Model Based Processing in Gojalia Area, Tripura

Bhumija Agarwal*, K. Baskaran, M.V.M. Rao, C.P. Daswal ,
Gita Singh, M.Das, D.V.R.Murti,
RCC, ONGC, Jorhat

Summary

The Tripura-Cachar area forms the northern part of the folded belt of the Assam-Arakan Geosyncline . Tectonically, the Tripura region is characterized by a series of sub-parallel, elongated, arcuate, doubly plunging, tightly folded asymmetrical anticlines arranged enechelon and separated by wide, flat and more or less symmetrical open synclines. These folds are trending NNW-SSE to N-S direction and the intensity of folding increases from west to east, with progressively older rocks exposed in the anticlinal cores. Exploration is mainly based on the surface structures identified by field mapping and drilling was mainly confined along the structural axes. The fault closures along the flanks and stratigraphic prospects form the future targets of exploration.Thus subsurface imaging of the anticlines alongwith their bounding fault planes as well as stratigraphic features in the adjoining synclines is the main objective of data processing in this area.

To improve the sub-surface image of the area, efforts are put in both at the seismic data acquisition and processing stages. Due to erosion of anticlinal folds and exposure of older formations, the surface is highly undulating . The dip of the beds is in general more than 45 degree. Most of the seismic energy is scattered and converted into noise, masking the sub-surface reflections. Suppressing the noise on shot gathers and model based processing have enabled the imaging of Gojalia anticline and meeting the exploration objective.

Introduction

Gojalia structure is located on the western part of Tripura which forms a part of frontal fold belt of Assam-Arakan geosyncline. The area is characterized by tight anticlines and broad synclines of Surma subbasin (Fig.1). The structure is a NNW-SSE trending doubly plunging anticline slightly asymmetric box shaped fold (Fig.2). The southern plunge of this anticline extends further south into Bangladesh. It is believed that differential vertical movement of the basement rocks gave rise to the development of the anticlines. Bokabil Formation is exposed in the core of anticline while younger formations are exposed on the flanks and in the plunges.

The topography of the area is rugged and older formations are successively exposed as one moves towards the core. The elevation in the area varies from 12m to 127m. The hard rock poses problem in drilling shot hole. Seismic sections are dominated by many kinds of undesirable energy and reflections are often masked. Lateral velocity variations add to the challenge of generating optimum stacks.

Status of exploration

Gojalia is one of the important structures in the south-western Tripura. The area has been extensively covered by geological surveys, based on these field geological studies four wells, W-1, W-2, W-3, and W-4 were drilled on the crestal part of the Gojalia anticline and two on the northern plunge, W-5 and W-6 (Fig.3).

The subsurface stratigraphy of the structure based on the drilled wells is given in Table-1, and exposes nearly 1000m of thick Tertiary rocks of Tipam and Surma Group(Bokabil Formation) consisting mainly of sandstones, siltstone, silty shale and shales.

Well W-1 proved commercial gas during 1982 and subsequently 3 more wells were drilled on the central culmination viz. W-2,W-3 and W-4 out of which wells W-2 and W-4 produced gas. Later wells W-5 and W-6 drilled in the northern plunge too gave encouraging results.

Earlier, this area was not covered by CDP surveys because of the toughest logistics. However, seismic survey commenced with 2D crooked lines in 1990-91 and 1991-92. All these crooked lines were shot on the eastern part of the Gojalia anticline. Couple of years later, on the northern plunge of Gojalia anticline, straight lines were shot during the field season 2000-01 and 2001-02 respectively. The 2D seismic data were acquired with an objective to map the structural features of northern plunge of Gojalia anticline and examine the lateral continuity of the pay sands. Shot

Table - 1

WELL D.D./KB(m)	**W-5 2470.5/110**	**W-3 1800/95.01**	**W-1 3478/119.2**	**W-2 2349/119.6**	**W-4 2143/124.32**
Bokabil	Surface-1018	Surface-497	Surface-516	Surface-526	Surface-396
Up. Bhuban	1018-1810	497-1272	516-1291	526-1304	396-1211
Mid. Bhuban	1810-2470 +	1272-1800 +	1291-3260 +	1304-2349 +	1211-2143 +

