# DEPOSITIONAL SEDIMENTARY ENVIRONMENT AND HYDROCARBON POTENTIAL OF PANNA FORMATION IN THE SOUTHWEST OF MUMBAI HIGH - A CASE STUDY

**S. K. Sahu*, P.S.Basak, S. K. Verma and Dr. B. C. Rao**

***Oil and Natural Gas Corporation Ltd., VRC(Panvel), WOB, ONGC, Mumbai.**

**E-mail: sahu15458@yahoo.co.in**

**Abstract:**

**A total area of 2392 sq.km seismic 3D PSTM volume covering SW of MH has been studied for identifying the prospective areas for exploration. In the study area hydrocarbon accumulation is seen mainly in the upper part of Panna Formation. Several fluvial systems were observed following low axial trends and depositing their sediments as fan lobes in a continental-transitional marine set-up. These fan lobes are observed to be reshaped by the tidal influence. Panna Formation's coal-shale unit is the principal source rock of the area. The reservoirs observed in the study area are sands with in upper part of Panna Formation. Strati-structural entrapment may be expected for Panna reservoirs.**

**Keywords:**
Mumbai offshore Basin, Waveform classification

**Introduction:**

The area under study falls to the southwest of Bombay High and encompasses the proven structures of WO5, D-33 and B-41. Out of these structures WO5 produced oil & gas from Panna, Bassein and Mukta Formations and D-33 from Panna during initial testing. The well B-41 has given oil & gas during initial testing from Devgarh sandstone. Most of the structural highs have, thus, been explored thoroughly using the time data and structural maps made using the normal depth conversion methods. Panna Formation is having high potential for hydrocarbon exploration in the study area and this requires proper understanding of depositional environment.

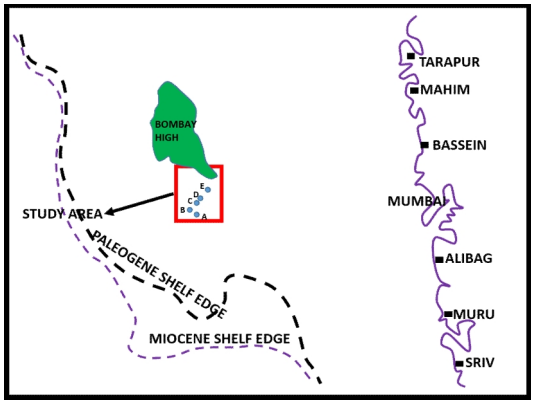



**Fig.1 Location map showing the study area**

**Stratigraphy:**

The generalized stratigraphy of the study area is given in the table below.

| AGE | FORMATION | SEISMIC MARKER | THICKNESS (M) | LITHOLOGY | HC OCCU. |
|---|---|---|---|---|---|
| RECENT TO LATE MIOCENE | CHINCHINI | H1A | 1100-1400 | | |
| EARLY TO MID. MIOCENE | RATNAGIRI / BOMBAY/ BANDRA | H3CGG | 650-750 | | |
| LATE OLIGOCENE | PANVEL | H3 | 300-350 | | |
| EARLY OLIGOCENE | HEERA | H3A | 60-80 | | |
| | MUKTA | H3B | 0 - 40 | | |
| MIDDLE EOCENE | BASSEIN | H4 | 0 - 200 | | |
| PALEOCENE TO E. EOCENE | DEVGARH / PANNA | H5 | 0-200 / 0-1500 | | |
| LATE CRETACEOUS / ARCHEAN | DECCAN TRAP / GRANITE | | | | |

**Depositional Environment of Panna Formation:**

Panna Formation is a synrift tectonic clastic sequence and comprises of alternations of Shale, siltstone, sandstone with occasional coal and limestone streaks. Over the paleo-highs in BH area the Deccan trap is overlain by 2-20m thick trap derivatives which are called as Basal Clastics. The Basal clastics sediment contains ferruginous clay, siltstone, sandstone, trap derived conglomerate and this is charged with oil and gas in WO5 and BH areas. The term Basal Clastics is normally confused with Panna Formation and the observations of the present study reveal that Basal clastics and Panna Formations are two entirely different litho units. Basal clastics are only seen on the MH-WO5 area and Panna sediments (rift fill) are wedging out against these highs. In Mumbai High area the Basement is overlain by Basal clastics and in turn Basal Clastics

are overlain by silici-clastics-carbonates of Bassein Formation.

