



Prognosticating New Hydrocarbon Plays and Unconventional Reservoirs through Integration of 3-D Seismic with Reprocessed Logs of “Missed-Oil Opportunities” In North Rudrasagar Field

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Summary

The Barail main sand, which is the principal producing sand in the Rudrasagar field, is in a mature stage with increasing trend of water-cut and declining oil production. Alternate reservoirs and structures as well as new concepts need to be identified and tested to improve production and accrete reserves.

Geoframe reprocessed logs of two ‘dry and abandoned wells’ and their pay zone correlation with isolated existing producers indicated ‘missed oil opportunities’ in TS-4 and BCS-I pay zones in North Rudrasagar area. Integration of log reanalysis data with the available 3-D seismic data of the area indicates possibility of new hydrocarbon plays that have potential to accrete new reserves through field growth. The study also indicates reservoir potential (substantiated by testing) in apparently unfavorable facies such as claystone in LCM section, when associated with deformation features such as faults. These features have been succinctly brought out through log reprocessing and 3-D analysis.

These concepts can help in log evaluation and identification of new prospects and hydrocarbon related tectonic plays.

Introduction

Prospecting for new hydrocarbon plays and unconventional reservoirs is particularly relevant to mainly single reservoir fields such as the Rudrasagar field where the Barail Main sand has 85% of the field reserves (with exception to the recent oil strike in Turas in Disangmukha and Panidihing areas), followed by BCS which has mainly gas reserves in BCS-I and BCS-VIII. Some isolated oil pockets are also available in BCS-I and TS-4. The available reserves are mainly in the PDD- proved developed category, hence identification of new reserves is essential to improve the R/P ratio of the field, though this aspect has got a major boost from the recent oil strike in the Tura formation in Disangmukha and Panidihing area.

The present study based on two missed oil opportunities in the BCS-I and TS-4 offers exciting prospects for field growth in the area north of the main Rudrasagar field.

The concept of oil accumulation in unconventional reservoir like claystone, that has been linked to a new hydrocarbon play, offers a new insight into the tectonics related oil migration and accumulation.

Methodology of revaluation and pay zone assessment with examples

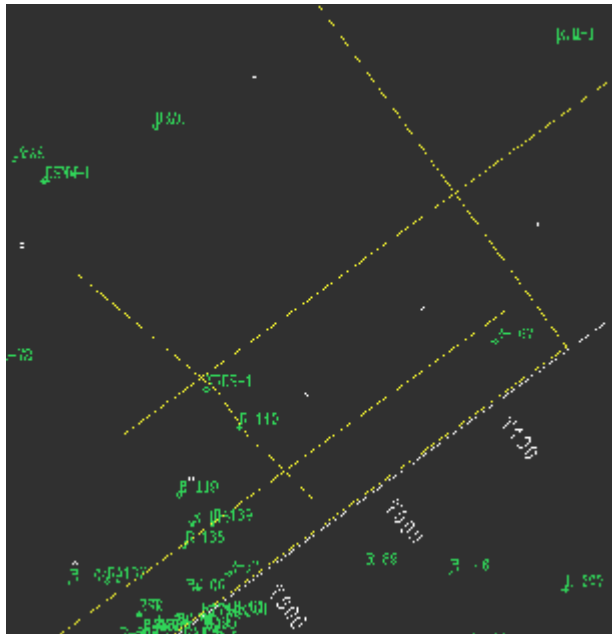
1. New TS-4/5 hydrocarbon play in N. Rudrasagar area through innovative workover testing and evaluation of “missed-oil opportunity”



1a. Delineation of hydrocarbon play in the blk of well R#115-

Striking of oil in an unconventional reservoir in LCM section in well R#115, along with its subsequent integration with 3-D seismic and correlation with reprocessed log of well NRDS-1 has indicated missed oil prospects in TS-4. The study shows bright prospects of delineation of a new hydrocarbon play and accretion of new reserves, besides re-estimating the prospectivity of apparently tight but fractured reservoirs linked to regional faults.

