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APPLICATION OF IMAGE LOG AND DIPMETER DATA TO LESSEN UNCERTAINITIES IN HYDROCARBON EXPLORATION AND DEVELOPMENT IN PALIYAD AREA OF CAMBAY BASIN

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Abstract:

Paliyad structure is located to the NNE of Kalol field in Cambay Basin, India, having high potential from hydrocarbon production point of view. The most promising oil pays, viz: K-V, K-VIII, K-IX+X and K-XI (1447-1544m) in this structure, are mostly siltstones of Eocene age. These reservoirs are discrete and discontinuous in nature,

P-B) on Paliyad structure along with basic wireline log and core data were used for interpretation to focus primarily on environments of deposition, paleo-flow direction deposited under tidal /deltaic system.

Since these reservoirs are having limited areal distribution, identification of sedimentary facies and their lateral extension is of prime importance to lessen uncertainties in exploration and development in this structure.

On the basis of available Image and Dipmeter log data of two wells (viz: P-O and and reservoir distribution, which provide crucial information for future development of these oil pay sands in this structure.

Dip spread was in the order of 0^0-16^0 and mega strong patterns in the studied section were absent. Green patterns displayed very low values, therefore, subtraction of structural dip was not considered. At several places typical micro red and blue patterns depicted short cycles of deposition, bioturbation and reworking of sediments represented by yellow patterns. Dip data, Image log and wireline log motifs in the aforesaid interval affirmed major part of the sedimentation took place in the delta front and tidal flat. Cyclic transgressions and regressions (ending each event with deposition of thick coal deposited under delta plain area) characterize the area.

Sedimentary features like lenticular, wavy, flaser, parallel and cross bedding, bioturbation, ferruginous sandstone etc. indicating shallow water deposits in variable dynamic energy conditions and inputs from provenance, at certain sections.

Along with adjustment of basinal architecture, sea-level fluctuations had resulted in the minor shifting of delta orientation and led to uneven distribution of sediments in the area. This is one of the prime factors for discontinuity in the reservoirs at some places.

Data suggest deposition took place mainly in tidal deltaic environment in the area. Overall analysis of data affirms that better reservoir facies can be expected in the NE-SW and E-W directions with reference to the well P-O.

Introduction:

Kalol is one of the largest onshore oil fields located in the Cambay basin, with some minor fields like Paliyad, Wadu, Motera etc. around it. Paliyad and Wadu are considered as a single unit hydrodynamically.Paliyad structure is located in the alluvial plains around 25 km. NNW of Ahmedabad town.

Paliyad structure is a small culmination of an anticline feature trending NE-SW direction and it is located to the NNE of Kalol main field. Till date 23 wells have been drilled on this structure, which have shown significant potential in pay sands K-V,K-VIII and K-IX+X, which were deposited in channels. These reservoirs are mainly of siltstone and silty sandstone nature.

The present study is an attempt to understand sedimentary facies, the geometry of reservoir sand bodies and their regional distribution within Paliyad structure using Image Logs and Dipmeter data for further development of the field. These reservoirs occur in Kalol formation of Middle Eocene age in Mehsana-Ahmedabad block of Cambay basin.

Cambay basin

Cambay basin is an elongated (NNW-SSE) intracratonic rift basin in the western part of Indian craton. In this basin three major trends have been observed viz: NW-SE Dharwar orogeny, NE-SW Aravalli-Delhi orogeny and WSW-ENE Satpura orogeny.

Based on the lineaments, this basin is divided into six tectonic blocks.The Paliyad field falls in one of the blocks i.e. Ahmedabad–Mehsana block.

(Detailed description of sedimentary features, Sedimentary facies and Paleo-current directions are given in the Table/plates below).

