# A New Approach in Processing in Fold Belt Area - A Case History in Assam Arakan Basin

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**Summary**

Imaging the subsurface in the fold belt area is a difficult task. The structures, near the surface have varied lithologies and difference of weathering degrees causing ambiguity in static corrections. In such area crestal portions are devoid of reflections events associated with poor signal to noise ratio. The authors carried out extensive studies to resolve the issues by applying precision static corrections obtained through stage wise calculation, surface consistent deconvolution which is suitable in such geologically complex areas and coherency based velocity picking with an objective of better imaging of subsurface. This methodology was adopted and applied in Khubal area of Assam Arakan Fold Belt. The study gave encouraging results in compare to conventionally processed sections, which will give more confidence to the interpreter in deciphering a reliable geological model.

## Introduction

The Tripura-Cachar-Mizoram fold belt of Assam-Arakan basin is characterized by a succession of sub-parallel anticlinal ridges/hills separated by synclinal valleys. It exposes a thick alternating sequences of shales and sandstones of mainly late Paleocene to Pliocene age.They were deposited mainly under shallow marine to deltaic condition, grading to fluviatile at the top. Lithostratigraphically three major groups namely Barail (Oligocene), Surma (L. Miocene) and Tipam (Pliocene) have been recognized in the basin. Out of the sub-parallel anticline ridges/hills Khubal is situated in western Tripura (Fig-1). This prospect in the exposed northern part is flat, gentle and seems to have less affected by the intense tectonic activity to which this area was subjected to. The southern part of the structure appears to have been pushed under the western Machhlithum anticline as a subthrust block. In this area Khubal is structurally least complicated. The exposed formation over the crest in this structure Bokabil (Late Miocene-Early Pliocene), is relatively younger one while exposed formation is Upper or Middle Bhuban (Eocene) over all other structures of Eastern Tripura. The exposed part of the structure measures about 20 Km. in length & 6 Km. in width, and the area of coverage is about 120 Sq. Km.

Several gas accumulations are found in the normal and transition pressure zones of Upper and Middle Bhuban section in nearby structures. The sequence within normal pressure regimes over Khubal structure is much larger in comparison to other structures of eastern Tripura. The upper part of the Middle Bhuban, as is the case elsewhere revealed the pressure of thick gas bearing sands within normal pressure regime. To identify the shallow gas prospects and also map the structural features at deeper levels. 2-D seismic acquisition were carried out in 2003-2004 and the field parameters like group interval 20 mts, Shot interval 40 mts, type of shooting sym. Split spread 148 ch on either side , fold 74 and far offset 3000m. were used.

After acquiring the data, processing was carried out and the processed sections do not show clarity in the seismic events and reflection events disappear in some portion of the section, by which the interpretation more difficult of the strati-structural features in the section. The signal to noise ratio also is very poor in the area.

To improve the imaging an attempt was made to reprocess the data in this area. Different methodologies like application of precision statics, surface consistent predictive deconvolution, coherency based velocity picking etc were applied on the seismic data while reprocessing. The authors in this article explained the methodology, application and the results.

## Methodology

In the fold belt area the data quality is poor in crestal portions. To improve this data quality, the field parameter were fine tuned off late with longer offsets, closer surface sampling interval and deeper shot holes. However these parameters could not improve the imaging of the crestal portion. The thickness and the near surface velocities are varying very rapidly both in lateral and vertical directions. High velocities of the order of 3000 m/sec to 4000 m/sec also are encountered in the near surface due to steep thrust. When such rapid variations in the velocities are encountered the conventional uphole surveys or shallow refraction survey at an interval of 1 km can not give accurate near surface model which leads to ambiguity in static corrections. In such type of situation continuous shallow refraction survey is one of the solution ( Chowdhary et all 2005 ).

In the absence of continuous shallow refraction survey, static corrections are to be calculated stage wise ( Srivastva et all 2005 ). In the first stage static corrections are calculated up to LVL, latter the static corrections are calculated up to the intermediate datum with the help of sub weathering velocity obtained through uphole and shallow refraction surveys. In the third stage statics are calculated up to mean sea level (Fig-2). A similar method was followed by Feng Zeyuan (2003). In these methods since the continuous information about lateral changes in the velocities are not available at each picket, iterations are to be carried out till they converge. The convergence is estimated with the help of quality checks on real data. This method has been followed while applying static corrections in the seismic data.