Panna sedimentation is marked by continental to transitional marine set-up. All around Mumbai High areas like MH, WO5, B119 and B121, continental sedimentation with number of ridges and gullies are present. Sands are expected to be guided in paleo-lows with lobate geometry as it is deposited along western and southern boundaries of the main Mumbai High as well as the B119-B121 inlier with likely shallow marine set-up. In the vicinity of Deccan trap country, B-121, WO-5 and WO-15 area, weathered granite / trap derived debris were deposited at the mouth and along valleys in the form of alluvial fan with coarser proximal, distal finer fan facies. The fans were associated by braided channel system with development of crevasse splays and accretionery bar deposits. It opens up and meets the sea to the south. Thus, the fan system is further modified by marine processes, which led to development of broad tidal flats (Rastogi et al 2005).

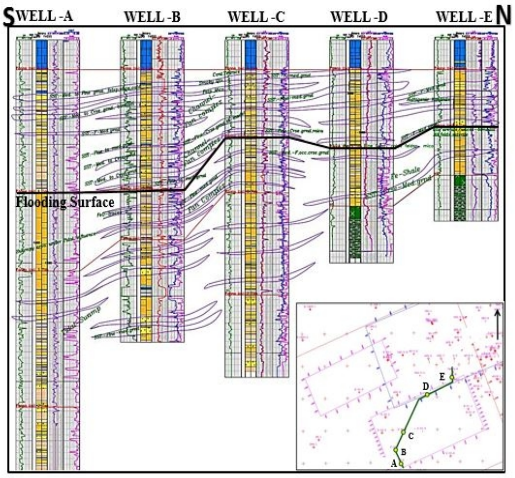


Fig. 2: Stratigraphic Correlation showing fan lobes on a flooding surface

**Results and Discussion:**

In the study area hydrocarbon accumulation is seen in the upper part of Panna Formation. Electro-log correlation (Fig.2, 3) along south-north profile depicts several fan lobes above the flooding surface. Isopach and Sand Isolith maps were prepared for upper part of Panna Formation by taking well data as input to identify depositional environment and sand geometry.

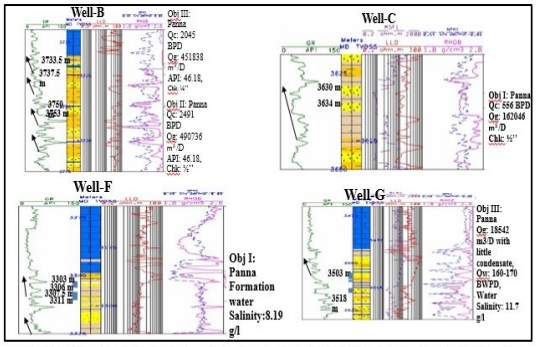
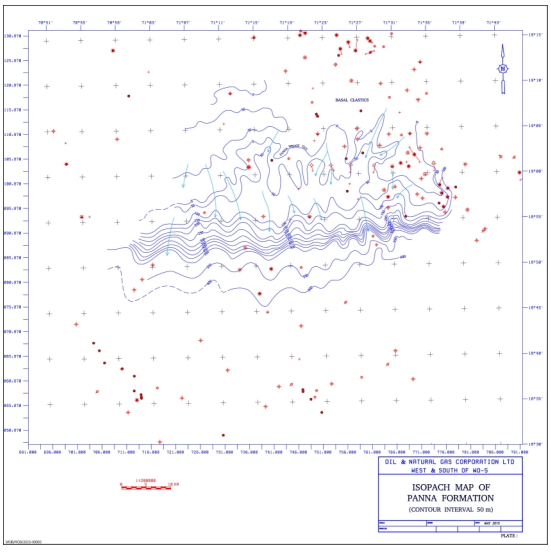


Fig. 3: Log signatures of Panna Formation showing Fan lobes (Coarsening upward) associated with channels (Fining upward)

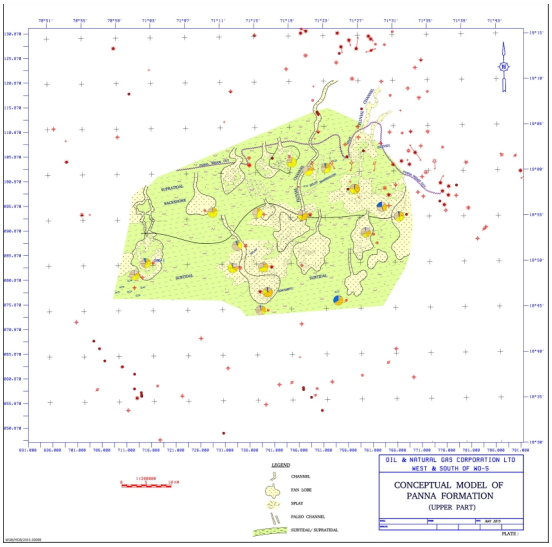
Isopach map of Panna Formation (Fig.4) shows thinning and wedging out towards north and northeast paleo-highs. The Formation is thickening towards south and southwest (sloping axis towards paleo low). Several fluvial systems were observed following low axial trends and depositing their sediments as fan lobes in a coastal-transitional marine set-up. These fan lobes are observed to be reshaped by the tidal influence.

