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Fine tuning of pre stack migration parameters - A quantum jump in sub-surface Imaging: A case study from Mori-Adivipalem of KG Basin

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Summary

The mapability and the sub surface imaging below and around Vasishta River in KG Basin is very challenging task. The problem of energy penetration through deeper sediments in the area falling with in the vicinity of the river and recording over the river pose a lot of problems. It has been a tough task not only for data acquisition but also for data processing. The present paper deals with a case study of 3D data acquisition and Processing for PSTM in Mori-Adivipalem area falling with in East Godavari of KG Basin, exploring for multi-pay prospects. Therefore, the 3D data acquisition and processing assumed a great importance. The Rigorous testing of parameters for conditioning the data especially for hydrophones was carried out. As a result of applying optimized parameters and closer grid velocity analysis, the quality of subsurface imaging has been greatly enhanced for resolution, amplitude and frequency below river. On the basis of processed data three exploratory locations have been proposed and out of that one location under drilling (KC) struck sand column of 4mts bearing hydrocarbon.

Introduction and study area

The study area (location map shown in Fig.1) falls in KG-PG Basin and is situated south of Matsyapuri-Palakollu fault in Island area of East Godavari sub-basin of Krishna- Godavari Basin and to the west of coastal line of Bay of Bengal. The area was covered with 2D seismic lines before this 3D data. Out of these, most of the lines were terminated at the bank of river from either sides. So there was large data gap across the river.

The lines which were shot with laying hydrophones across the river could not also image the subsurface events below river. Hence 3D data was acquired with latest recording unit available at that time and suitable geometry with geophones and hydrophones as receivers across the river and processed the data with scaling, amplitude and phase matching of hydrophone traces to the level of geophone traces to get the seamless subsurface image of events across the river.

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Fig.1: Location map of study area

The objective of this campaign was to bring out the straiti-structural prospects and inter grabnel features within Eocene and Paleocene (Pasarlapudi and Palakollu formations) in Mori-Adivipalem area. The multi pay development within Eocene (Lower Pasarlapudi formation) in the study area and the Tatipaka oil field in the adjoining area are the leads for exploring Pasarlapudi Formation in Razole and Tatipaka fields

The data was acquired using both geophones over land part and hydrophones over Vasishta River. A foot print of river is clearly seen in the fold map as shown in Fig. 2.

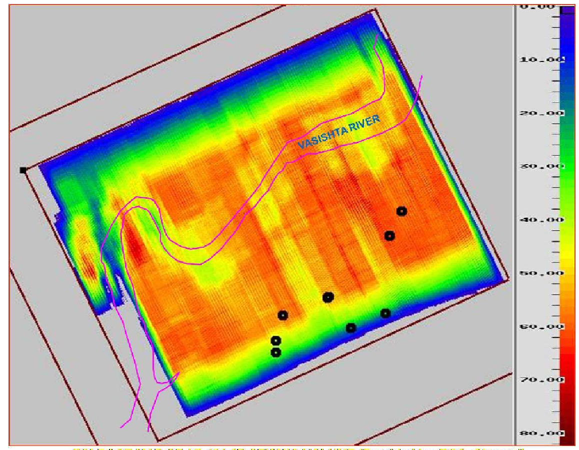

Fig. 2: Fold map with River`s foot print

Special efforts

A rigorous analysis was carried out for bringing the amplitude/phase of hydrophone traces to the level of geophone traces. The amplitude correction is applied to each of the hydrophone traces in the gather, and the summation scalar is derived and used to sum geophone and hydrophone traces for each source receiver path. The summation scalar may be selected to compensate not only for ghosts but also receiver-side reverberations. The summation scalar may also be derived using an estimate for the seafloor reflectivity that takes into account source-side reverberations (Soubaras et al 1996). In this analysis initially trace header has been updated for identification of receiver's type in the record. On the basis of identification, hydrophone receivers have been separated from the record. Thus two sets of data were prepared for study of their amplitude. After analyzing the amplitude, its level in the data set of hydrophone traces has been scaled to the level of data set of geophone traces. In next process of matching, a phase and amplitude filter has been generated by assuming the data set of geophone traces as output data and dataset of hydrophone traces as input data. Finally generated filter operator has been applied to the dataset of hydrophone traces for achieving desirable output as shown in Fig. 3.