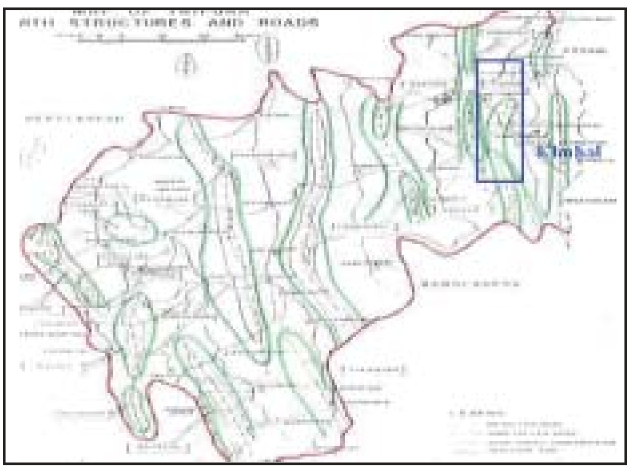


**Fig.1 :** Geological Map

The wavelet shape varies due to near source, near receiver condition and source receiver separation. This is more pertinent to fold belt areas where the near surface conditions drastically vary. In such type of areas surface consistent deconvolution is more suitable. Deconvolution can be formulated in this process as a surface consistent spectral decomposition. In such a formulation the seismic traces is decomposed into the convolutional effects of source, receiver, offset and the earth's impulse response, thus explicitly accounting for variations in wavelet shape due to near surface conditions. The assumption of surface consistency implies that basic wavelet shape depends only on the source and receiver locations but not on the details of the raypath from source to reflector to receiver ( Yilmaz, 1988 ). Moreover coherency based velocity picking on the gather helps in reliable velocity picking. Thus Entire reprocessing of the data was based on three methodologies viz precision static corrections, surface consistent deconvolution and coherency based velocity picking.

