



Analysis of Kalyanpur Field Discovery in Low Resistivity Silty Reservoir in Dhansiri Valley, A&AA Basin, Assam –A Case Study

* **G.V.Reddy**, ONGC, Chennai, **Trishna Saha**, **B.K.Chowdhury**, **N.Chandra Sekhar**, **N.G.Das**, **Vikas Sharma**, **T.E.Sivaramakrishnan** ONGC, Jorhat, Email: guntakavreddy@yahoo.co.in

Summary

This paper deals with the integrated approach by G&G team at the base office and geologists at the well site in tracking down the low resistivity silty reservoir sands of Middle Bokabil Formation in Well Kalyanpur-1(KP-1) in Dhansiri Valley of Assam & Assam Arakan Basin in the state of Assam, India. The location KP-1 was drilled on a linear structure (upto Bokabil level) formed in the hanging wall fault closure formed against the major down to basin, east hading fault. It is the first well drilled on this prospect with the objective to test the hydrocarbon potentiality of Barail & Bokabil sands. The well fulfilled the target by successfully penetrating Barail and Bokabil section and finally reached basement without encountering the intervening Sylhet Formation due to a major fault passing through this well.

Standard suit of logs were recorded and analysed. Initially the logs appeared uninteresting with the resistivities of the order of 7 to 13 Ω m. As the hydrocarbon shows were observed in Bokabil, Barail and Kopili sections in the form of GYF/ mild positive cut, the logs were compared with those of low resistivity HC bearing sands encountered in the Uriamghat field. Based on the clue from Uriamghat log character, the low resistivity silty sands of KP-1 well were also interpreted as oil bearing. SWC were then attempted for entire section from Kopili to Bokabil, of which 6 nos. (2487m to 2523.5m) pertaining to Bokabil section showed strong GYF and moderate to strong positive cut. MDT has yielded 7lts of oil and 26cu. ft of gas from 2490.2m and 5.2 lts of oil and 21.6cu.ft of gas from 2507.4m. Pressures observed at these two depths are around 240 & 243 KSC respectively. The promising hydrocarbon bearing layer encountered in this well is confined to the interval of 2483m to 2526m. Top part of this interval is siltstone that grades into fine sandstone towards bottom with shale laminae.

While the drilling was on, the existing seismic data were reprocessed for Post Stack Depth imaging. This PSDM data was integrated with the drilling results of KP-1 and geological data of surrounding wells. Structural setting similar to that of KP-1 was identified at different places within the hanging wall fault blocks in the western rising margin of the area. Similar Amplitude attribute corresponding to KP-1 area was also observed in these places. Revisiting of the entire PSDM data in conjunction with the drilled well data enabled identifying prospective areas for further exploration.

Introduction

Structuration of Assam Foreland Basin has attained highly complex nature due to episodic tectonic activities. Dhansiri valley which is the part of Assam Foreland Basin also exhibits such imprint. Kalyanpur oil field situated towards the eastern side of Dhansiri valley adjacent to Naga thrust

(Fig.1). Discovery well Kalyanpur -1 is drilled down to basement with the primary objective to probe silici-clastic deposits within Barail/Bokabil Formation. Success of Kalyanpur can be attributed to its location in the unique structural setting and focused monitoring on low resistivity sands during drilling.



"HYDERABAD 2008"

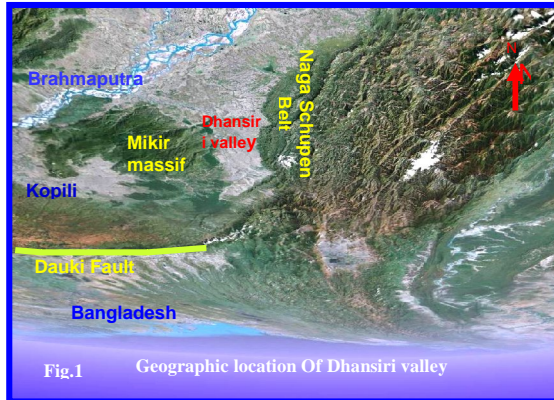
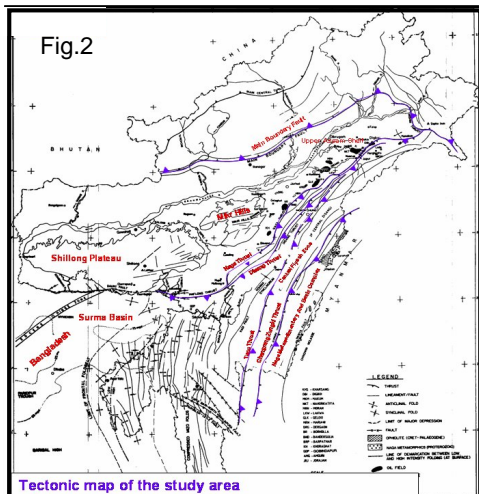