Hydrocarbon entrapment in well R#115 in TS-4/5 pay zone appears to be related to a NW-SE fault, hading to NE. In the well logs (Fig.2), the fault may be interpreted by cycle skipping in the sonic log and in the time slices of the area (Fig 3-6), it is indicated by a strong linear trend incorporating the likely fault and producing lithology. Initial log evaluation of TS-4/5 in well R#115 had indicated marginal prospects in the sand layers above and below the interval which was initially perforated and gave oil on testing. This interval (2746-2749m) not assessed and recommended for perforation as the lithology was indicated to be claystone. On perforation the well became active with oil and gas. A PI of 0.9 m³/d/ksc indicated a good influx from the zone. Currently well is producing with QI- 15m³/d, w/c- 55%. Subsequently, int. 2749-51m in TS-5 and 2741-45m in TS-4 were also added but there has not been any apparent change in the rate of influx or water-cut indicating good communication of the reservoir from the initially perforated tight part. It is also notable that oil production is constrained currently due to a common flow line with two other wells otherwise a production of 25m³/d is likely.



RUDRASAGAR TS-4: STRUCTURE & ISOPAY MAPS

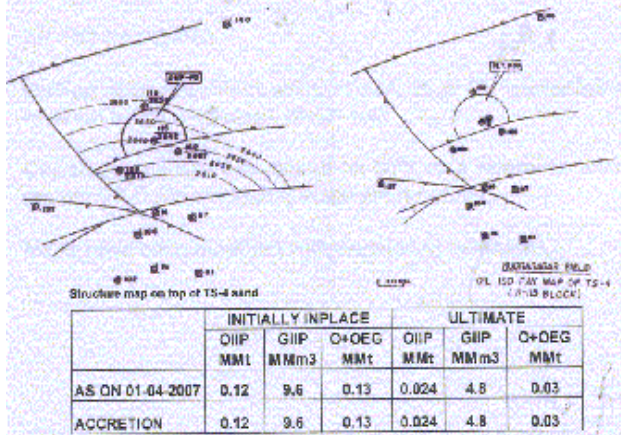


Fig 1A (upper) .& 1B. Study area, Location map and REC map for new reserves in TS-4