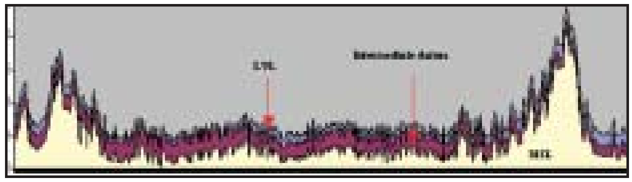

**Fig.2 :** Schhmatic Diagram for Statics

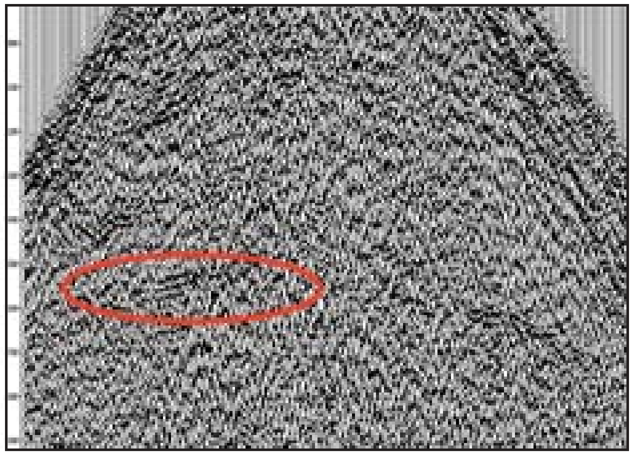

**Fig . 3a :** Gather with Conventional Method

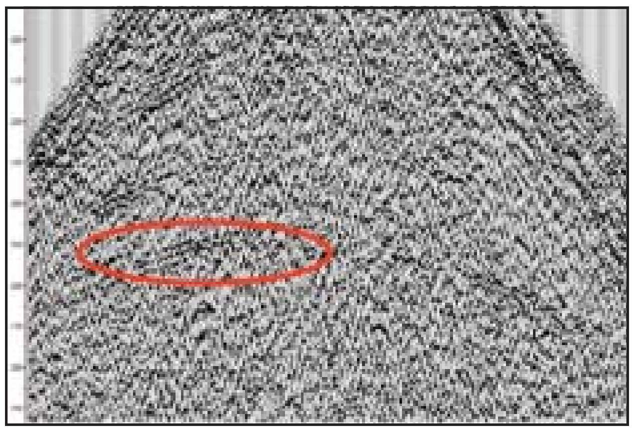

**Fig .3b :** Gather with New Method

## Application

The processing includes editing of shot gather to eliminate the noisy and dead traces. Band pass filter of 6-12 Hz has been used to eliminate the ground roll. The precision static calculated by above explained methodology was used. The difference in Static corrections by two methodologies are shown in Fig-4. Surface consistent predictive deconvolution has been applied, which is more suitable for this type of area for compressing the wavelet has been applied . This further attenuated mono frequency noise present in the data. Coherency based velocity picking on the super gathers of 11 CMP gathers was used for a reliable velocity pick. Model based velocity analysis along with CVST markedly improved the stack section. Residual time shifts were corrected by surface consistent residual statics computed on NMO- corrected CMP gathers for better semblance of the reflectors. Dip move out has been applied for proper position of reflectors. Random noise attenuation was carried out to enhance S/N ratio. Migration was performed for the correct disposition of seismic reflectors. The processing sequence is given in Fig-5. Final processed stack section is shown in Fig-7 -9 .The improvement brought out by new approach of processing computation is appreciable.

