



Role of Trace Weights in Acquisition foot print Suppression - A Case study from A&AA Basin

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Summary

Two campaigns of 3D seismic data in Geleki field of Assam were acquired by two different field crews. During processing these campaigns were merged and Pre stack time migration was carried out. Acquisition footprints arising due to foldage jumps and the geometries were seen even in the Pre Stack Time Migrated volumes. Trace offset distribution in the near middle and far offset classes show large scale differences in their population. Such, irregular distribution of traces result in amplitude striping in the stack volume. Appropriate trace weighting schemes were adopted prior to pre stack time migration to minimize the amplitude striping and footprints.

Introduction

Geleki field, a northeast-southwest trending asymmetric anticline, is situated close to Naga-Schuppen belt. It is located on the south/southeastern rising flank of the Nazira low. On the western side, this anticlinal structure is cut by a prominent fault with down-throw towards west.

It is generally believed that this western bounding fault plays a crucial role in entrapment and evolution of Geleki structure. Geleki field is the second largest oil field of ONGC in North Assam Shelf and was discovered in the year 1968. Since its inception, so far about three hundred wells have been drilled.

Plays of Geleki area lies within Kopili, BCS and Tipam sands. These sands have been deposited in fluvial to shallow marine setup and at places these are small in areal extent separated by non porous shells. Attribute studies carried out on a good quality 3D data is always helpful in identifying such sands with limited areal extent. Amplitude preserved processing of 3D is must for such studies. However acquisition related differences, especially foldage variation are bound to be detrimental to such data sets, if not dully compensated.

Present data under study comprises of two different 3D seismic campaigns acquired by two different field parties in the same year and merged at pre stack level. Foldage variation is observed in the data set due to skip and recovery shots. This foldage variation, gives rise to strong acquisition foot prints on the processed output, especially

on horizon slices. A study was taken up to assess the effectiveness of trace weight application in Kirchoff's migration for suppression of acquisition foot prints.