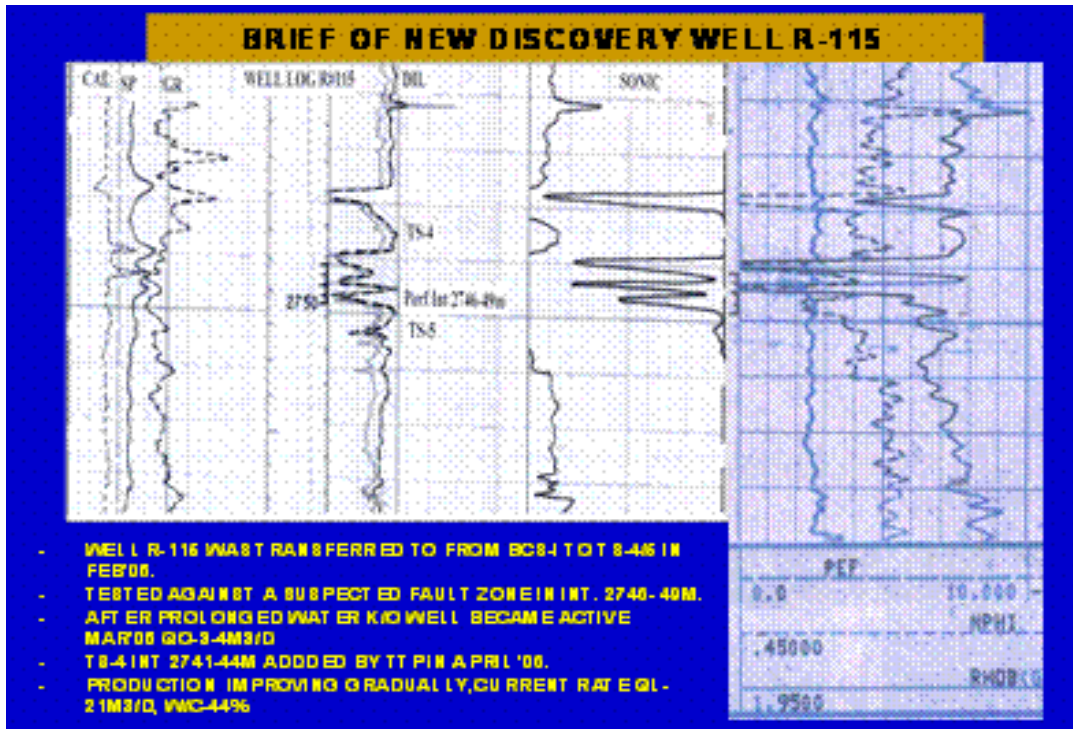


Fig.2. Composite log of well with perforated interval in LCM

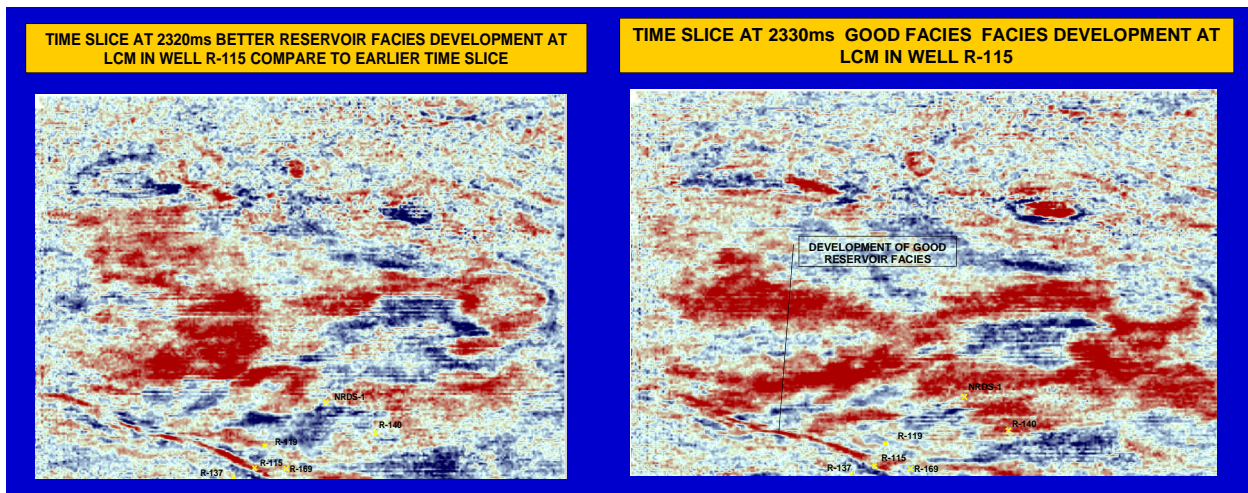


Fig 3& 4. Time slices at LCM level

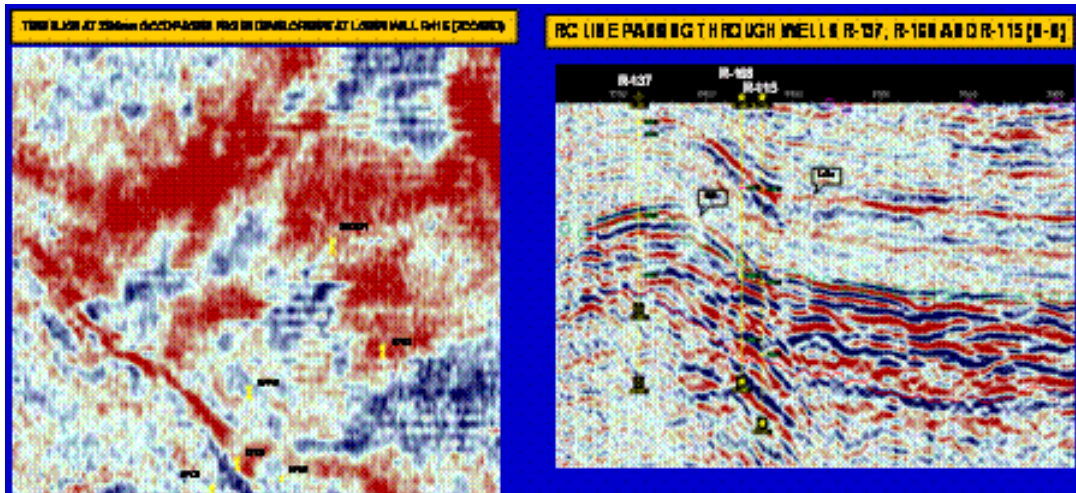


Fig 5&6. Close-up of time slice at 2320ms and RC line across the area

The study was presented in REC 2006 following which the structure and isopay maps for TS-4 were made (on the pattern of BCS-I) and only “well-bore“ reserves of 0.13 Mmt were estimated in PD category. (Fig 1B)

However, considering the extent of reservoir facies and fracture trend implied in the above time slices, it is felt that the pay will cover a significantly more area along the identified fracture and will help in delineation of a new hydrocarbon play along with new reserves accretion

1b. Delineation of new TS-4 prospects thro’ “missed- oil” opportunity in well NRDS-1

A good development of TS-4 was also observed in well NRDS-1, which is located north of well R#115. The TS-4 development in this well was not assessed and cased behind 95/8” casing. The log motifs and Rt of 8-10 ohm.m.m compare favorably with that of R#115 and after reprocessing,(Fig.8,9) employing the parameters of oil producer well R#115, appears very promising with So upto 65% and pay thickness of 8m. Firming up of hydrocarbon prospects in TS-4 in this area would result in huge reserves accretion as it would cover the entire area between these two wells except the intervening low present along well R#119 as given above (Fig 7).