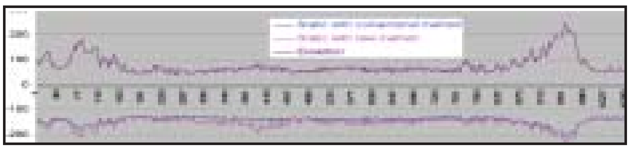

**Fig.4** : Difference in Static corrections

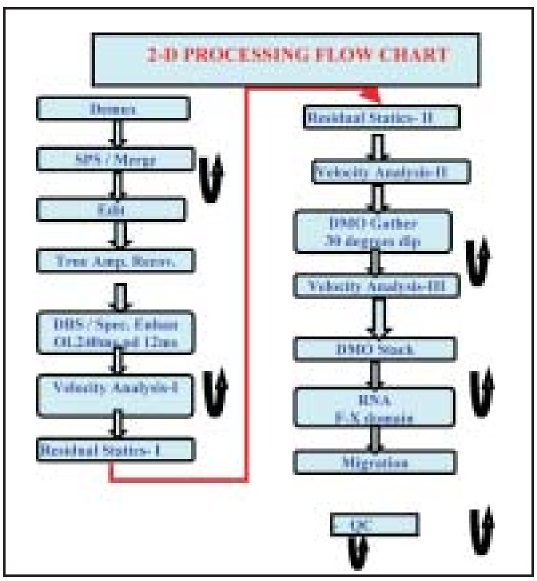


**Fig.5** : Processing Sequence

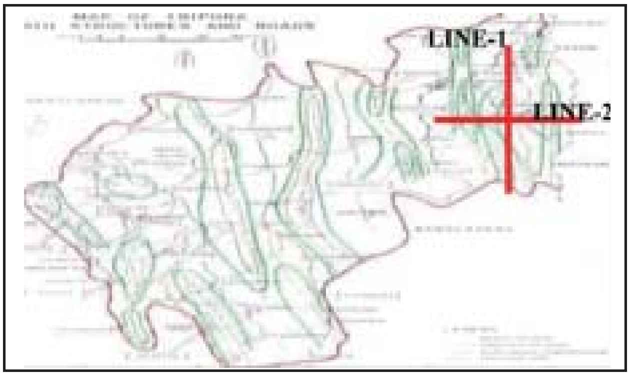


**Fig.6** : Showing Seismic Lines

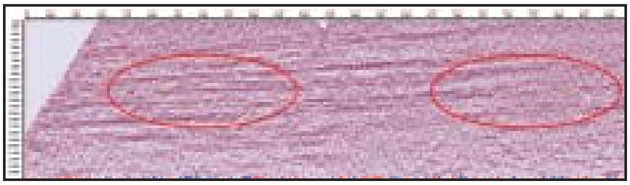

**Fig 7a** : Processed with conventional Method

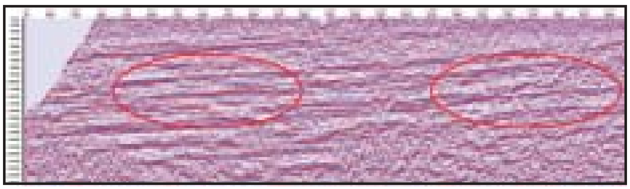

**Fig 7b** : Processed with New Method

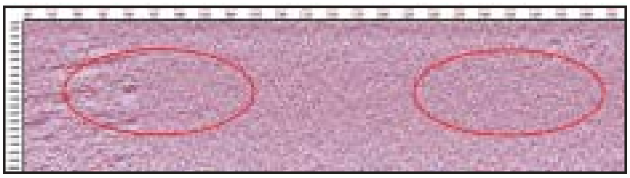

**Fig 8a** : Processed with Conventional Method

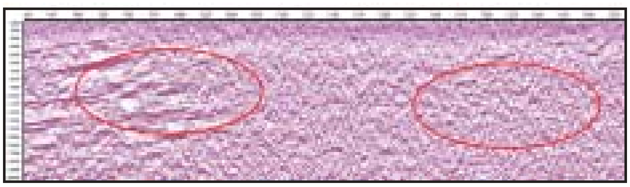

**Fig 8b** : Processed with New Method

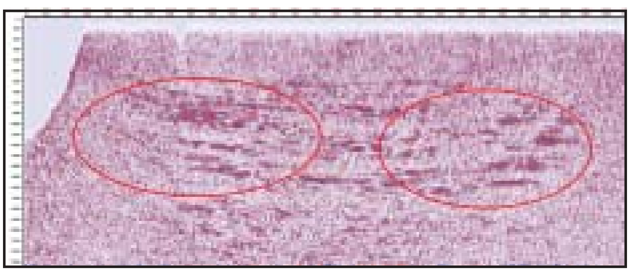

**Fig 9a** : Processed with Conventional Method

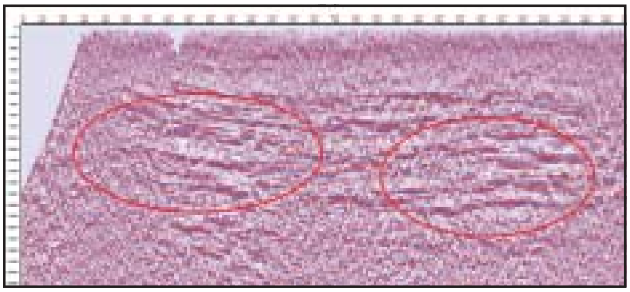

**Fig .9b** : Processed with New Method

The shot gather ( Fig 3a) after application of earlier statics calculated by conventional method is showing poor response at 1600 ms. The same shot gather ( Fig 3b) after application, the precision statics calculated by new methodology shows considerable improvement in the reflector, with better coherency.

## Results

The method was applied in Khubal anticline of Eastern Tripura area. The processed sections after application of new methodology for processing and earlier processed sections are compared and a considerable improvement is observed in the events. The seismic lines are passing across & perpendicular Khubal anticline structure. The earlier processed line shows discontinuity in middle portion and no events in crestal portion Fig-6. The processed section with step method has brought out appreciable improvement in both the places Fig. 7-9.

## Conclusion

Improvement in signal to noise ratio is seen in all the sections processed with new methodology. Reflections are continuous. Shallow reflections are improved. The method gave impetus to change the processing procedure to a great extent particularly for applying static corrections, deconvolution & velocity picking. Close grid up hole surveys are essential for more reliable for near surface model. Some deeper up hole surveys are also necessary for deciphering velocities of sub-weathered layer up to MSL. The method is more effective and sensitive where topography of terrain varies more than 100 meters. This method, if applied in old data, where the quality of data is very good, the geological model can be derived with greater confidence.

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