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Improved Lateral & Vertical Resolution through PSDM to Delineate Wedgeout - A Case History from Mumbai Offshore Basin

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Summary

Seismic exploration in geologically complex areas has been a challenging task before explorationists. Traditionally the geoscientist has been confined to work with seismic images in time, which provided a good picture of the subsurface structure in areas of less complexity. However in areas of complex geological structures and lateral velocity variations, the time imaging is not so effective. It fails to image the subsurface in its true perspective. At this juncture, the most robust but compute intensive technique of depth imaging help to put the subsurface in proper vertical and lateral positions.Though the theory of depth imaging is not new to the seismic industry, its practical use was restricted mainly due to the high computational needs and robust techniques to estimate the ever eluding velocity field. Prestack depth migration provides better subsurface image where there are complex structures and lateral variation of velocity.

This paper deals a case study of pre-stack depth migration on a 3D data set of a prospect from an area South of Mumbai High and west of Mumbai High East Fault of Western offshore basin to brings out better resolution in identification of wedge outs of important formations with the basement. Time imaging of recently acquired data improved the image of subsurface but could not provide desired resolution. Available geophysical data were utilized to build interval velocity models which is crucial step of successful PSDM project. Results obtained with this work are encouraging and considerable improvement in resolution is obtained.

Keywords*: PSDM, Mumbai Offshore Basin, Velocity Model Building*

Introduction

"Right Technology is an important factor for imaging the geological complexities in a cost effective manner and the selection of right technology is a challenging task. Moreover technology alone will not meet expectations of tomorrow; we need right hardware, right software and right humanware" (3 R's) (A Saha,2004)

Depth migration algorithms are now frequently used during the processing of seismic data especially in geologically complex areas. They are theoretically more fit to solve positioning problems (migration) in presence of subsurface velocity anomalies and steep dips. Moreover the final depth volume allows a better integration of the many professionals involved in E&P projects: geologists, geophysicists and engineers. In fact such an integration should start well before the final depth migration is run: the construction of the velocity model is indeed the result of a close integration between time and depth processers, geophysicists, subsurface and structural geologists and also reservoir engineers (L. Pizzaferri et al., 1998). Nowadays Pre-Stack Depth Migration (PSDM) algorithms are becoming more and more affordable, due to the available low cost computing power. PSDM has proved indeed to be a very effective tool for better seismic imaging. The Flow chart of PSDM is shown in figure 1.

Study Area

A study area lies the south of Mumbai high and west of Mumbai High East fault in Western offshore basin which has wedge out of different formations like Bassein, Panna and Mukta with the basement. The Location map of the area are shown in figure 2.The data has been undertaken for Pre-Stack Depth migration with the

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geophysical objective to understand areal distribution of L-V, L-VI, Mukta, Basalt clastic pays & Basement configuration in the area. The water bottom is very shallow and the target zone was within time 1.0 sec to 2.5 sec in prestack time migration processed earlier.

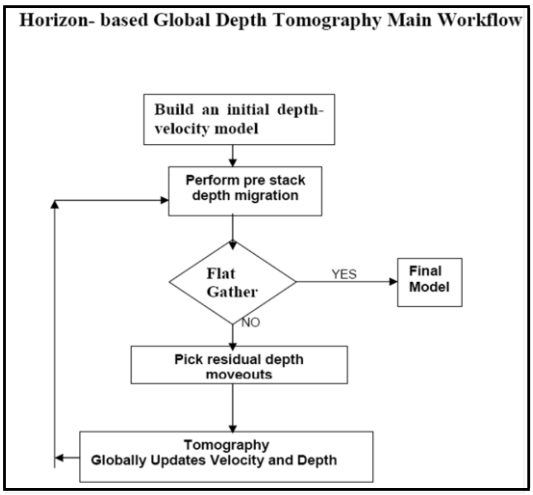

Figure1: shows the flow chart of the PSDM followed for the present project

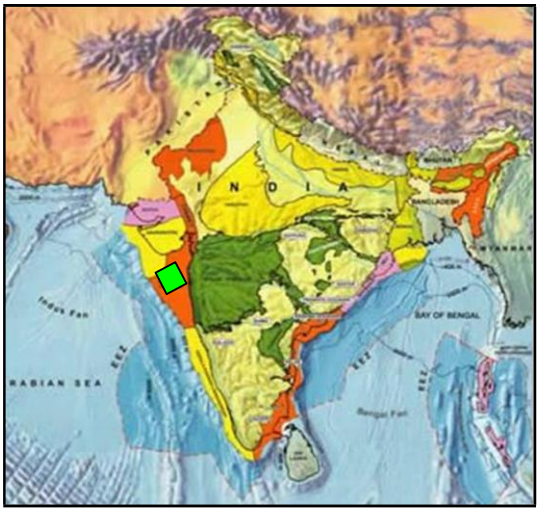

Figure 2: Study area

Input Data and Model Building

To start with DECON gather, RMS velocity and Time migrated section ware taken as input. Ten important horizons (Figure 3) were taken up for proper imaging of the area. Velocity gradient in a layer is also incorporated for flattening of events within that layer. Then DIX conversion is used to get the initial interval velocity model. Four iterations of horizon tomography were carried out for updating the interval velocity model. Residuals were picked at each stage for each horizon for updating the interval velocity model (Figure 4). Figure 5 shows interval velocity model after second iteration and PSDM section scaled to time. The section clearly shows delineation of fault pattern.