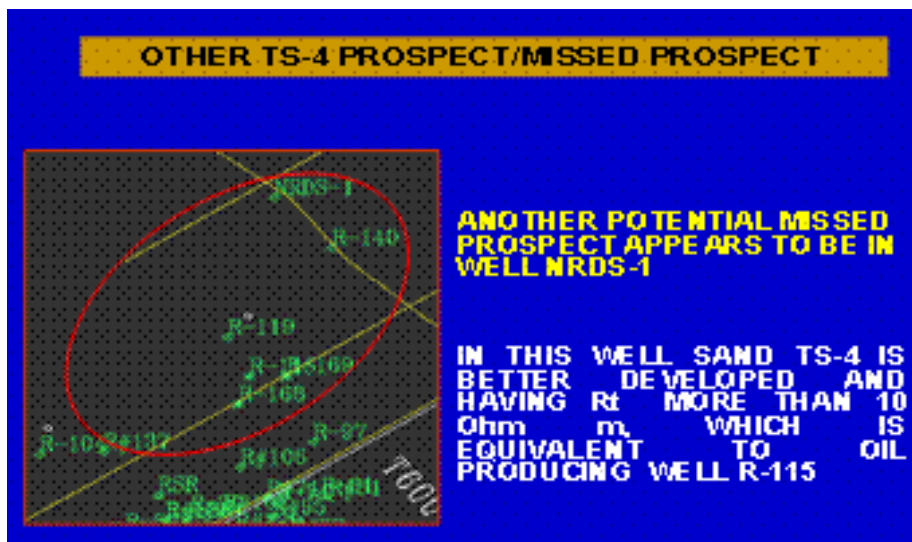




Fig.7 Location Map of NRDS-1

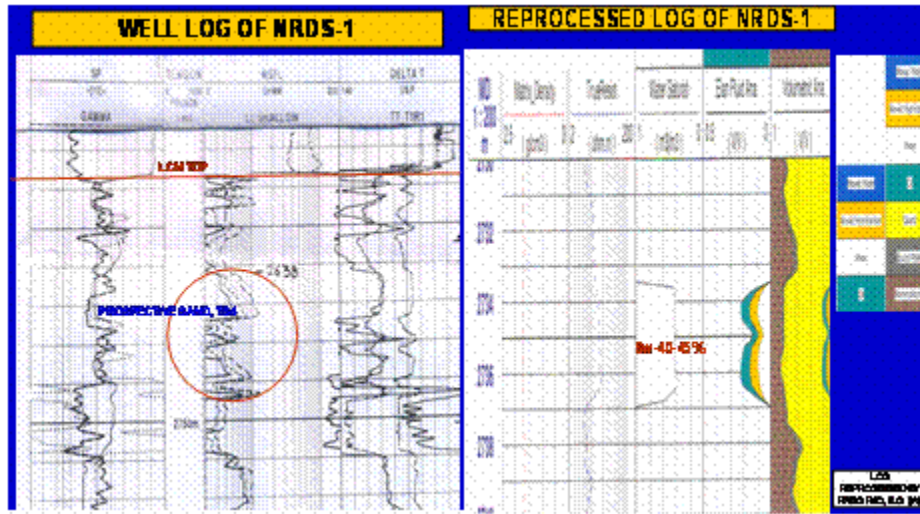


Fig. 8 & 9. Original and Reprocessed TS-4 section of well NRDS-1

2. Prospects Of New Reserves Accretion In BCS-1 Through “Missed-Oil Opportunity” In N. Rudrasagar Area.

Log reprocessing by Geoframe, of well R#140 (Expl well, drld in 1996, Abandoned w/o lowering Prod. Csg) indicates yet another missed oil prospect). In this well BCS-I appears oil bearing in the int. 3170-3180m as indicated below in the original and the reprocessed log section (Fig.12). As per the proposed log correlation, this layer appears equivalent to the oil producer BCS-1 layer of R#115 and is structurally up by 74m. In such a case there would be a tremendous scope for new reserves accretion by opening up a vast new area for exploitation (Fig 10 & 11). The well R#115 produced 28.750 tons of oil till Nov’ 2005, when it ceased due to choking of its Gravel pack

which could not be retrieved and the well was transferred to TS-4. Its initial rate was 38m³/d which raises optimism of good oil rate from well R#140. As this well was abandoned, a substitute well will be required.