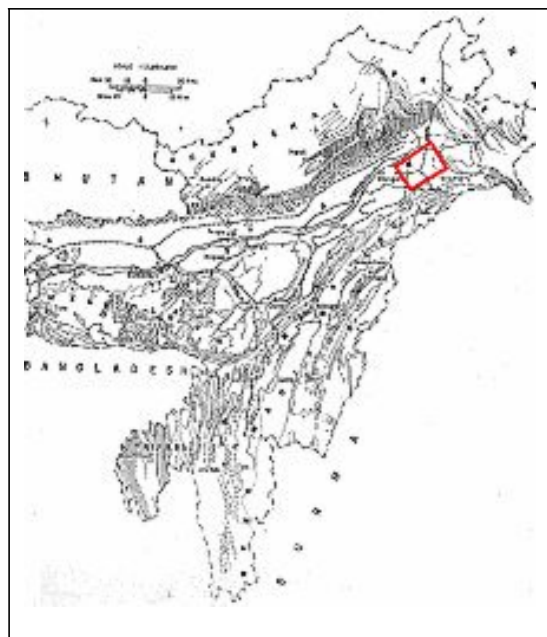


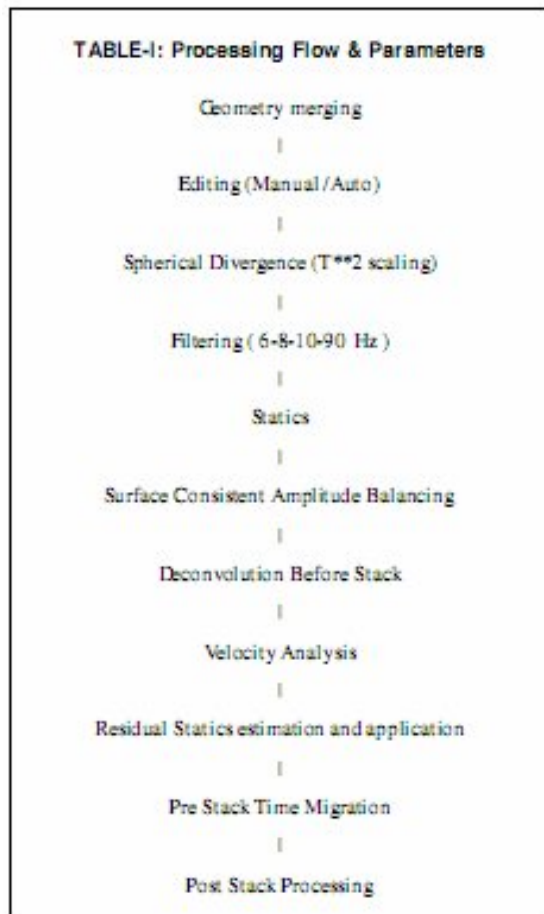
Fig-1 Map showing area of study



The merged data set was processed to generate two sets of outputs, first one consisting of PSTM without any trace weighting and the other set generated by PSTM applying trace weight. Outputs were analyzed along different inlines, crosslines, time slices and horizon slices. Comparative study of the two sets shows the overall improvement in the output with trace weight in the form of minimized acquisition foot prints related to foldage variation.

Data Analysis

3D data was acquired in the area using orthogonal swath Geometry of 6 Receiver lines having 126 receivers per line. No. of shots taken per salvo is 60 with a salvo line spacing of 450m. In general data quality is fair to good. Fig2 shows a part of representative shot gather and fig3 shows the same gather after initial processing and Deconvolution. In some patches the data is infested by cultural noise along with high amplitude ground roll. Different combinations of signal conditioning approaches were applied judiciously, which resulted in overall improvement of signal to noise ratio. Basic processing workflow adopted for the data is given in Table-1.



Foldage variation and its artifacts

Fig-4 shows the foldage variation of the input data. In general the data has been acquired maintaining a smooth foldage distribution. However, southern part of the area has a high foldage buildup because of recovery shots. The effect of this foldage increase can be seen in the CMP stack shown in fig-5. Foldage variation along inline 160 shown on the top of the figure has caused the enhanced strength of the events on this stack. Even after Pre-Stack Time Migration this artifact is seen in the form of high amplitude build up in the vicinity of cross-line 600 to 700 on fig-10.

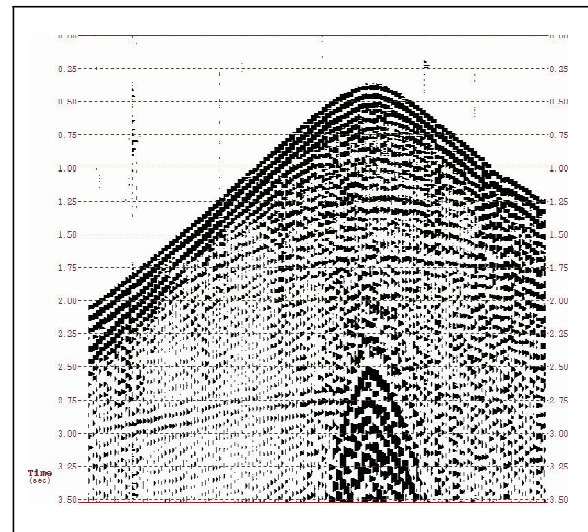


Fig-2 Raw time gather

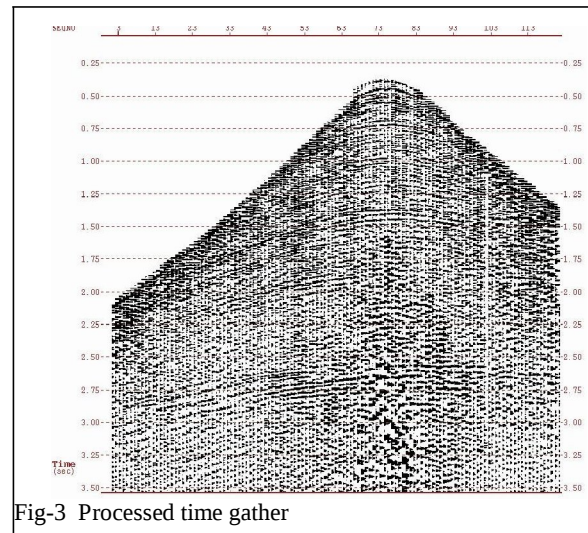


Fig-3 Processed time gather

Importance of Trace weights

The acquisition patterns of 3D surveys often have a significant effect on the result of pre stack migration when the spatial distribution of input traces is irregular and the results of migration may be contaminated by significant artifacts. In some cases this acquisition footprint can be seen in migrated outputs and may result in incorrect interpretation,



and may have a very significant effect on AVO analysis. In reality irregular spatial distribution of traces is very common with 3D seismic surveys. The midpoints are usually distributed irregularly and this trace distribution pattern varies between bins.