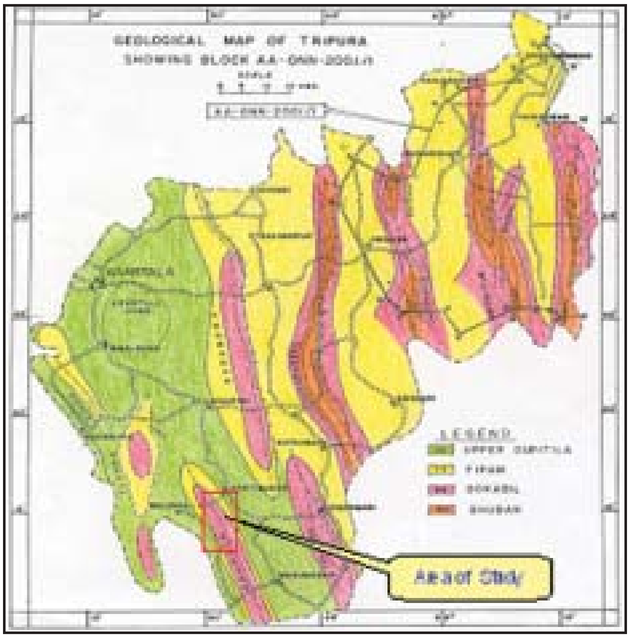

Fig.1.

Fig.2.

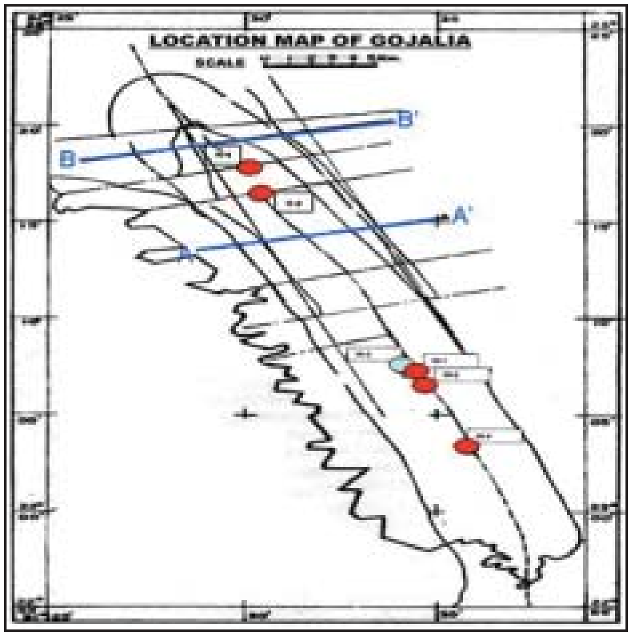

Fig.3.

hole drilling in large part of the area was extremely difficult due to presence of hard rock layers at shallow depths, added to these constraints is insurgency prone area. These facts reveal that seismic imaging on the Gojalia anticline is very challenging.

Present study

The present study was taken up on the northern part of Gojalia Anticline, with an objective to image the Gojalia Anticline. 2D seismic data was acquired recently taking into account the previous experience of data acquisition in a thrust regime, rigorous experimental work was executed to study the variations in the weathered layer thicknesses for field statics estimation. In addition, several experiments were carried out to determine the optimum depth and charge sizes at different locations in the area, particularly whenever there was change of formation. These efforts resulted in satisfactory acquisition data quality.

Methodology adopted

The acquired data was processed at RCC, Jorhat. The fundamental philosophy behind processing was an attempt to image the anticline using the available data and the algorithms of seismic data processing. The surface geological data regarding exposed structures, formation boundaries, dip of the beds, the borehole seismic data, specially the dipmeter logs for subsurface dips were thoroughly analyzed to be incorporated as and when required during processing sequence (Fig.4).

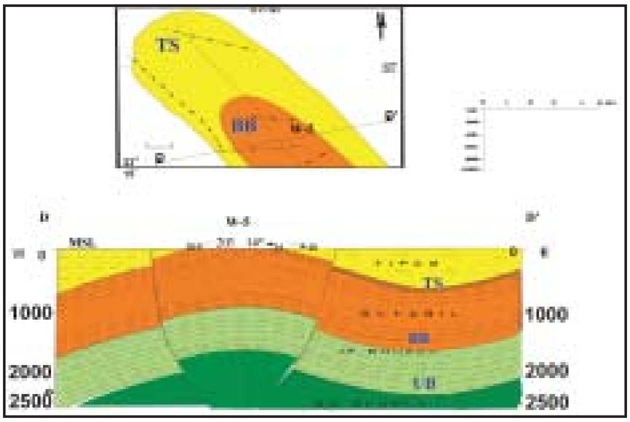

Fig.4. Geological Model of Gojalia Structure

The shot gathers show the presence of ground rolls having frequency (4-16)Hz (Fig.5). The frequency of the reflected signal is (10-32)Hz. The data was subjected to filtering, spectral balancing and deconvolution for attenuating the noise and enhancing the signal (Fig.6). The effectiveness of this can be seen in the above figs.