The max. Rt in well R#140 is 30 ohm.m with estimated Sw of 0.3 in the int. 3171-73m, while in the eqv.zone in R#115 the Sw is 0.4-0.5. The OWC in R#140 is estimated at 3175m in the reprocessed log against 3180m in conventional log. This zone was not evaluated in the initial well evaluation.

Integration with the 3-D seismic of the area indicates good structural position as well as facies development in the area. There also appears to be a fault adjacent to the well at BCS-I level that may have impacted oil accumulation (Fig 14)

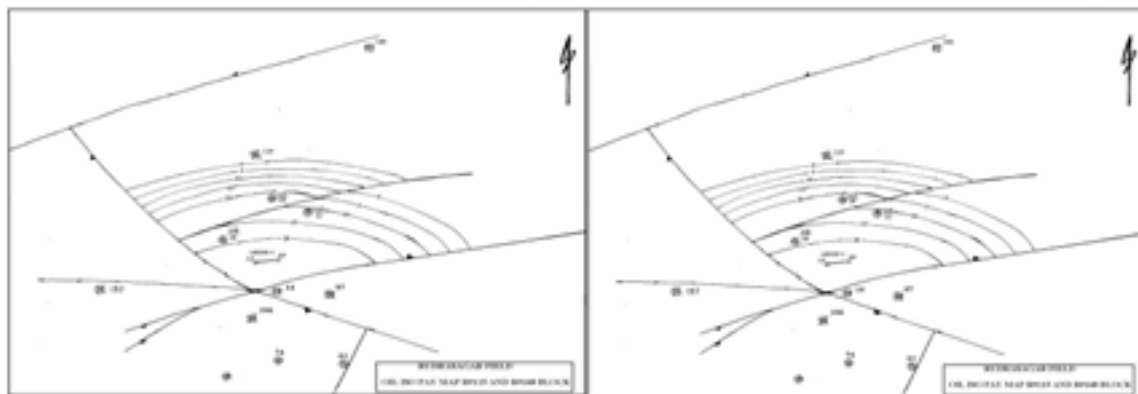


Fig 10 & 11. REC Structure Contour and Oil Isopay map for BCS-I in R#115 Blk



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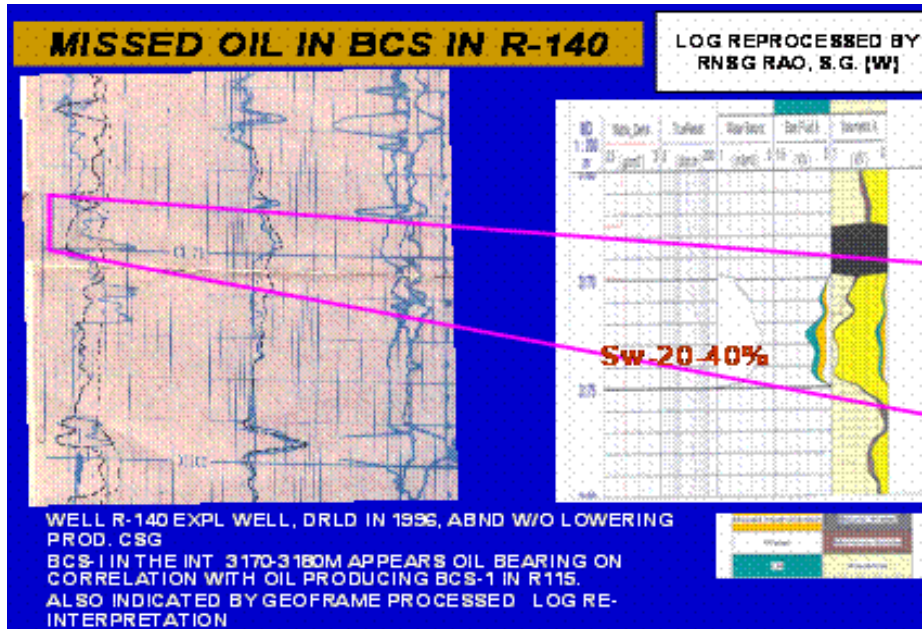