Interval	Average thickness	General description/ Observation	Transgression/ Regression	Inferred facies	Palaeo current towards
Plate-1 1447-1490m	43m	Alternations of sandstone, Siltstone, silty shale, shale. Overall Gamma Ray log pattern shows serrated blocky type. Minor dip patterns, structural dip of 2^0, parallel laminations indicating a flat area 1474-78m radial A-F diagram, cross bedding at some places and profuse bioturbation around 1473m., 1484m were observed. Lenticular to flaser bedding around 1464m.,1451m., between 1485-1489m., Unstable dips observed at several places can be attributed to prevalence of high energy conditions. A few minor patterns point the orientation of the channel in NNE-SSW direction.	Transgression	Tidal flat	
Plate-2 1496.5-1512.5	16.5m	This unit comprises sandstone-siltstone-shale alternations. **Core**: (1496.5-1500m): Lenticular, wavy and flaser bedding and ferruginous sandstone were observed in the core section, depicting shallow water conditions.Serrated fining upward log signature. 1500-1511.5m: Alternations of Mud/shale/fine siltstone Observed obliteration of bedding at several places due to reworking of sediments, represented by frequent minor yellow patterns. Scour around 1503m. and cross bedding at several places, Dips are in range of 2^0-12^0 Gamma ray shows coarsening-up sequences. Reversal in azimuths around 1498m and 1511.5m can be attributed to transgressive and regressive phases respectively.	(1496.5-1500m): Distributary channel (1500-1511.5m): Delta front (1511.5-1512.5m) Wash over zone		West/ SW

Plate-3 1512.5-1523	10.5	Massive coal, GR-blocky type	Transgression	Delta plain swamp	NE/East
Plate-4 1523-1527	4.0m	Alternations of Siltstone and Shale. This unit displays fining upward gamma ray log motif and slope patterns and dips in the range of 4^0-$12^{0.}$.	Distributary channel		SSE
Plate-5 1527-1533.5	6.5m	Alternations of sand-shale. Observed typical hybrid log motif (serrated funnel shape), distinct wavy ripple laminations, alternations of current and slope patterns with 2^0-26^0 dip spread were observed. Data suggests prevalence of low energy conditions at the time of deposition of this unit. Shift in direction of bedding gradually from NNW to NNE (from bottom to top of the unit) was observed and this change can be attributed to the shift of flow pattern/delta orientation.	Marine transgression over delta		NE/East
Plate-6 1533.5-1544m	10.5m	Alternations of Siltstone and Shale. Planar laminations in the interval 1541-1542.5m followed by profuse bioturbation (in the interval 1537.5-1540m) Bedding obliterated due to bioturbation in this unit.This unit indicates predominant wave action. Overall serrated funnel shape is displayed by GR log against this unit.	Shore face		West
1544			Regression		

