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Value addition through re-processing of vintage data by Pre Stack Time Imaging- A Case history from Mumbai offshore basin

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Summary

Pre - Stack Imaging through re-processing of seismic data not only resulted in image enhancement but were good enough to result in detection of hydro carbons by suitably re- positioning of drilling location. The present study is about a data acquired about two decades back, processed in 2001 and later re-processed in 2009.With the advancing of processing technologies it is now made possible to re-look and re- interpret the data making use of various attributes thereby adding value to the existing hydro carbon potential. Based on the current data a location deviated from earlier dry well resulted in place reserve accretion of more than 4.0 mmt.

Keywords: *Angle stacks , Mumbai offshore*

Introduction

The present study is an Re-processing of 150 sq km 3D seismic data of CA-CD area. The 3D seismic data in the area was acquired by deploying 2 streamers, each having 96 channels at a group interval of 25m and air gun firing at 25 m interval alternately. The prospect was covered in 313 sequences.

The main objective was to know the lateral extent of hydrocarbon bearing sand bodies and to know the continuity in the area which are within Mahim to Panna formation. These were further to relook into depositional patterns for Daman and Mahuva sands based on the seismic attribute analysis to refine structural picture of the area and to locate strati-structural prospects

Geological Setting

The Mumbai Offshore Basin is a rift basin evolved in a passive margin basin through four evolutionary stages in two major phases: 'Early rift' phase comprising of - Narrow rift valley stage and Proto-oceanic stage and 'Post Rift' phase comprising of – Shallow marine platform stage and Open marine stage. The stratigraphic fill of basin consists of Tertiary sediments, which are in places more than 5000 mts thick. Initial subsidence in Trap basement and deposition of probably Trap-derived fine clastics in isolated depressions started in Late Paleocene. During this time small depression developed in the Tarp Basement which were filled with finer clastics. This sequence was followed by a period of large scale faulting resulting into several horst and graben features which were filled with a dominantly finer clastics sequence alongwith presence of medium and coarse clastics indicating high energy conditions towards the margins of the basin close to the graben forming basement faults as witnessed in Cambay basin where these represent a coarse clastic sequence in general. This sequence shows large thickness variation, as its deposition is related to basement tectonics. Widespread transgression indicated by the extensive development of Panna marker and development of carbonate sequences during Middle Eocene.

Tapti-Daman is a clastic basin developed in the northern eastern part of Bombay Offshore basin in front of a narrow Cambay gulf having sedimentation history from Paleocene time onwards. Subsequent studies demonstrated the consanguineous relationship between Middle Eocene-Oligocene deltaic sediments of Proto-Narmada in Cambay basin and Late Oligocene-Miocene sediments in Tapti-Daman sector deposited as a result of progradation of the

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delta through narrow Cambay Gulf. In Tapti-Daman sector, apart from prominent hydrocarbon bearing structures ,many discrete hydrocarbon pools are discovered on the southern flank of Purna low primarily CA, CD, C25/TP, SD-1, B-170 etc. Hydrocarbons are found mainly within the sandstone reservoirs of Upper Mahuva Formation, though the Daman Formation sandstones are also found to be oil and gas bearing.

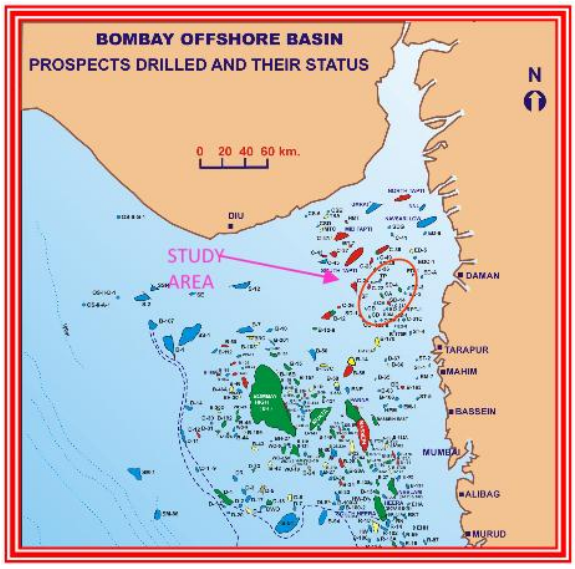

Fig.1 Location Map of Study area

Methodology

The data acquired in 1989 was with limited offset range and being a very old data set the navigation had to be regenerated