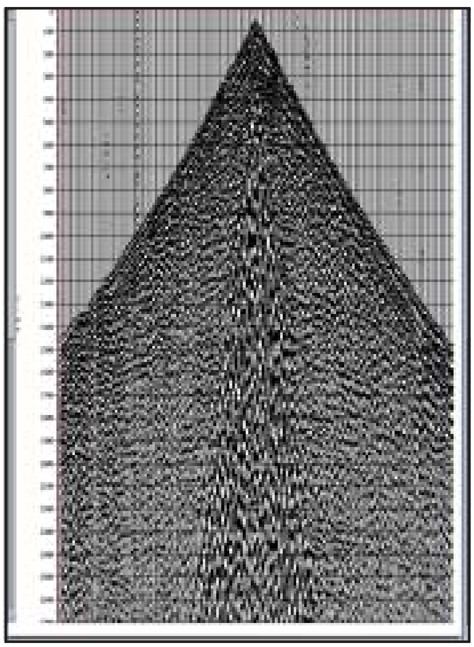

Fig.5 : Raw gather showing groundroll

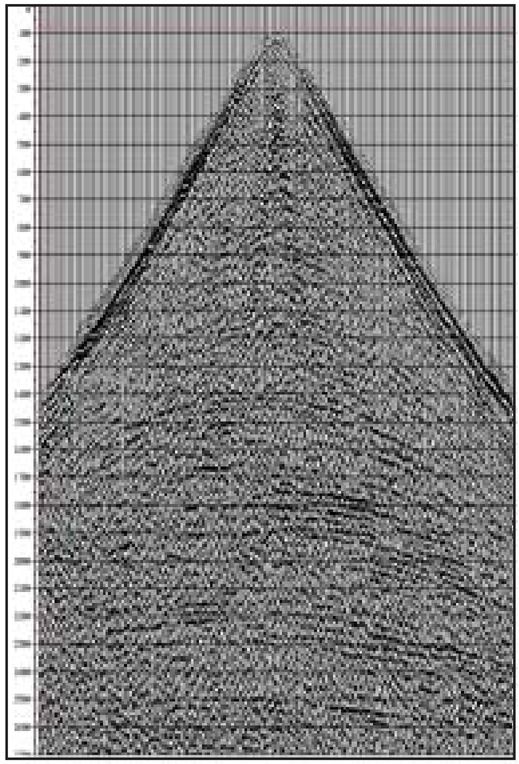

Fig.6. Filtering,Spectral balancing and Deconvoilution applied to the gather

The processing includes meticulously editing of merged gathers to eliminate the noisy and dead traces, selection of decon parameters to bring out the primaries, spectral analysis performed on the decon gathers specially on the crest of the anticline to eliminate the dominant noise frequencies through various filters. The most significant performance was through the model based velocity analysis incorporating available well velocity functions as well as the subsurface structural trends. Fig.7 shows rms velocity overlaid on the time migrated section of a dip profile A-A' depicting an appreciable match between the velocity model and the known structural trends. More passes of residual statics suppressed the noise as a result semblance of the reflectors improved. The dip move out velocity analysis brought out the structural disposition of the reflectors which were further improved by WEMIG migration.

Processing results

The final results are the Post stack Time Migration 2D seismic sections. The improvement made by the integrated approach is obvious, specially at the crest of the

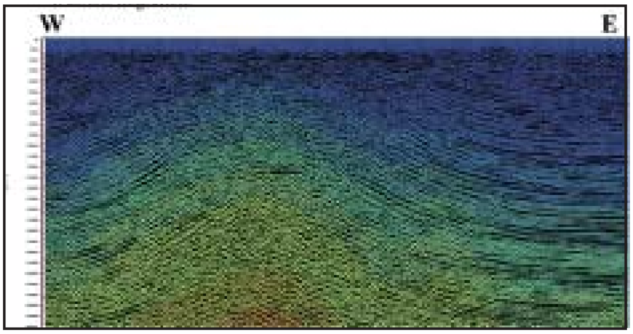

Fig.7 : RMS velocities overlaid on Migrated section of Line A-A’

anticlines. Fig 8 & Fig.9 are illustrations of post stack time migration sections of two parallel dip profiles viz. A-A’ and X-X’ where line A-A’ belongs to the current vintage and line X-X’ belongs to an earlier processed vintage . A comparative study of Fig 8 & 9 reveals that there is a remarkable improvement in the current vintage A-A’ at all the levels over the crest of the anticline. S/N ratio is improved tremendously leading to continuity of seismic sequences. Fault planes F1 & F2 are more pronouncing at these sequences.

