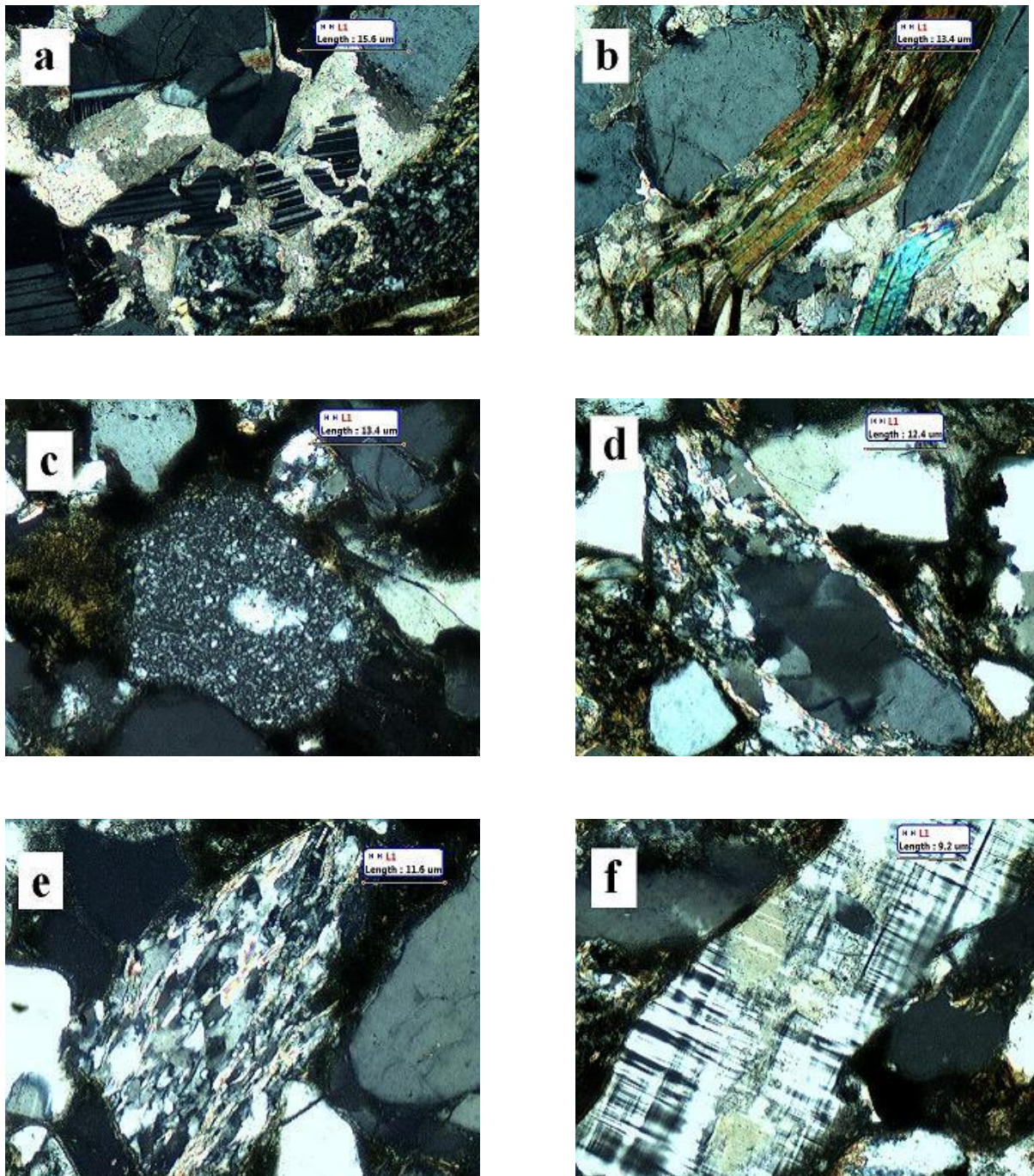


Figure 3. Photomicrographs of Lakadong reservoir sandstones. *a*, Dissolution of quartz and feldspar grains (100x). *b*, Dissolution and kink bend of mica flakes (100x). *c*, Authigenic chert (100x). *d*, Rock fragment (100x). *e*, Metamorphic Rock fragment (100x). *f*, Surface corrosion on microcline grains by cementing material (100x).