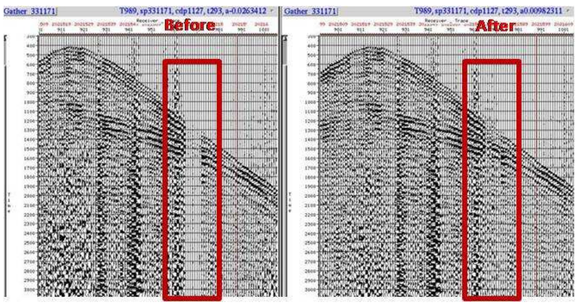

Fig-3: Scaling and matching for hydrophones

Further the data was subjected to a suitable noise attenuation algorithm after a rigorous data scanning and testing. The radial trace transform offers an attractive vehicle to remove ground-roll and coherent linear noise in prestack gathers. A common technique employed is to model the noise by applying a low-pass filter in the radial domain and then subtract the inverse-transformed - modeled noise - from the original input gather. Interpolation is a key component of the radial transform, and in most practical cases it can severely limit its performance (Zhu etal (2004). The data has been edited statistically in three phases preserving the relative amplitude and higher frequencies as shown in Fig.4a, 4b & 4c.

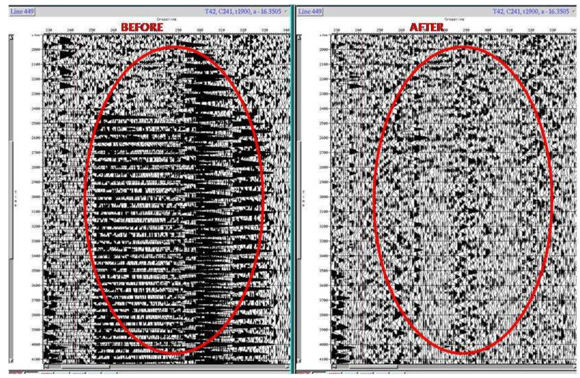

Fig-4a: Noise editing for spikes in the data

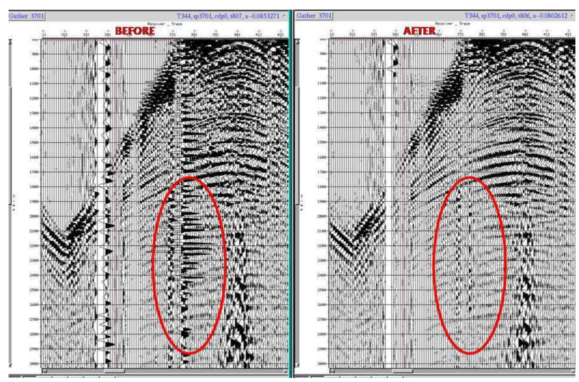

Fig. 4b: Noise editing for impulsive noise

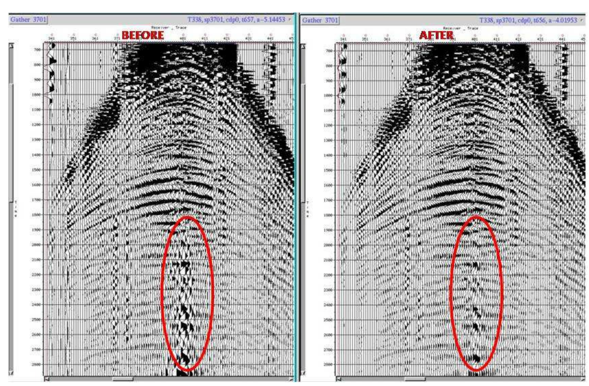

Fig-4c: Editing for ground roll noise

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A thorough testing for important processing parameters such as Decon and migration aperture was carried out. Two iterations of residual static correction were carried out. It was observed that second iteration was not so necessary as further improvement was not seen on the data and hence the output with first pass residual static correction was subjected to PSTM. Even though there were foot prints in fold, a special weight age has been given to the foot print area in processing before migration such that these would not have any effect on the data quality.

The PSTM methodology

The PSTM methodology included the following:

1. Stacking velocity analysis at 400m X 400m
2. Conversion of stacking velocity volume to RMS velocity Volume
3. First pass migration
4. RMS vertical function on PSTM gathers at 200m x 200m
5. Picking of horizons at a grid of 200m x 200m
6. Creation, editing and smoothening of time maps.
7. Generation of velocity maps.
8. Cross correlating of velocity maps with time maps and smoothening of velocity maps.
9. Generation of RMS velocity volume.
10. PSTM application with latest RMS velocity volume.
11. Residual move out analysis.
12. Generation of flat gathers
13. Stack flat gathers, scaling and filtering for final PSTM stack volume