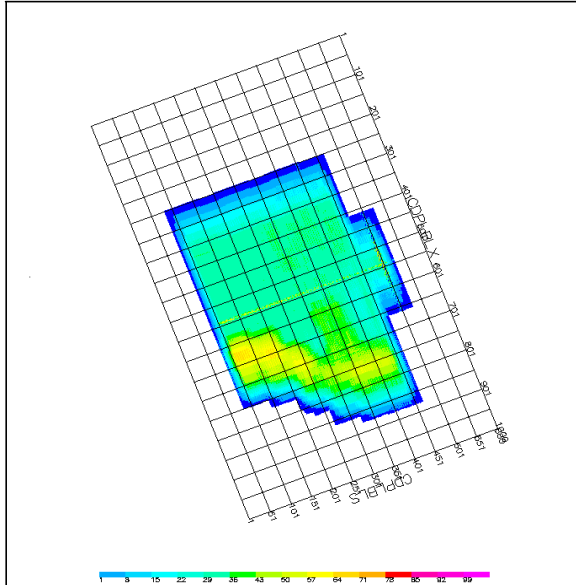


Fig-4 Foldage map

The philosophy of trace weighting is explained by Canning and Gardner (1998). To calculate a weight for each trace all traces are divided into groups according to their offsets. The shot receiver midpoints for each output offset are triangulated and a voronoi diagram is constructed. For each offset bin midpoints of all traces are plotted on an X, Y map. Then polygons are drawn around each point (Voronoi diagram) which represents the relative area that is represented by each point. With common-offset migration, each offset plane is weighted independently. The weighting function is defined by the relative area that is represented by each trace and is derived by calculating the area within the polygon that surrounds each point. Each input trace is then weighted (before migration) by a constant value defined by the relative area represented by the trace. This procedure balances the output amplitudes.

The offset distribution in the data is shown in fig-6 and the estimated trace weights for near (400 - 650m) middle (3400 - 3650m) and far (6150 - 6400m) offset ranges are shown in figs-7 - 9. These data clearly show an unusual population of near offsets (~ 3000000) compared to middle (~ 90000) and far (~ 80000).

Fig. 10 shows the PSTM stacks along an inline with and without accounting trace weights. The difficulty arising due to irregular trace distribution is very well seen in the circled zones in the PSTM stack without trace weight accounting. However, the PSTM stack with trace weights appears more uniform and balanced. The Amplitude variation with offset trends in the PSTM gathers with and without accounting trace

weights are shown in figs-11 and 12 for a shallower and a deeper event. The gather without trace weight accounting, exhibits unusual AVO trends in both the levels. On the other hand, the AVO trends on the gather accounting trace weights exhibit more realistic and smooth trends.

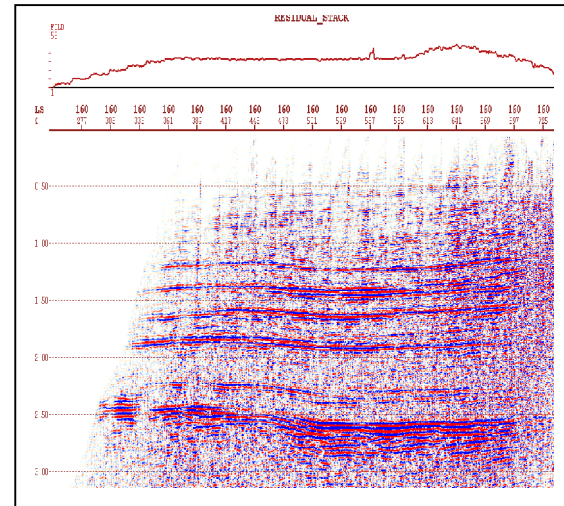


Fig-5. CMP stack. Amplitude stripping arising due to acquisition footprints is seen clearly in the shallower parts of the section. Foldage is shown above the section.