Fig.1 Geographic location Of Dhansiri valley

Geology of the Area

The Assam-Foreland Basin is located at the tri-junction of Indian shield, Himalayan geo-syncline and Arakan-Yoma geo-syncline. The arcuate eastern Himalayan frontal folded zone, marked by the Himalayan Foot-hill Thrust, defines the northern limit of the Basin. The northeastern boundary is limited by the Mishmi Hills with an exposure of Granites, Gneisses and Ophiolites. Thrust zones forming the eastern limit with the rocks of Naga Metamorphic Complex thrusting over the Tertiary sediments. The southern limit of the Assam-Arakan Basin is difficult to demarcate; however the Barisal-Chandipur gravity high trending in NE-SW direction with the probable surface manifestation of Hail-Hakalula lineament, may be considered to be the southern limit of Assam-Arakan Basin (Fig.2)



Broadly the sedimentation history of Assam-Arakan basin can be classified in to three phases. They are a) Inland rift

Gondwana sediments (Early Permian to Early Cretaceous) b) Passive margin sediments (Late Cretaceous to Oligocene) and c) Fore deep sediments (Miocene to Recent) (Fig3).

Age	Formation /Unit	Thick ness.(m)	Lithology / Environment
Pleisto - Cene to Recent	Alluvium	700	Fluvial
Pliocene	Post Tipam (Undifferentiated)	700 -1000	Fluvial (Braided stream to Flood plains)
Miocene	Tipam Bokabil		Shallow marginal marine (tidal influence)
Oligocene	Barail		Deltaic
Eocene	Kopili	250 -300	Shallow marine (Tidal channel & Tidal bar)
	Sylhet	70 - 120	
Early Cretaceous to	Tura		Mrg - shallow marine
	Gondwana	20 - 535	Non marine
Pre-Cambrian	Basement		

Fig.3 Generalized Litho-Stratigraphy of Dhansiri Valley.

Structural Style

Due to poly-phase deformational history of the basin, the fault system attained complexity. The NE-SW trending down to basin normal faults are the major fault systems in the area showing considerable displacements in the Paleogene section that even extending into much younger sequences. A set of cross faults trending E-W & ENE-WSW are also observed in the area which generally offsets the older NE-SW trending down to basin normal faults (Fig.4)

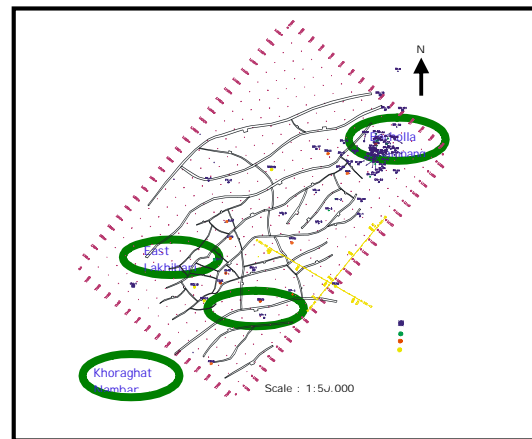


Fig.4 General fault trend in Dhansiri Valley



"HYDERABAD 2008"

The cross faults in some places are Gondwana basin bounding faults which have been reactivated in geologically younger period. These are in conformity with the E-W and ENE-WSW trending lineaments that show up on satellite imagery lineament map (Fig.5).