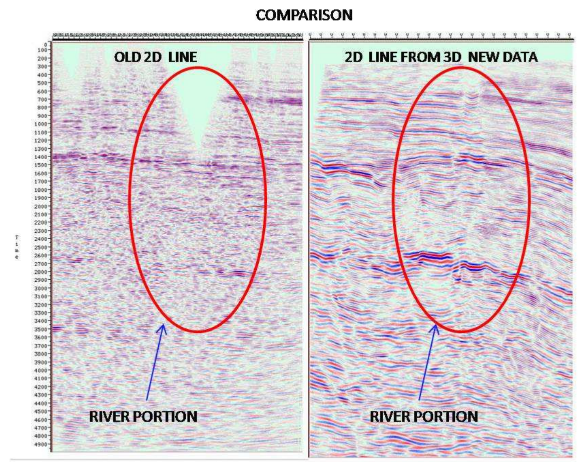

Fig. 5a: Comparison with old 2D data

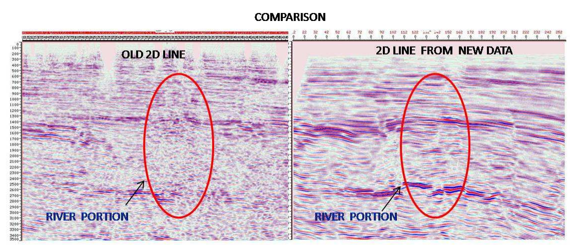

Fig.5b: Comparison with old 2D data

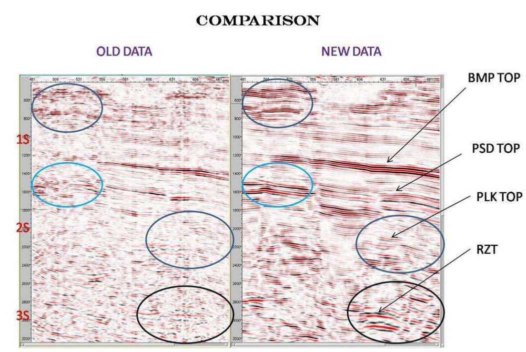

Fig-5c: Comparison with old 3D data

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Value addition

During the study several important observations have been made with regard to value addition in the final section. Data below the river has been imaged for the first time as 3D data by special efforts in processing. At different level data has better continuity and fault delineation. The data is the main input for proposing three exploratory wells (KA, KB and KC) and **KC** as shown in Fig. 5 & Fig. 6 drilled in four way closure between Lower Pasarlapudi formation and Razole trap and struk sand column of 4mts as pay bearing hydrocarbon.

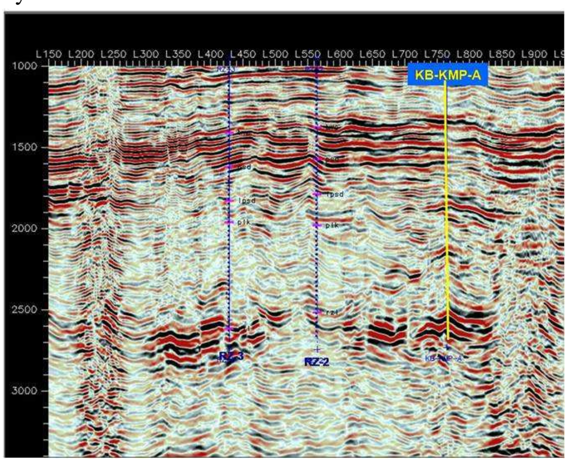

Fig-5: Location of Well_KC in seismic section xline

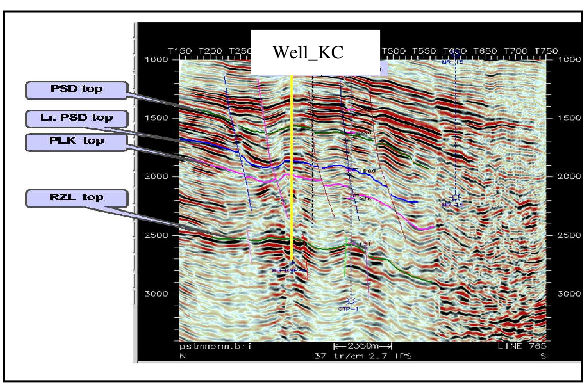

Fig-6: Location of Well_KC in seismic section inline

Conclusion

The rigorous efforts for attenuating noise, special treatment to hydrophone, the close picking of RMS velocity and optimization of aperture in PSTM process of data which was acquired with suitable bin size and nearly regular offset classes, has clearly brought the main seismic markers in the area that is Razole trap, Pasarlapudi and Palakollu layers can be correlated throughout section. The processed data has brought out various horizons of interests with better clarity and fault delineation.

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