

Pre-Stack Merging and Depth Imaging: An example from North Assam Shelf, India

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Abstract

Pre-Stack merging of four 3D seismic data sets in the North Assam Shelf of India and subsequent isotropic Pre-Stack Kirchhoff depth migration of merged data has been carried out. Total volume of the data is approximately 400 sq. kms. Data acquisition was done for a viable composite geological modelling to delineate pay sands within Girujan to Tura and Basement formations in the project area of the Assam Arakan Basin. Earlier all the campaigns were processed and merged up to PSTM level. Inherent complications of Pre-stack merging have been taken care with best efforts.

Key words: Pre-STM, Pre-SDM, Interval Velocity, Tomography

Introduction

Pre-stack level merging and depth imaging in the NE part of India has been performed with the objective of suitable depth conversion conforming to the drilled well locations for Girujan, Tipams, Barails, Pre-barails and Basement. Basic issues of pre-stack merging e.g., difference in geometries, irregular folds and offsets, mismatch in amplitude and phase characteristics, difference in gain etc., which are inherent to any merging project, have been addressed systematically.

Brief Geology of the area

The location map of the project area is shown in the Fig.1. The Sylhet-Kopili/Barail-Tipam Composite Total Petroleum system (TPS) is located in the Assam Province in north eastern most India and includes the Assam Shelf in the south of the Brahmaputra River. The area is primarily a southeast-dipping shelf over thrust by the Naga Hills on the southeast and the Himalaya Mountain range to the north. These rocks in the TPS system are those of the Eocene-Oligocene Jaintia Group Sylhet and Kopili Formations, the Oligocene Barail Group, and the Oligocene-Miocene Surma and Tipam Groups. Source rocks include the Sylhet and Kopili Formation shales,

Barail Group coals and shales, and in the south the Surma Group shales. Reservoir rocks are carbonates of the Sylhet formation, interbedded sandstones of the Kopili formation and sandstones of the Barail, Surma, and Tipam Groups. Traps are primarily anticlines and faulted anticlines with a few subtle stratigraphic traps. There is also a likelihood of anticlinal traps in the sub thrust. Seals include interbedded Oligocene and Miocene shales and clays, and the thick clays of the Pliocene Girujan Group.

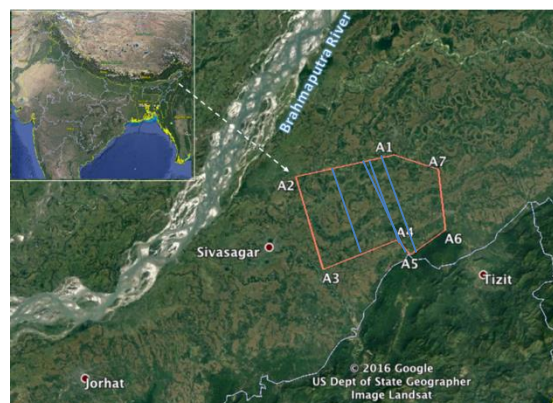


Fig 1: Location map of the project area

Pre-Processing

The normal pre-processing sequences of pre-sack merging have been followed prior to interval velocity model building step. These sequences are as following.

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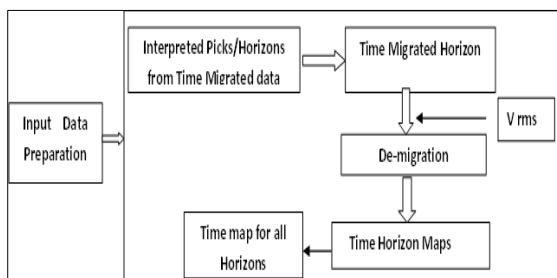
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1. Format conversion from SEG Y to software internal format.
2. Geometry Merging/QC checks.
3. Polarity correction/Field Statics/Tomostatics application.
4. Spherical Divergence correction.
5. Denoise in local grid.
6. Deconvolution Operator Length: 300ms, Gap: 24ms, white Noise: 0.1%, Application Window: 500-4000 ms.
7. 1st pass Velocity Analysis with the help of available individual velocity volumes.
8. Application of Residual statics in individual local grid.
7. Regrid from Local Grid to Master grid with bin size 25 m x 25 m.
9. Static Shift correction.
10. Application of Residual statics in Master grid in full volume.
11. Full window gain equalization.
12. Offset regularization.
13. Spectral balancing.
14. Target line Pre-stack time migration and initial RMS velocity model building.