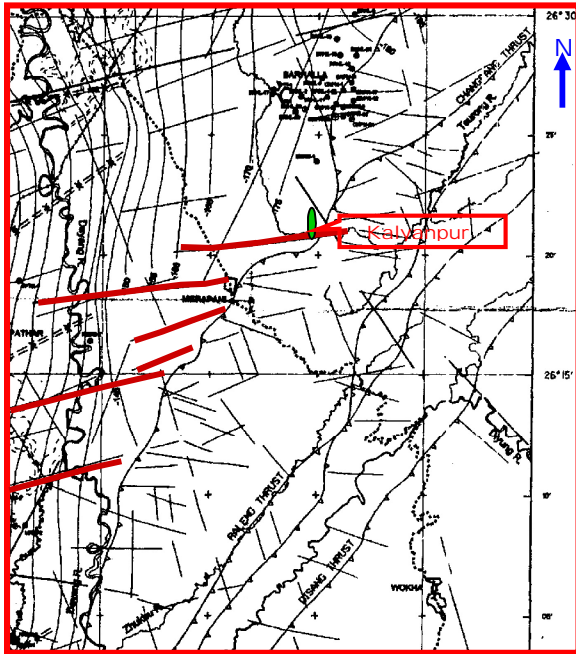


Fig.5 Lineaments trend as observed from satellite imagery

Analysis of FMI Log Data

Analysis of FMI log suggests the presence of both normal and reverse faults. Dominant strike direction is NE-SW. Presence of fractures and stylites are also noticed on FMI logs. The fractures are both resistive and conductive in nature and strike in the similar direction to that of the faults. However, some fractures/faults striking NW- SE are likely to be the conjugate set of the former. The interpretation of faults and fractures on FMI log is summarized in Fig.6 that shows the direction of compression and extension.

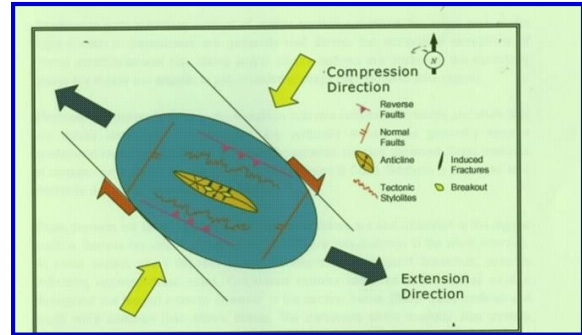


Fig.6 Showing the orientation of Faults, Fractures encountered in transpressional regime (Local structural setting) After Schlumberger report on FMI logs.

Analysis and Interpretation of Seismic data:

Mapping of the area with PSDM 3D data suggests that the main NE-SW trending high angle normal fault (AA) is associated with splaying of antithetic fault (BB) which has resulted in the elongated pop-up structure against the main fault in hanging wall block at Bokabil level. Seismic section showing the pop-up structure is placed at fig.7. The structure narrowing towards west eventually closes against the main fault (AA) and widens towards east. KP-1 is drilled in the central part of this structure (Fig.8). Similar pop-up structures are seen in the hanging wall side of fault CC also.

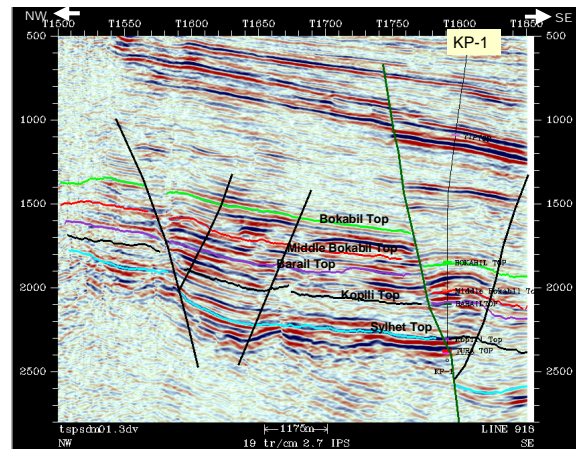


Fig.7 Inline showing drilled well KP-1 on a pop-up feature in the hanging wall block



"HYDERABAD 2008"

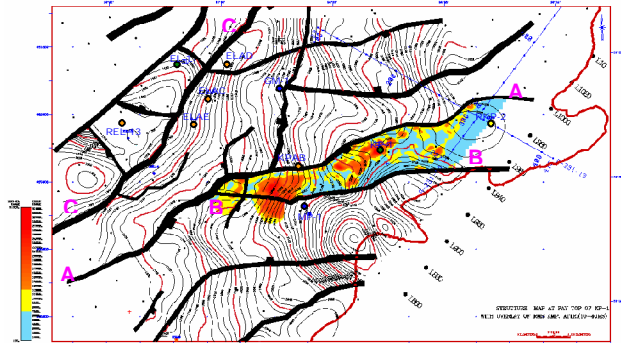


Fig.8 Structure map on Pay Top of KP-1 superimposed with RMS amplitude attribute (window 10 – 40 ms)