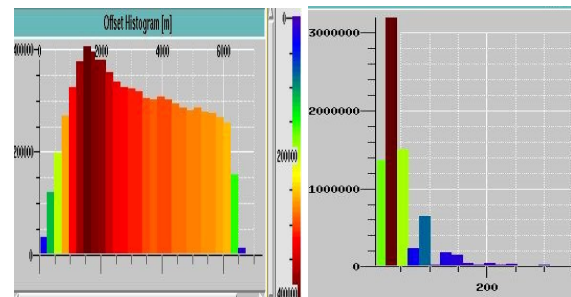


Fig-6. Offset distribution.

Fig-7. Trace weights for offset Class 400 to 650 m

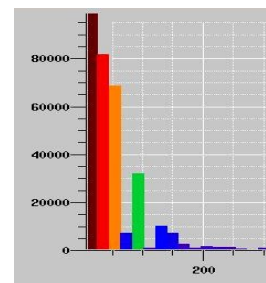


Fig-8. Trace weights for offset class 3400 to 3650m

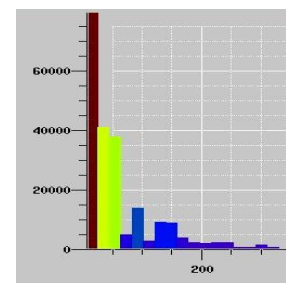


Fig-9. Trace weights for offset class 6150 to 6400m

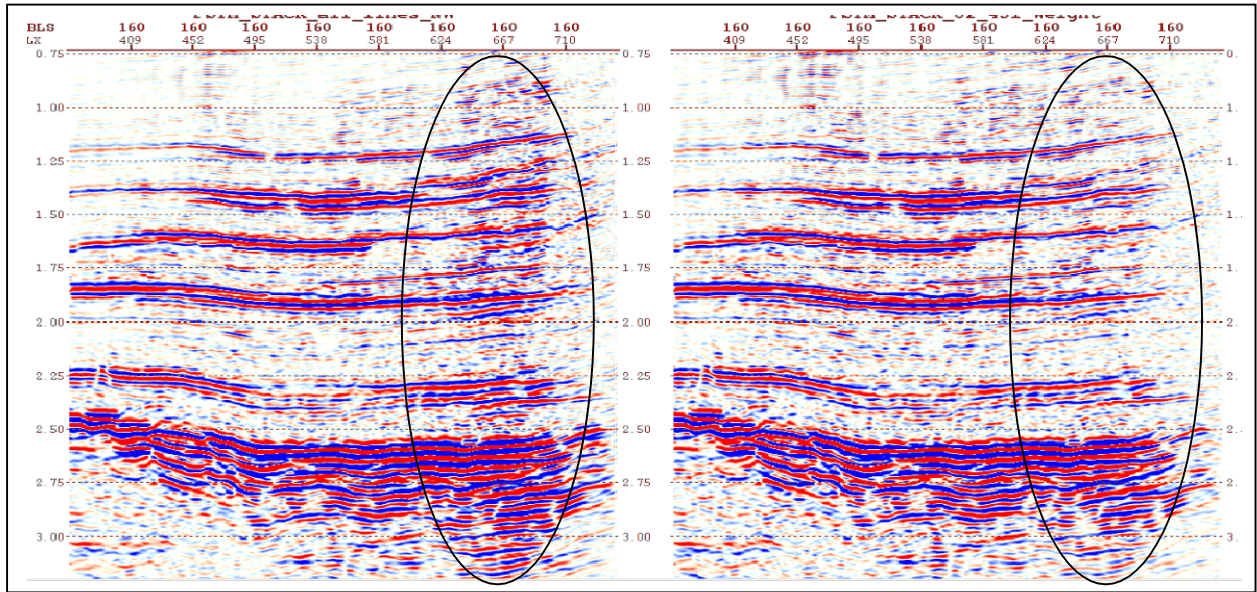


Fig-10. Comparison of Pre Stack Time Migrated stacks without (left) and with (right) trace weights. Amplitude stripping in the high foldage zones (circled zones) is fairly taken care in the stack with trace weights.