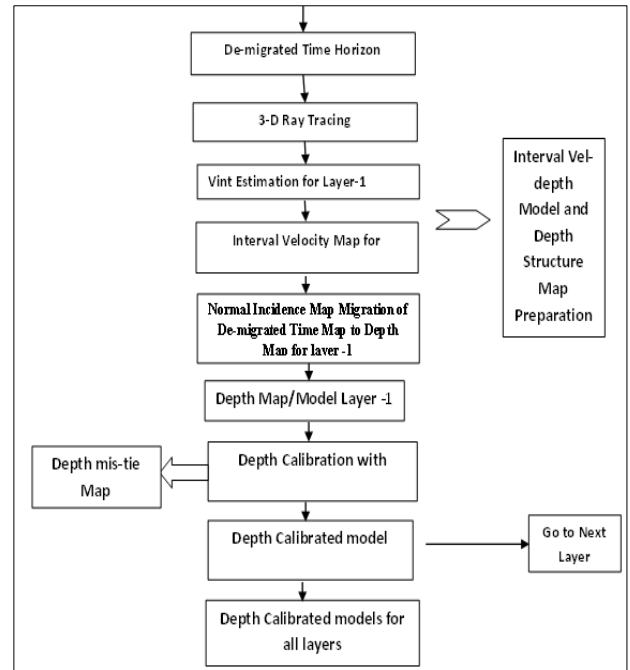
Pre-SDM workflow

Kirchhoff's PSDM consists of three main steps : 1.Input data preparation 2.Interval velocity–depth model and depth structure map preparation and 3.Tomography and final PSDM run. Schematic of these are shown in the following flow charts.

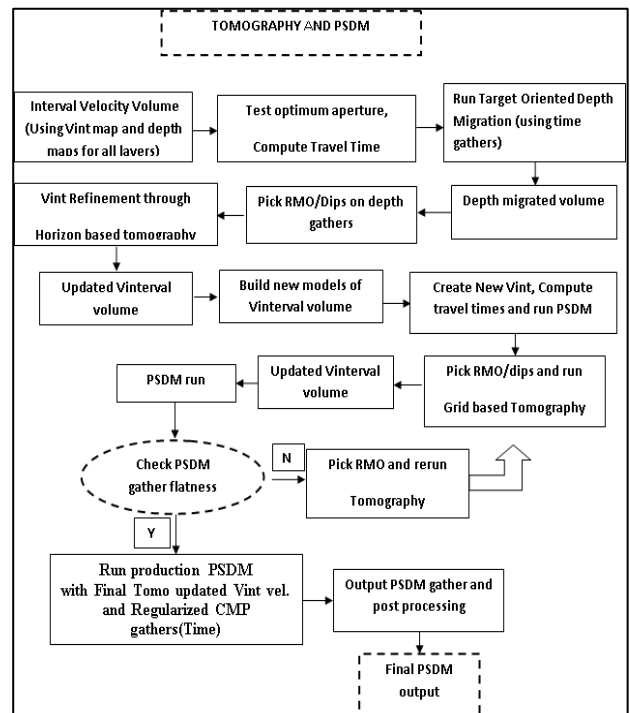
1. Input data preparation



2. Isotropic interval velocity-depth model



3. Tomography



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Well calibration

There are no of wells in the project area as shown in the map. Out of all these wells 27 wells were considered for calibration. We have taken well markers corresponding to the Girujan, TS1, TS2, LCM, BCS, LBS2 and TURA formations for well calibration process.

Well calibration QC

QC checks were done by clients. Well calibrated new velocity model was finally updated with linear tomography method using RMO curves and local dips picked on stack.

Results and Discussions

Final depth migrated outputs have been scaled back to time domain and compared to the existing PSTM sections. Clear improvements in deeper parts of the depth migrated outputs are observed in Fig.2. Amplitude spectra in the selected area also show relative improvements. Initial RMS velocity and final velocity models from one crossline are shown in the Fig.2a and Fig.2b. The common image gather flatness has been quality checked properly (Fig. 5). One depth slice at 1800 meters is shown in Fig.6.