RMS amplitude attribute was generated for window of 10-40ms below the pay horizon to map the probable extent of reservoir facies. High amplitudes correspond to the reservoir facies encountered in the well. The amplitudes decrease towards ENE of the drilled well along the structure. Offset VSP survey was carried in the ENE direction along the structure to ascertain the possible extent of reservoir facies. This also indicated good amplitudes up to a distance of about 600m from the well and weakening of the amplitudes towards ENE direction (Fig.9). When we move further beyond 3D area, high amplitude signatures at Barail/Bokabil level are again noticed on 2D lines (Fig.10)

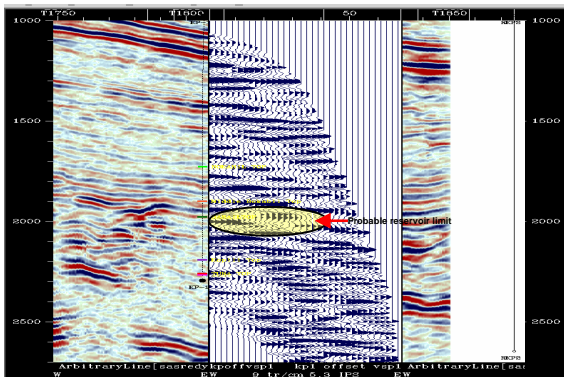


FIG.9 Offset VSP In the direction from KP-1 to RKP-2 matched with 3D Seismic

Therefore, the entire linear structure encompassed within the fault block is considered prospective for middle Bokabil. Encouraged by the oil strike with in middle Bokabil layer in Kalyanpur, the entire PSDM data has been re-evaluated for similar play type. Similar pop-up structures have been mapped at the foot wall side of next major fault in the west near Esat Lakhibari area. Based on the structural style and pattern of accumulation, the foot wall blocks are considered prospective for Sylhet prospectivity and hanging wall blocks for Bokabil/Barail prospectivity.

Success in Kalyanpur well and subsequent search for similar play enabled identification of about 42 Sq.Km area prospective for Bokabil play.

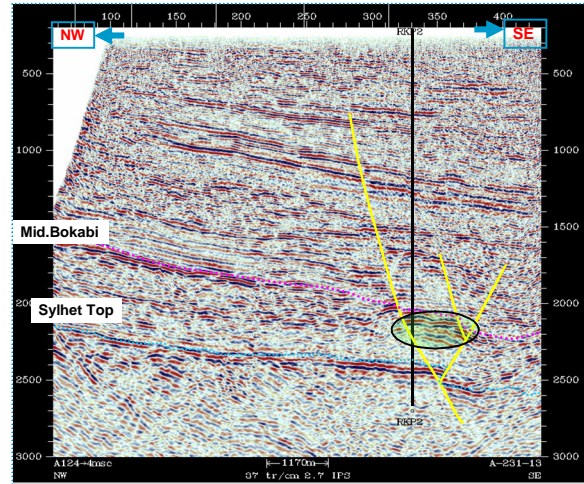


Fig.10 2D Line showing similar features in the area NE of KP-1

Some of the lines which are perceived to be having similar play type are shown at figure Nos.11 through 11f.

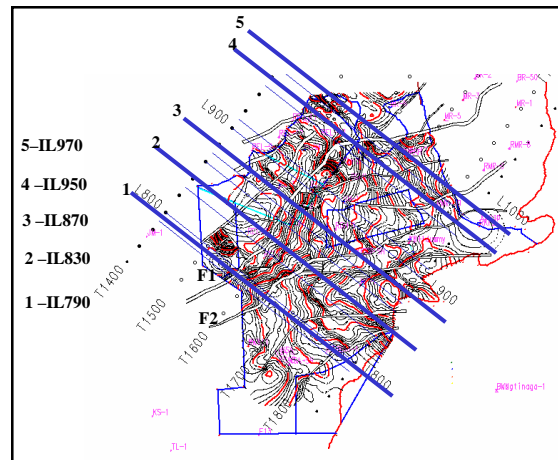


Fig.11. Map showing the scheme of lines for depicting Bokabil prospectivity



"HYDERABAD 2008"