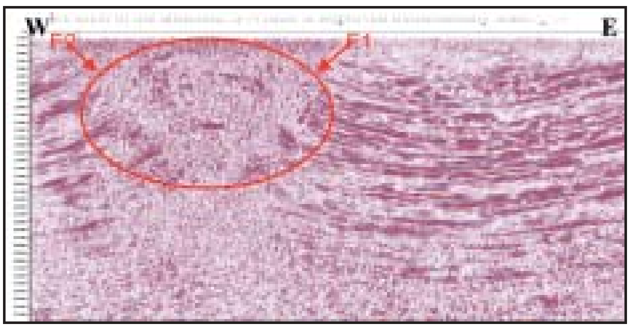

Fig.8. Time Migrated Section along Line A-A’

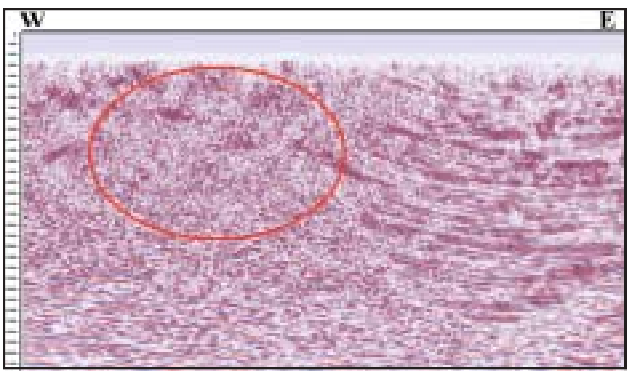

FIG.9. Time Migrated Section along Line X-X’

Line B-B’ passes close to the well W-6 (Fig 10) . The section clearly brings out the fault F1 on the right flank . On comparison with an older parallel seismic line Y-Y’ passing through well W-6 (Fig.11), an appreciable increase

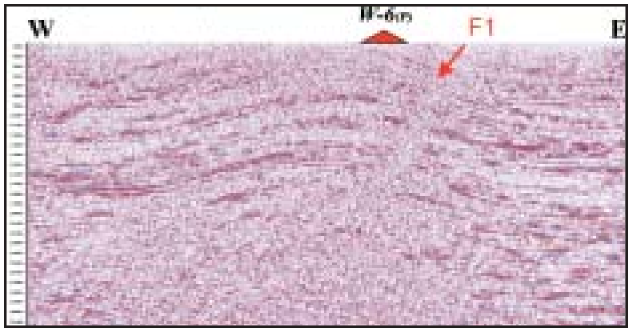

FIG. 10. Time Migrated Section along Line B-B’

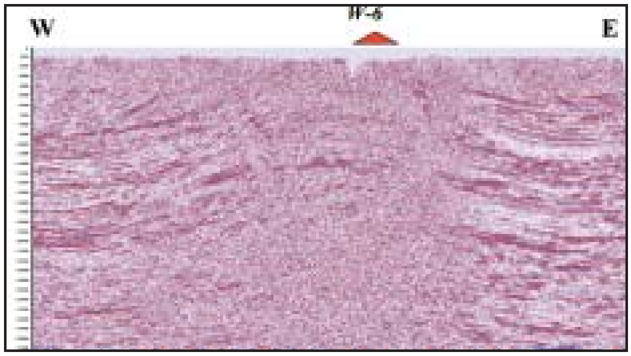

FIG. 11. Time Migrated Section of Line Y-Y’

in continuity of the seismic sequences is observed in line B-B’. The fault plane F1 is clearly resolved in the current vintage B-B’.

PSTM carried out on the lines have given a better fault definition, added resolution, given more confidence in the structural interpretation/ risk assessment of the complex anticline. This is very well demonstrated on a pre-stack time migration section of Line B-B’ (Fig 12). Resolution of stratigraphic features i.e. the channel cut on the right side of the section C1, terminations of events close to the fault F1 provide additional valuable information.

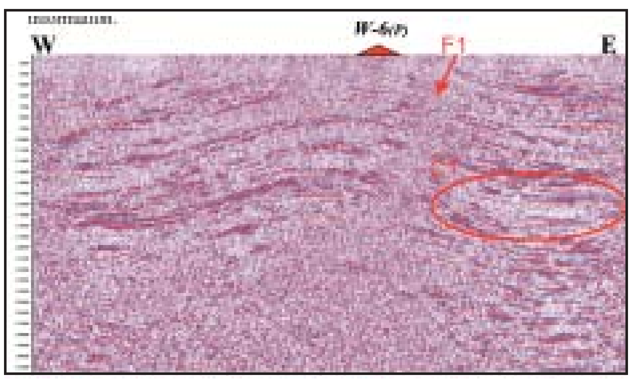

Fig.12. Pre-stack Time Migrated Section of Line B-B’

Conclusions

Overall improvement in imaging the crest of Gojalia anticline started with the early detailed evaluation of the earlier 2D data which led to acquisition of recently acquired 2D surface seismic.

Time processing showed tremendous improvement in the data quality over the earlier 2D series. Prestack Time migration showed another level of improvement specially close to the fault and subtle stratigraphy features which were less clear on the POSTM section.

These 2D data POSTM will provide more accurate maps giving more confidence /risk assessment of the area yielding more accurate estimates of the reserves and lower risk.

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