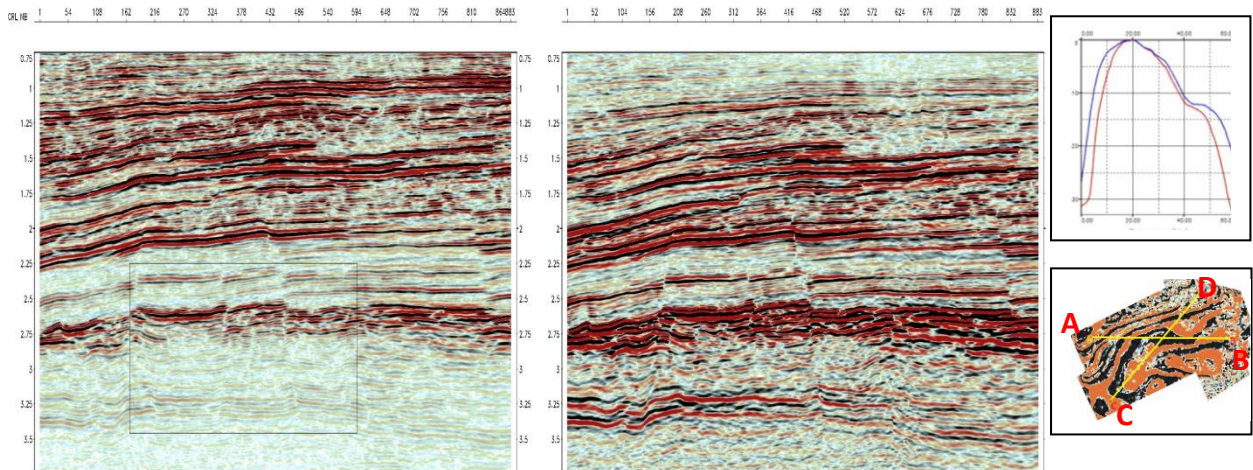


Fig.2: Left section from existing PSTM and right one time scaled PSDM for arbitrary line AB, blue curve in spectrum represents psdm and red one for pstm section

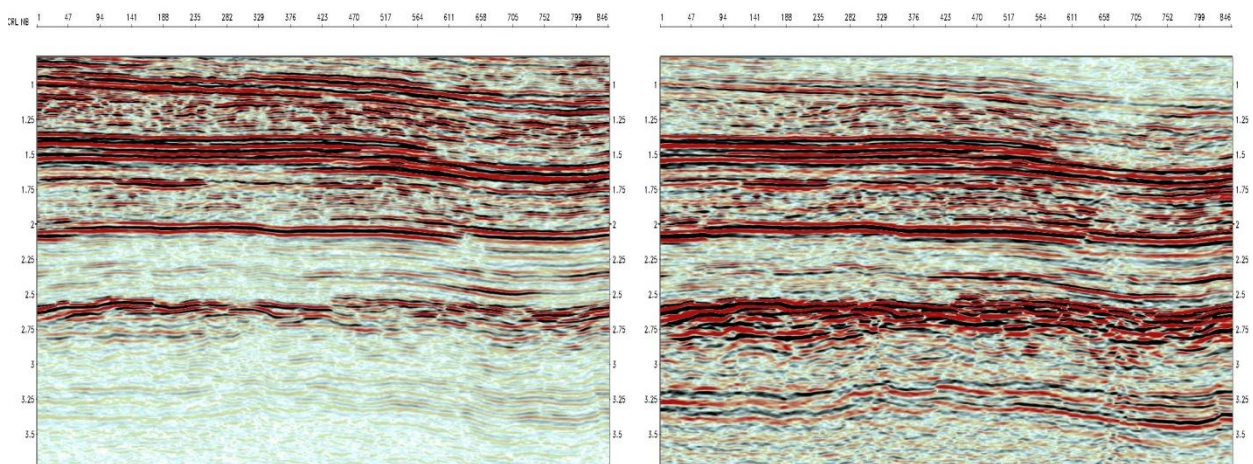


Fig.3: Left section from existing PSTM and right one from time scaled PSDM of arbitrary line CD