Fig.12. Original and the reprocessed BCS-I log section of well NRDS-1

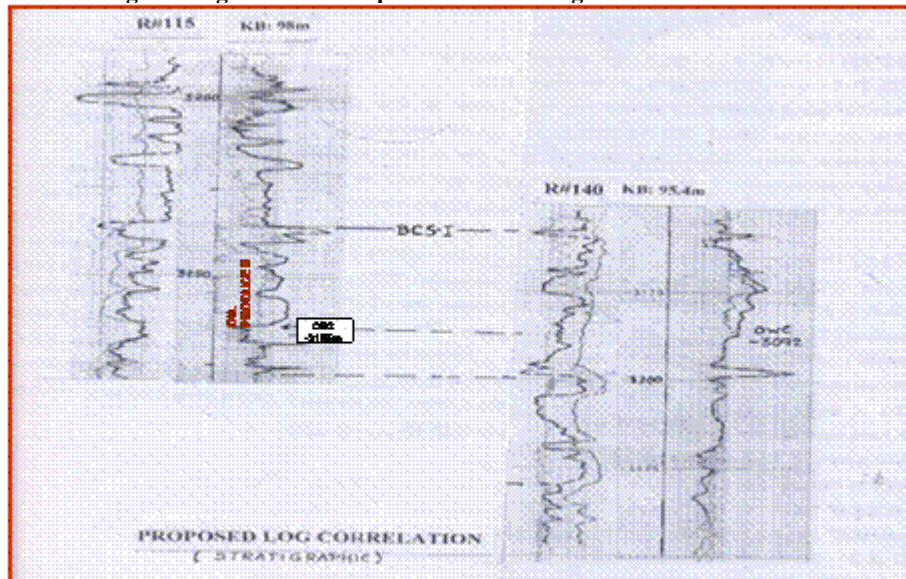


Fig 13. Proposed log correlation of R#115 BCS-I pay zone with R#140

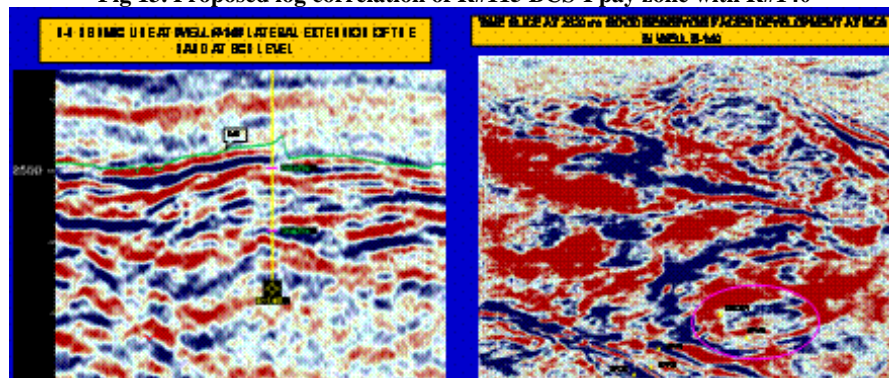


Fig 14 & 15. Facies development at BCS-I with likely fault near well R#140



Conclusions and Recommendations

1. In mature fields, new concepts for field growth and new prospect identification are urgently needed to improve the R/P ratio.
2. The present study has identified “Missed oil” prospects in TS-4 and BCS-I, backed up by well log reanalysis and integration with 3-D data, in North Rudrasagar area.
3. Good, sustained oil production against a tight layer (Clay Section) in well R#115 along with interpretation of a fault zone along this layer has thrown new light on the prospectivity of the so-called tight reservoirs and indicates possibility of a new fault-related hydrocarbon play in the area.
4. Geoframe reprocessing of well logs of wells NRDS-1 and R#140 indicates missed oil opportunities in TS-4 and BCS-I respectively. Both pays are well correlatable with the equivalent oil-bearing/producing zones in well R#115.
5. Integration of above features with the regional 3-D seismic data indicates extension of prospective facies, associated with faults that have possibly acted as conduits for oil migration and accumulation in adjacent facies.
6. The study suggests and good scope for new reserves accretion in these layers and helps in better understanding of the tectonics and deposition environment.
7. The above concepts can also have application in reevaluating oil prospects and understanding the role of faults, fractures in similar tectonic settings.

References

REC maps and well logs and production data of wells of Rudrasagar field.

Attribute, TWT, Depth Maps at TS-4, BCS-I and BMS level prepared at NAS, Jorhat.
Sections and time slices at various levels.

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