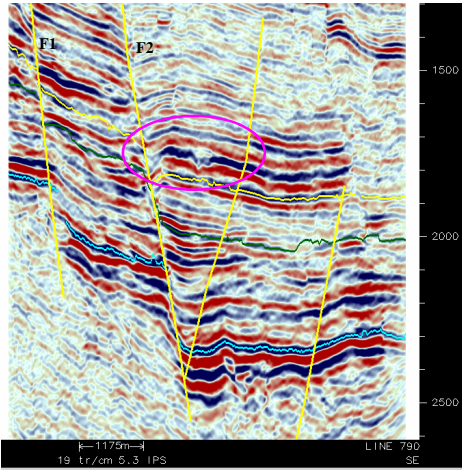


Fig.11a Line 790 showing pop-up type feature at Middle Bokabil level against fault F2

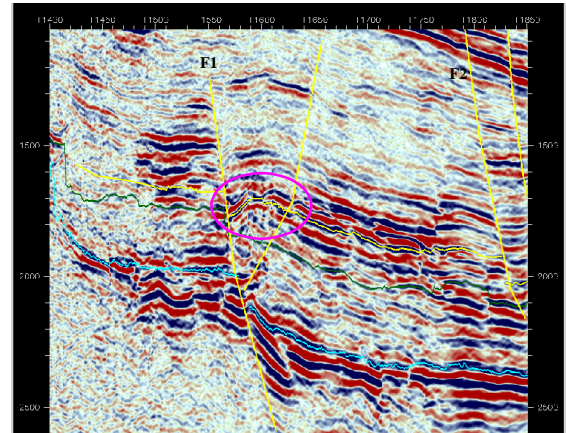


Fig.11d Line 950 showing pop-up type feature at Middle Bokabil level against fault F1

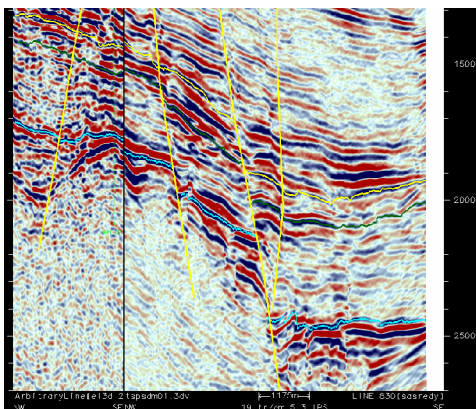


Fig.11b Line-830 showing horst feature at Sylhet level in Foot Wall Block

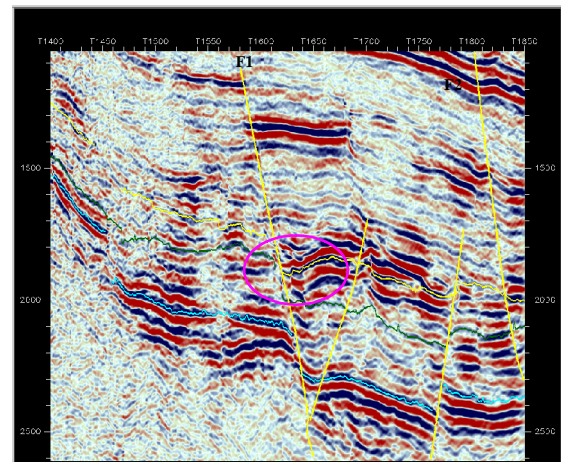
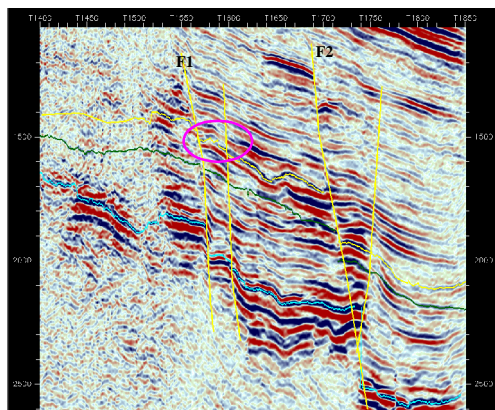


Fig.11e Line 970 showing pop-up type feature at Middle Bokabil level against fault F1



Bokabil level against faults F1 & F2

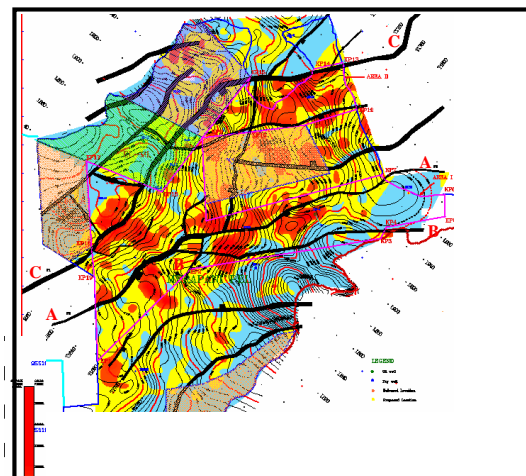


Fig.11f Sequence attribute map for Bokabil unit with overlay of structure map of Bokabil showing the prospective areas.