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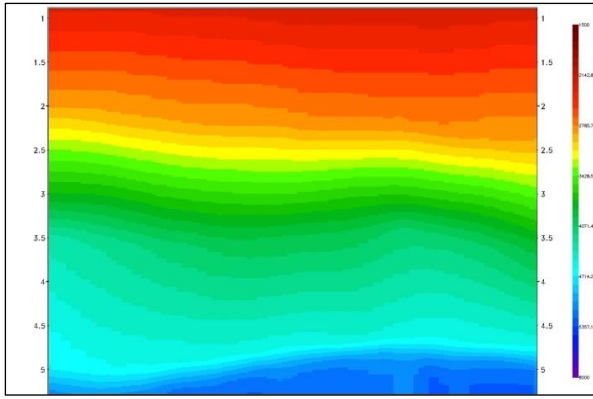


Fig.4a: Initial RMS velocity from one crossline

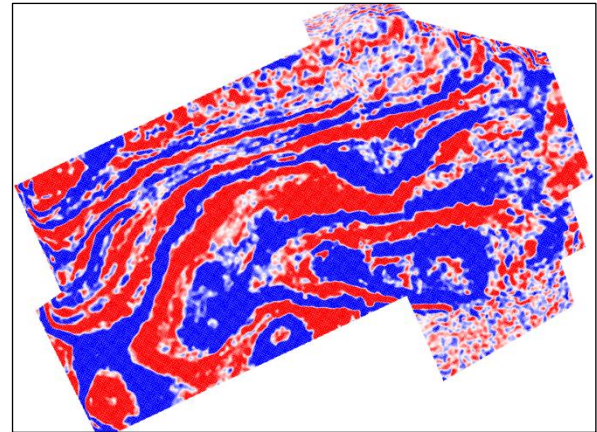


Fig.6: Depth slice at 1800 metres

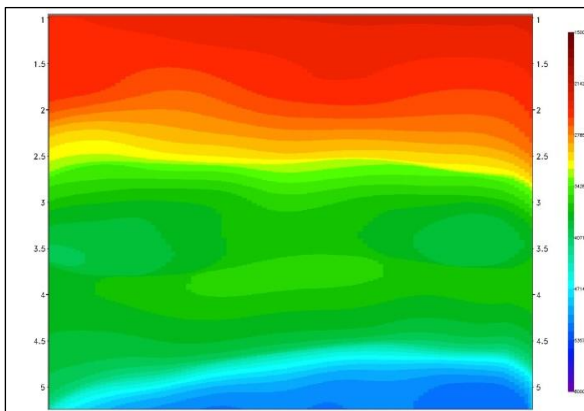


Fig.4b: Final isotropic interval velocity from same cross line

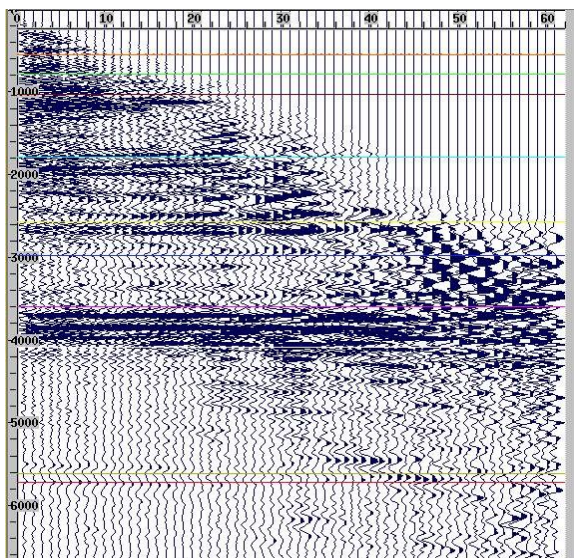


Fig.5: Example of Common Image Gather flatness

Conclusions

Depth image of Pre-stack level merged data sets have yielded satisfactory results in terms of events resolution and it has fulfilled overall objectives of the project. Deeper parts of the sections of the arbitrary lines AB and CD in Fig. 2 and Fig.3 clearly show the improvement with respect to earlier existing data sets. Main intricacies of any pre-stack level merging project like shifts, polarity and other associated artefacts have been taken care during the processing stages.

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Views expressed in this work are entirely of the authors only and do not reflect those of ONGC.

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