One conceptual depositional model was prepared for the Panna Formation (Fig.5) and the model is showing development of several fan-delta lobes in the study area with provenance from north, northeast and northwest side paleo-highs. Waveform classification (Fig.6) at Panna level (covering upper two units) is confirming the above fan-delta model.




Seismic section flattened at Panna level (Fig.8) is showing low axial depositional trend and the normal seismic section (Fig.7) is showing high trend at Panna level and the sands deposited during paleo low trend got charged with hydrocarbons.

Panna Formation's coal-shale unit is the principal source rock in the study area. Strati-structural entrapment may be expected for Panna reservoirs due to the presence of shales with in Panna Formation and tight carbonate layers with in Bassein Formation. Fault closures are also providing good entrapment conditions for Panna reservoirs.



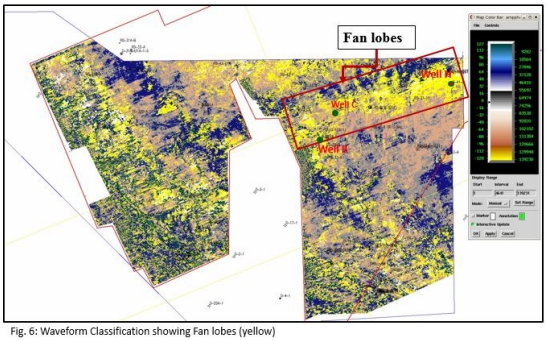




Fig. 6: Waveform Classification showing Fan lobes (yellow)

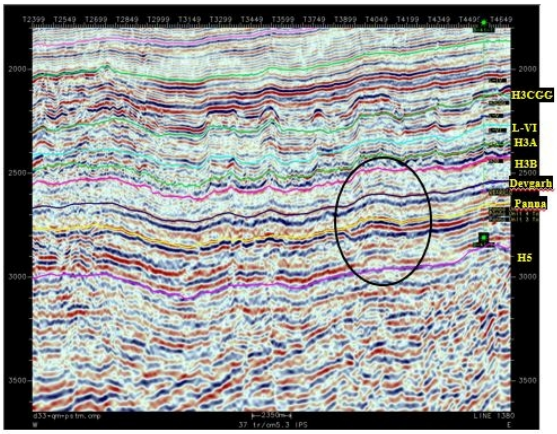



Fig. 7: Seismic section showing high trend at Panna level

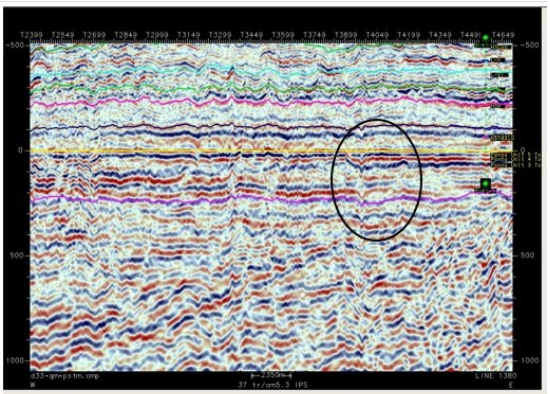


Fig. 8: Seismic section Flatten at Panna showing paleo low depositional trend

**Acknowledgements:**

The authors are grateful to the Management of Oil and Natural Gas Corporation Ltd. for assigning this project, providing an opportunity to complete the project.

**References**

1. Biswas S.K 1982. Rift basins in the western margin of India and their hydrocarbon prospects. AAPG Bull, V-66, no.10, p 1496-1513.
2. R Rastogi and M M Mishra, May 2005. Paleocene-Eocene depositional system-Southern and southwestern part of DCS area: (Unpublished report, ONGC)
3. S.K.Biswal and HariLal. Geohorizons, January 2006. Sand dispersal pattern within Panna Formation in Central Graben, Bombay Offshore Basin: A model based approach.