Assessment of Hydrocarbon Potential of Kutch Offshore Plays through Petroleum System Modelling of Kutch Basin

For Eocene source rock, a default type III kinetics, Pepper & Corvi (1965), T-III-H-(DE) has been assigned in the model.

Heat Flow

Thermal calibration of present day heat flow regime was made using observed corrected BHT values from wells.

Maturity and Transformation Ratios of Source Rocks

Source rock layer modelled within Early Eocene Sequence is observed to be mostly in immature window except north of proposed location where early oil window maturities are seen (Fig-6) with negligible transformation ratios (TR%).

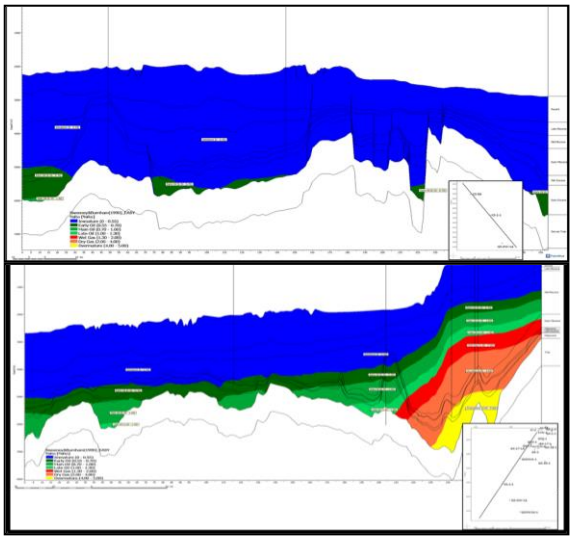

Fig-6: Present day rock maturity along modeled sections

Petroleum Accumulation in Modeled Section

In Modeled 2D sections little hydrocarbon accumulation is observed as the source rock is not able to attain sufficient maturity in larger areas and required kerogen transformations (Fig-7) in the deep water area.

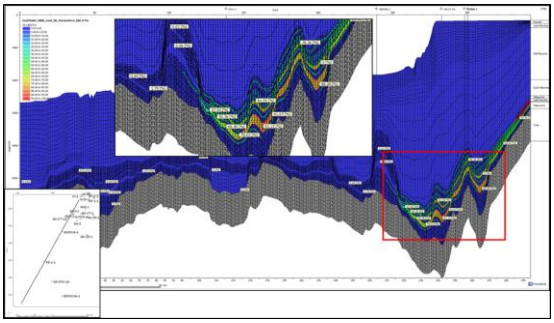

Fig-7: Transformation Ratios and Migration Vectors along modeled section

Additional scenarios with Mesozoic sediments below Deccan Trap

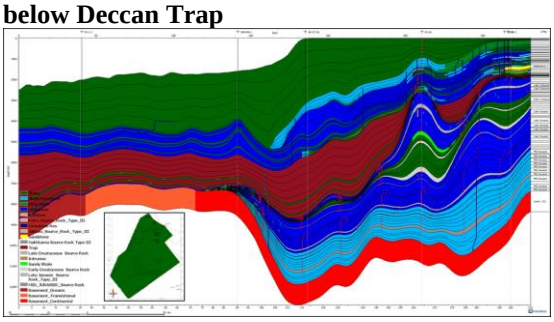

Fig-8: Lateral Facies variation and Mesozoic sequences

Mesozoic extent is envisaged (Fig-8)and modeled from GM data till the COB. Assigned speculative source rock layers in Mesozoic sequences have attained sufficient maturity (Fig-9) and Migration vectors show that generated hydrocarbons have the capacity to move through Faults into Tertiary sequences.

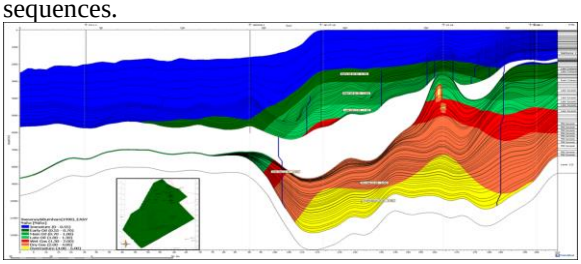

Fig-9: Present day rock maturity along modelled section

Biogenic Modeling

Geochemistry studies

As per the WCR of MBS-A, the gas hydrate phase plot indicates conditions favourable within the sediments to a depth of 1200m (theoretical BSR) to

Assessment of Hydrocarbon Potential of Kutch Offshore Plays through Petroleum System Modelling of Kutch Basin

form gas hydrates. However, the same is not seen on the seismic data. LWD logs indicated possible presence of shallow gas. Also, seepages and small crater at the wellhead indicate presence of gas. Therefore, there exists the possibility of shallow gas or gas hydrates being present at the location.

One Biogenic scenario was modeled based on present day temperature regime, in which few zones are identified as probable generative centers of biogenic gas. In this scenario, Biogenic gas generation window is observed within the sediments of Middle Miocene age (Fig-10) as assigned biogenic source rock layers are showing biogenic gas migration vectors. Therefore if we are able to detect good reservoirs in vicinity of methanogenic activity zone there could be a chance of getting Biogenic gas accumulations based on this study.

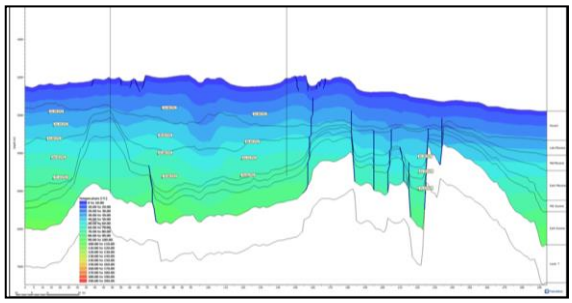

Fig-10: Isotherm for section-1 indicative of the Present day Temperature regimes which may lead to Biogenic activity

Conclusions

- PSM studies brought out paleo-history and assessed the timing and sequence of geologic and tectonic events since 65Ma onwards, vis-à-vis, hydrocarbon generation and migration to evaluate the prospectivity in Deep waters area of Kutch Offshore basin.
- Tertiary sediments got deposited in a stable passive margin set up. Deeper areas of shelf are dominated by argillaceous limestone / shale intercalations.
- Late Paleocene and younger source rocks are barely reaching the main oil window in deep water areas, due to less overburden sediments. In the shelf area, Late Paleocene and younger source rocks are in main oil to wet gas window.
- Main hydrocarbon generation maturity window falls approximately below 2400m and which vary in depth depending on present day water depth i.e. for Shallow water areas generation window is below 2400 m and for deeper water areas it is starting from ~5000m onwards.
- Additional scenarios with Mesozoic sediments below Deccan Trap have attained sufficient maturity.
- Biogenic gas generation window is observed within the sediments of Middle Miocene age. If we are able to detect good reservoirs in vicinity of methanogenic activity zone there could be a chance of getting Biogenic gas accumulations based on this study.

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Acknowledgements

The author is grateful to Director (Exploration), Oil & Natural Gas Corporation Limited for according permission to publish the article. Encouragement from Ed-HOI KDMIP, Dr Hari Lal is greatly acknowledged. The authors wish to express thanks to Dr. A.Siawal, GGM, KDMIPE, for his encouragement.