Plate-1

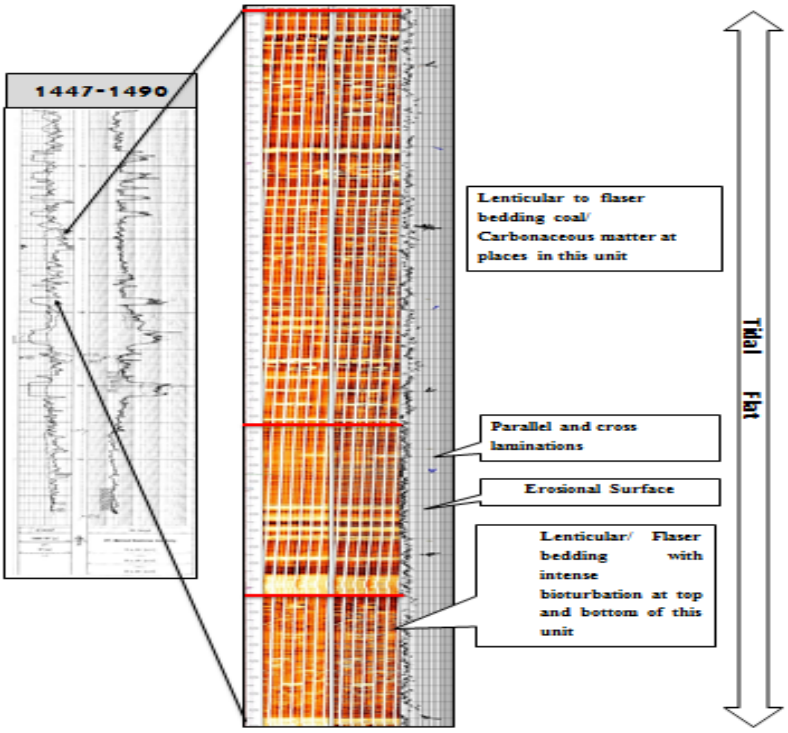


Plate-2

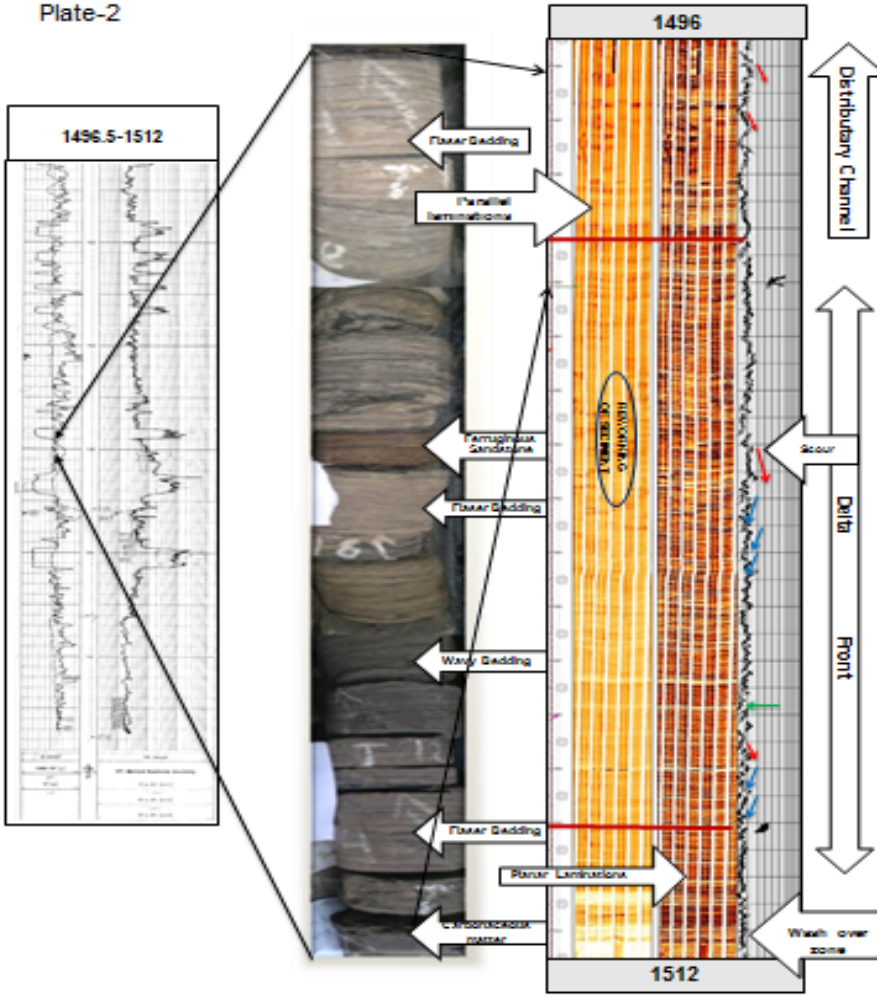


Plate-3

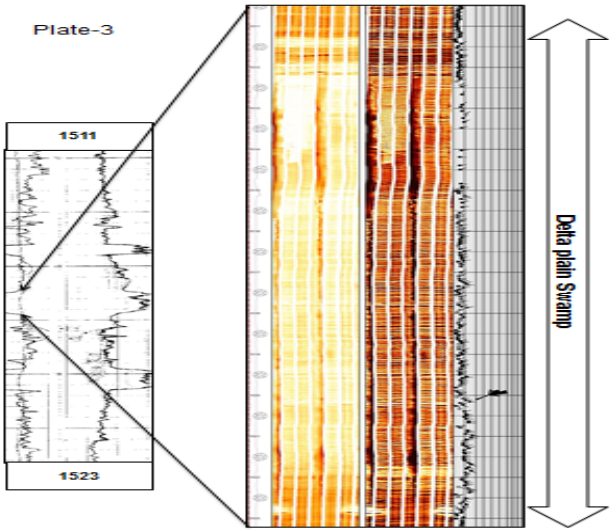


Plate-4

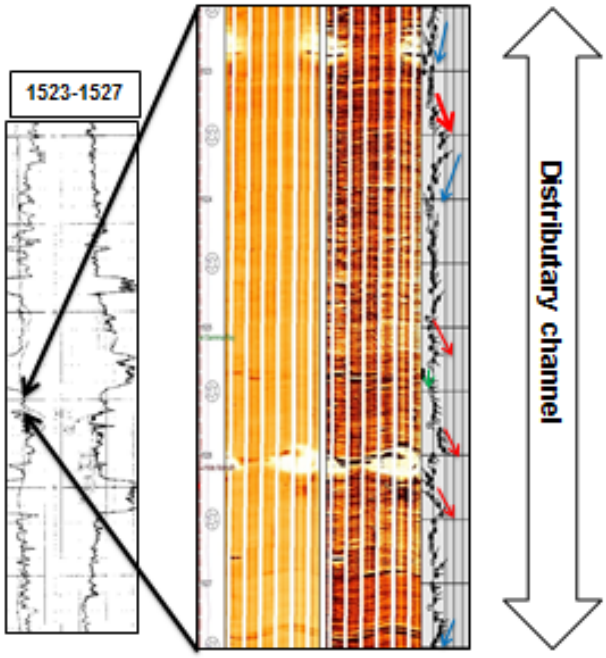


Plate-5

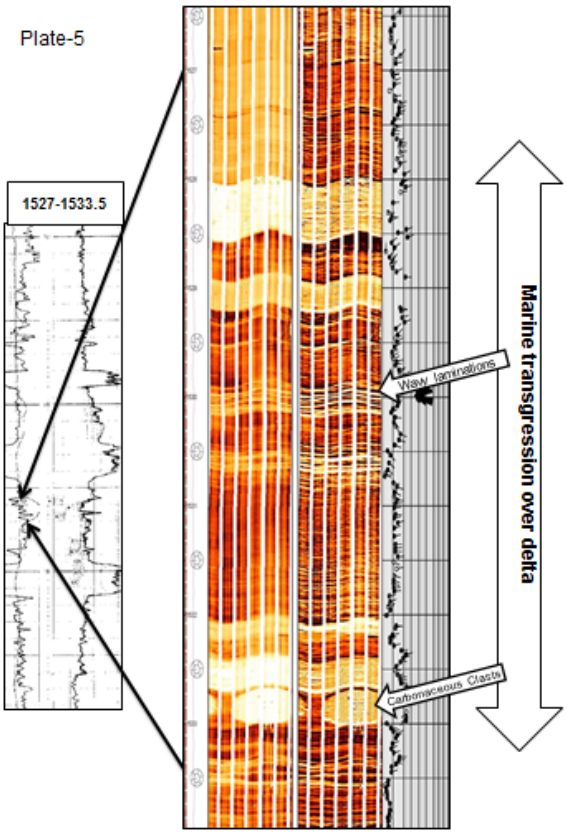
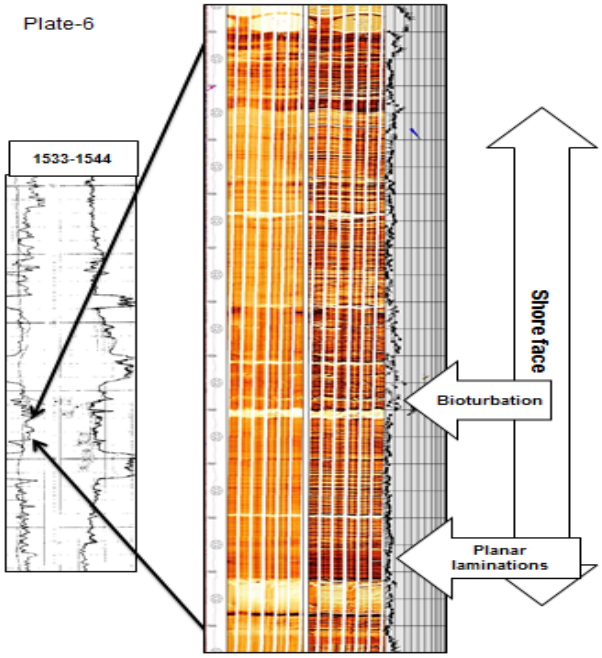


Plate-6



Conclusions:

Image log and GR/SP logs, Geological and other available data was considered for this study.

A). The studied section (1447-1544m) of the well P-O (which comprises main hydrocarbon bearing pays in this structure), indicates that most of the sedimentary sequences ended either with Transgressive / Regressive Phase, emphasising that this basin had witnessed several sea-level fluctuations. **B).** Inequal distribution of sediments in the area can be subscribed to frequent shifting of flow directions/ shifting of delta **C)**. One of the prime factors for development of discrete, at some places, thin sand bodies may be the end result of shifting in paleo-flows.**E).** Overall data suggests that better reservoir facies development can be expected in NE- SW and E-W directions with reference to the well P-O.

References:

1).Sedimentary environments from wire line logs by Schlumberger

2).Geological well logs by Stefan M Luthi

3).Crain's Petrophysical handbooks

4).Sedimentary Environments: Processes, Facies and Stratigraphy by H.G.Reading

5) Well completion Reports of different wells of the area