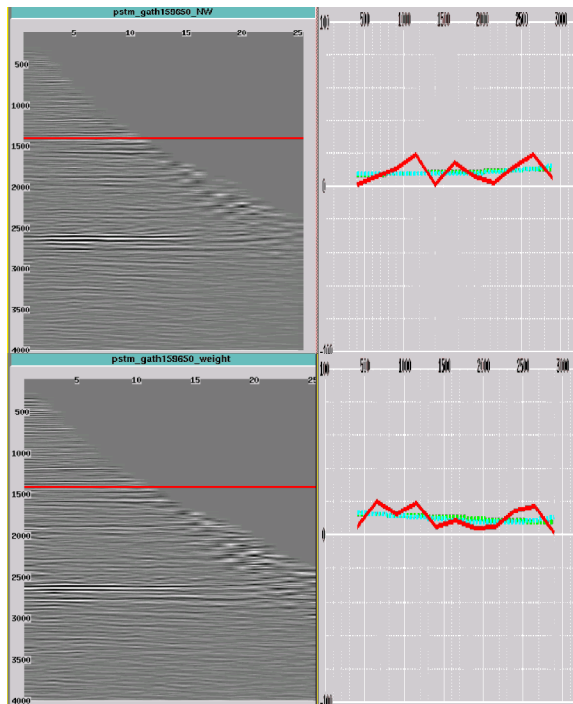


Fig-11. Amplitude variation with offset (AVO) trends along a shallower event on a PSTM gather without (top) and with (bottom) trace weights in the PSTM.

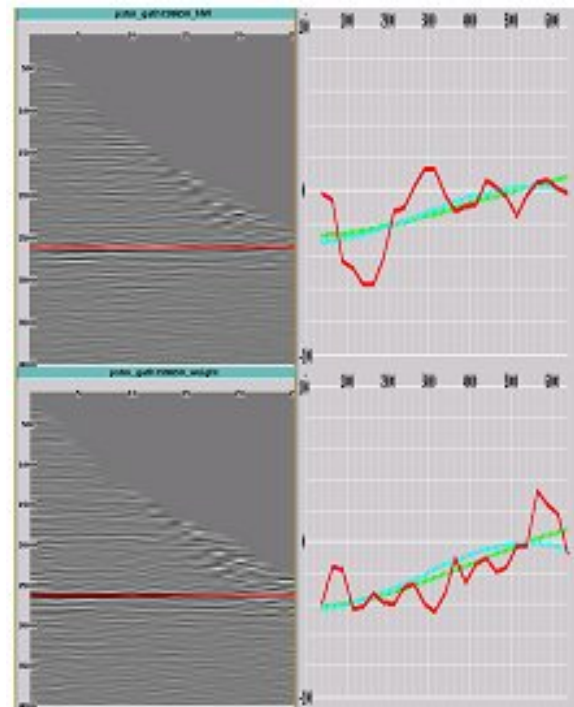


Fig-12. Amplitude variation with offset (AVO) trends along a deeper event on a PSTM gather without (top) and with (bottom) trace weights in the PSTM.



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Horizon slice generated along the Girujan formation from Pre Stack Time Migrated stack without trace weights is shown fig.13. High amplitude signature observed in the lower half of the horizon slice is correlatable to high foldage observed on fold map shown in fig-4. Horizon slice generated from Pre Stack Time Migrated stack with trace weights (fig-14) is free from these artifacts and represent the feature of geological interest only.

Conclusions

3D data pertaining to Geleki – Mekeypur area of Upper Assam shelf was processed adopting relative amplitude preserved processing sequence. Separate Pre Stack Time Migrated outputs were generated, one with trace weights application and another without any trace weighting. Unrealistic amplitude variation observed on inline section as well as on horizon slice associated with foldage change of input data is considerably minimized on Pre Stack Time Migrated stack with proper trace weights computed based on the areal distribution of traces in different offset classes. Final processed volume is free from acquisition related foot prints and is amenable for amplitude interpretation.

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Views expressed in this study are solely of the authors only and do not necessarily reflect the views of ONGC

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