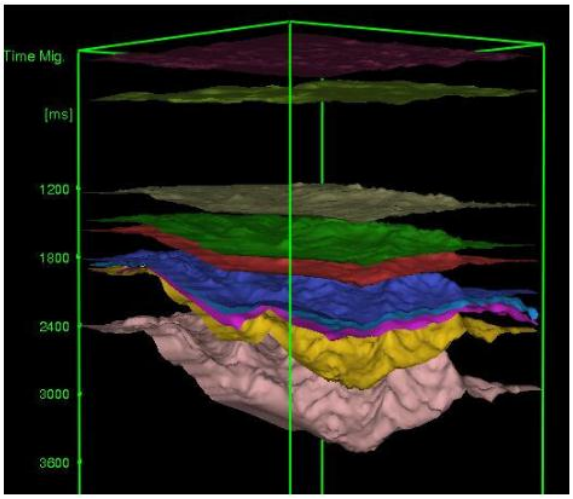

Figure 3: T set of time migrated Horizon

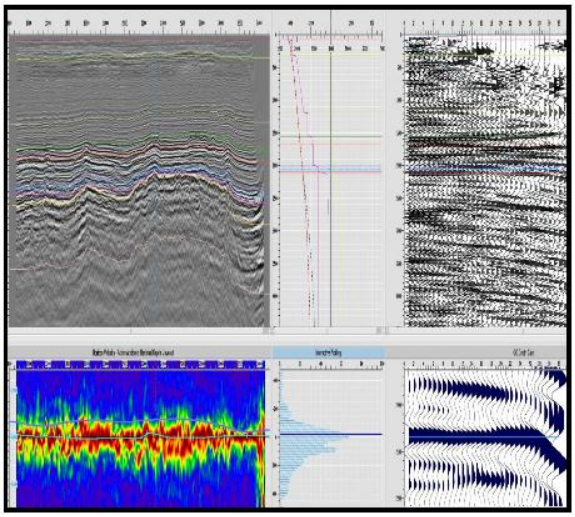

Figure 4: Tomographic updation of Interval Velocity – Residual depth move out picking

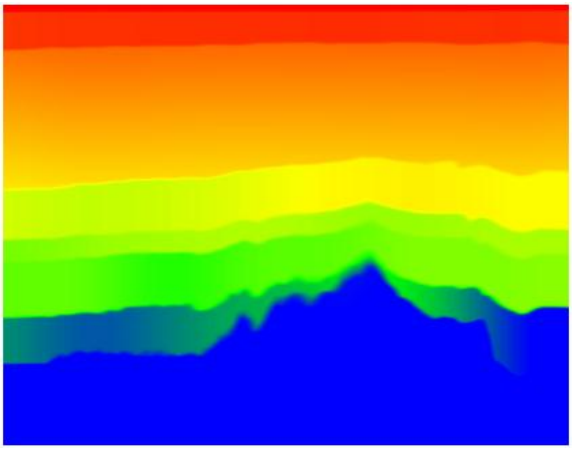

Figure 5: (a) Velocity model after second iteration and

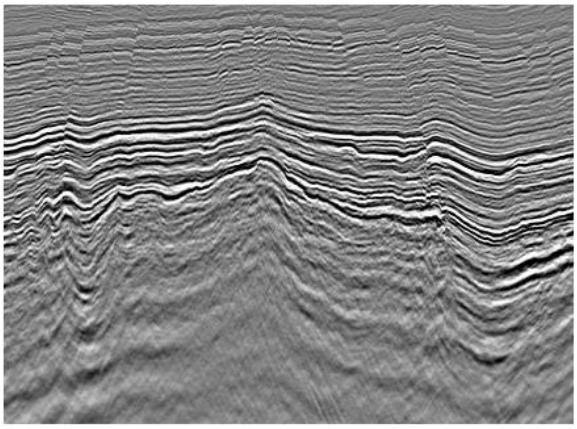

Figure 5(b) PSDM Stack scaled to Time Migrated .shows delineation of fault pattern.