The acquisition parameters were

Recording channels	:	96x2
Group Interval	:	25 m, foldage : 48
Streamer Length	:	2400 m
Offset range	:	155 – 2555 m
Bin Size	:	12.5 m x 75.0 m

The generalised processing flow used during re-processing of the data was as follows:

- Reformating
- Navmerge
- Ensembel Balance
- Tar , Filter
- Radon(Forward)Decon
- Radon(Inverse)
- Trace Edit,Statics
- Flexing
- 1st pass velocity
- Offset Regularisation
- RMS Velocity Picking (250mx 250m)
- PSTM
- Post Stack Processing
- TVF

The reformatted seismic data is merged with the navigation data. The nav data is flexed in both direction, no flexing at near offset and 300 % flexing at far offset (making flexed bin size 12.5 × 225 m). Flexing is achieved by running flexbin programme on navigation data. The programme takes care of redundant traces also. The navmerge is followed by flexdup module to copy missing traces from adjoining bins as per flexbin criterion. Parameters were thoroughly tested for operator length and prediction distance. The design window for the autocorrelation was kept beyond the first arrivals and was extended beyond the zone of interest. Following parameters were used in processing.

Operator length	480 ms
Gap	36 ms
Pre whitening	0.01 %

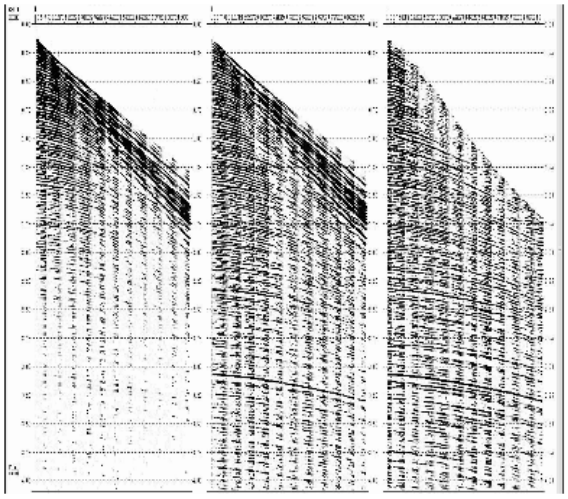

Fig.2 (a) Raw shot gathers,(b) with gain and filter,(c) Tau-p decon

After pre-processing and Ist pass velocity,the target line migration was run on every 20 inlines i.e. every 500m RMS velocities were picked closely in 250m x 250m in vertical mode using Inverse NMO .Sufficient care was

taken to ensure flatness of gathers. PSTM stack was generated after selecting a proper mute. Post stack processing was applied on the stack which was mainly for removal of noise. Post stack cross line interpolation was performed to bring the output to 12.5 x 37.5 m

Discussion

Fig 3 is a comparison between the vintage data and the current PSTM output.Overall improvement at various levels

Angle stacks (Fig4) were generated on PSTM gathers after pre conditioning for ranges 4-14, 13-23, 22-32 & 22-38 degree and interpolated in 12.5M x 37.5 M grid. The angle stacks were analysed thoroughly for any anomalies.

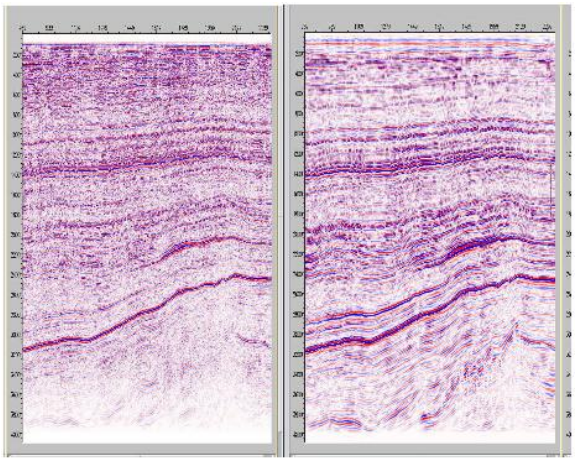

Fig.3 (a) vintage section,(b) current PSTM data.The current data shows a better dilineation of formations as well as deeper structural image.

The far angle stack is showing a larger amplitude as compared to the near stack thereby indicating AVO anomaly.