"HYDERABAD 2008"

The lines cutting across the faults F1 and F2 have been chosen to show the pop-up type feature in the hanging wall block of the respective faults.

Saga of Success:

The monitoring & interpretation team of the well kept track of every possible information during drilling. The cuttings were more thoroughly examined when the well reached interesting objects viz. Barail/Bokabil. The standard suit of logs when examined and interpreted initially were not found to be very promising. Resistivity of the order of 7 to 13 Ω -m was initially considered unworthy of further pursuing. However, the specky fluorescence observed in cuttings gave an insight that logs should be reinterpreted. These logs were then compared with those of Uriamgat field situated at about 50Km distance from this field (Fig12) which produced oil from low resistive silty reservoirs.

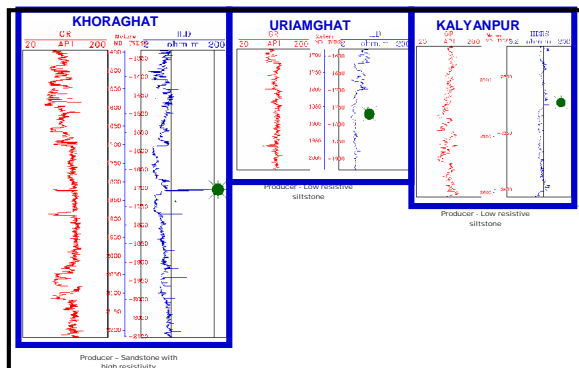


Fig.12 Comparison of KP-1 log motifs with those of producing fields in the near by area

78 nos. of SWC were attempted for entire Kopili to Bokabil sections, out of which 6 nos. are from 2487m to 2523.5m pertaining to Bokabil section showed strong GYF and moderate to strong positive cut. MDT sampling has yielded 7lts of oil and 26cu. ft of gas from 2490.2m and 5.2 lts of oil and 21.6cu.ft of gas from 2507.4m. Formation pressures observed at these two depths are around 240 & 243 KSC respectively. Interval between 2483m to 2526m was perforated through TCP gun. The well produced at the initial rate of 45m³ per day.

Conclusions

- The low resistivity silty reservoirs merit relook in the entire area.
- Specky fluorescence observed in the cutting samples held the key in finding hydrocarbons in this field.

- The success in Kalyanpur field led to the identification of 42 Sq.Km of prospective area having similar play in the surrounding area.

References

1. Comprehensive review of exploration & future strategy of exploration in Dhansiri Valley, Assam by S.C.Roychowdhary, 1997.
2. Microfacies and Source Rock Analysis of Sylhet Formation in Borholla-Changpang area by Kalyanbrat Dutta et. al.
3. Geology of Assam. Geological Society of India Bangalore. Dasgupta.A.B, Biswas, A.K. 2000.
4. Integration and analysis of surface and subsurface structural data using GIS- A study for the Dhansiri Valley adjoining Naga Schuppen Belt and Mikir Massif. ONGC unpublished report Dotiwala,F et.al. 1999.
5. Sequence Stratigraphy and Petroleum System of Assam Shelf, ONGC unpublished report Naik,G. C. et.al. 2001.
6. Integrated regional tectonic framework, depositional environment and petroleum systems in Dhansiri valley. Pradhan, U.C. et.al

Acknowledgement:

The authors wish to express their deep sense of gratitude to Shri.J.S.Sekhon G.M-Basin Manager, Cauvery Basin for his inspiring leadership as a Basin Manager, A&AA Basin. It was in fact under his leadership and guidance, each activity was undertaken that finally culminated into a discovery. They also would like to thank all those involved in well monitoring and well logging that led to this discovery. Dr. DVR Murthy GM-Block Manager, Cauvery Basin has constantly encouraged us to write paper for contributing to SPG. His unstinting support is thankfully acknowledged. The authors wish to thank ONGC Management for permitting to publish this paper.