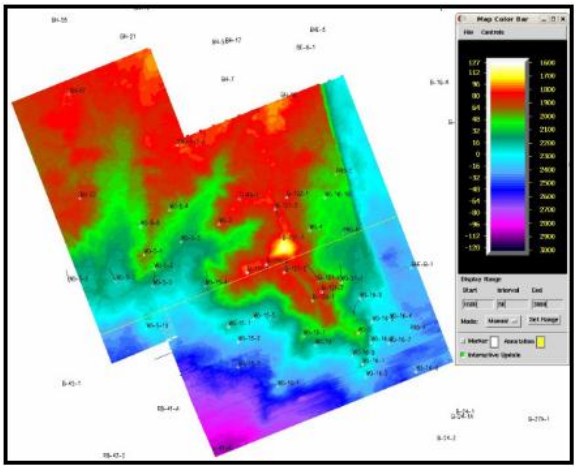

Figure 6A:) time map of basement

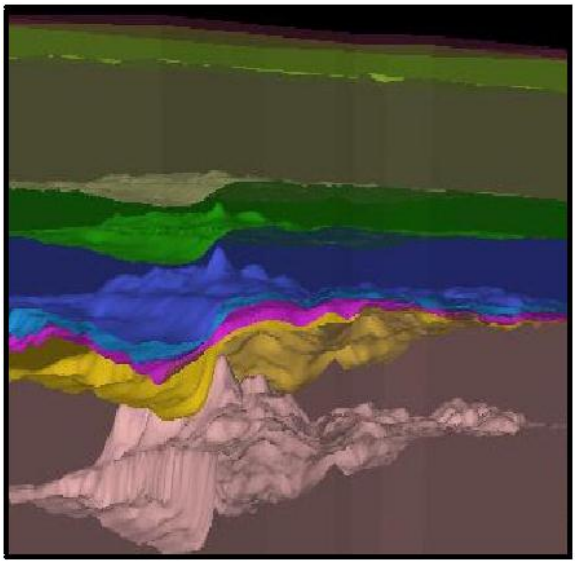

Figure6 (B) :Surface model in depth

Results and discussion

The basement time map is shown in figure 6 (a) and shows large variation in time within the area of study. The surface model in depth in (figure 6b) clearly shows the geological complexity and lateral velocity variation below fifth horizon. The results are compared with time migrated section and considerable improvement is observed in resolution and delineation of fault. Figure 7 shows final PSDM section scaled to time and compared with PSTM section. The depth image was of much superior quality improving the continuity of the seismic events, the interpretability of formations and identifying the wedge outs of some important formations with the basement.

Conclusions

The examples shown in this paper clearly demonstrate the great impact that a PSDM processing can have on the seismic image, producing a more focused image, with sharper details and an increased resolution. It is also clear that a reliable depth image requires a good definition of the velocity field in the subsurface which requires interaction with interpreters during velocity model building. It must also be stressed the fact that during the depth imaging process all available data used in model building.

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The views expressed here are those of the authors only and do not reflect the views of the organization which they belong to.

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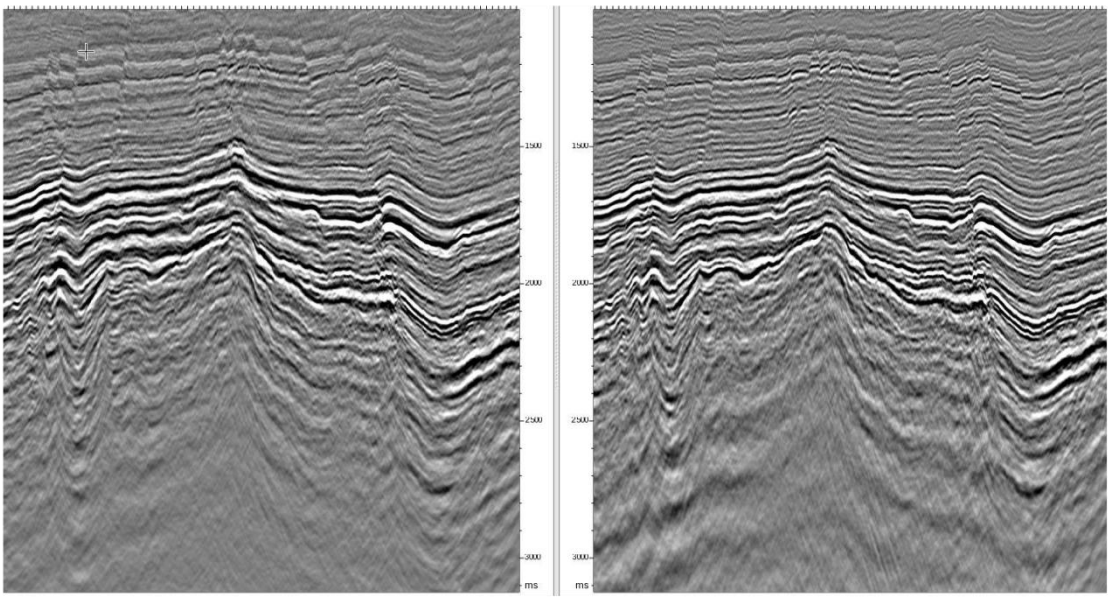

Figure 7: A comparison of Pre STM Stack (left) and PSDM (scaled) from this area showing Improvement in imaging at Basement level