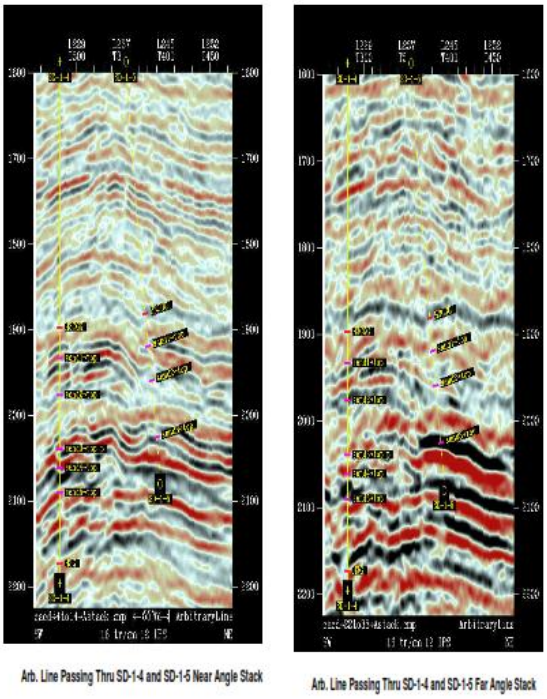

Fig.4 (a) Near angle stack and (b) Far angle stack on arbitrary line passing through wells SD-1-4 and SD-1-5.The high amplitude at Sand3 level is clearly evident in the Far angle stack.

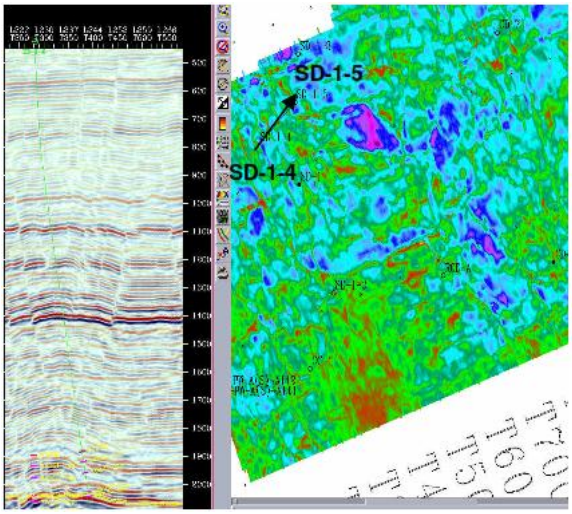

Fig.5 (a)Arbitrary section showing the dry well SD-1-4 and SD-1-5, (b)Maximum positive Amplitude map showing the new location.

The well SD-1-4 drilled on the basis of earlier data turned to be dry and the nearby location SD- 1-5 was proposed .It was drilled as a deviated well and encountered hydrocarbon at sand3 levels. Inversion studies carried out at new location

had also given promising indications to firm up the location as a drillable prospect. Model based post stack inversion was carried out on new PSTM data

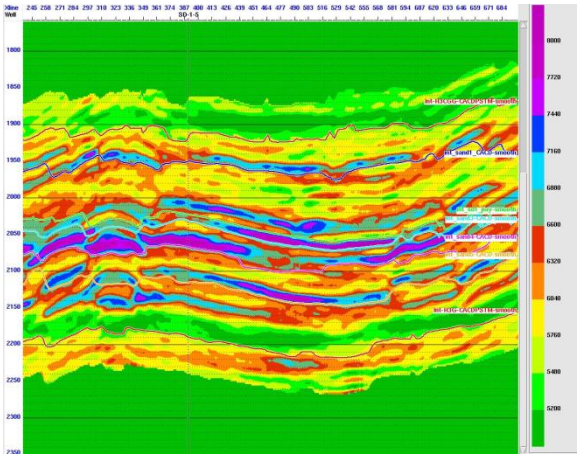

Fig 6.Inversion studies indicated a low impedance at sand3 level (Daman)

Conclusion

- Current Re-processing of the prospect not only enhanced the imaging but was helpful in identifying the new locations

- Critical analysis of AVO/Inversion attributes and positive amplitude attributes generated through current volume led to in-place reserve Accretion of more than 4.0 mmt

- The old vintage data can be re analysed taking into account the technological advancements and will prove to be useful in the long run.

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