Imaging of Deeper Events in Panidhing Area, Upper Assam, India

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Summary

The current thrusts for hydrocarbon exploration in Upper Assam Basin are the Deeper Horizons. Seismic imaging of deeper events in structurally complex areas is very challenging.

As a case study, reprocessing of three, 3D volumes were acquired in Panidhing area was taken up to improve the continuity and resolution of the events. The three 3D volumes were reprocessed with Prestack merging, by meticulous analysis of the available geoscientific information and model based studies. The study shows that in a complex area where number of 3D volumes have been acquired, prestack merging in time domain has better edge over poststack merge. PSTM further improved the imaging thereby facilitating the interpreter to generate prospects with confidence.

Introduction

The area Panidihing is located on the northern platform part of the Assam Arakan Basin (Fig 1) and represents the Assam shelf front.

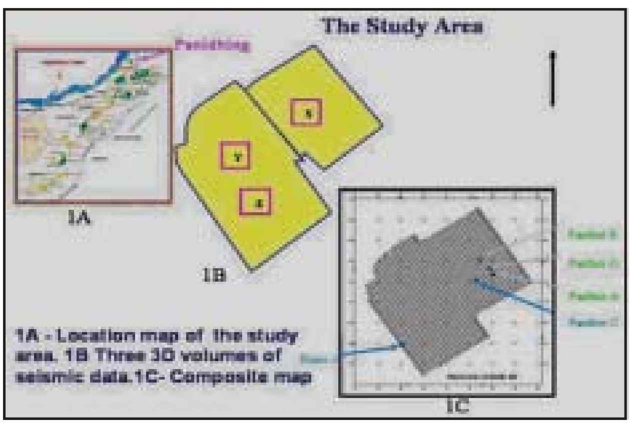

Fig 1

The area is in close proximity to the commercial hydrocarbon discoveries. The fields are endowed with hydrocarbon accumulations from multiple reservoirs of different age. The main oil reserves are from clastic reservoirs within Tipam Formation (Mio-Pliocene) and Barial Formation (Oligocene) occurring at a depth range of 2000 to 2500 m and 3000 to 3500 m below MSL respectively. Commercial hydrocarbon accumulation is also known from deeper levels as Kopili Formation, Sylhet Formation and Fractured Basement occurring at a depth of 3600m to 3750m, 4000m to 4250m and 4200m to 4440m respectively. In the northern part of Assam shelf, more than thirty wells have been drilled through Tura Formation of Paleocene to Early Eocene age. Two wells Panther-D(P-D) and Lion-D have produced oil in commercial quantity and have positive indications from Panther-B(P-B), Panther-A(P-A) and Rhino-A wells. These discoveries called for reevaluation of the available geoscientific data and formulate strategy on effective exploration and exploitation of Tura Formation occurring at a depth range of 4500m to 5000m below MSL.

The stratigraphy succession under the study area comprises of Tertiary and Quaternary sediments, unconformable overlying the Archaean Granitic Gneiss (Pre-Cambrian Basement) Fig-2.

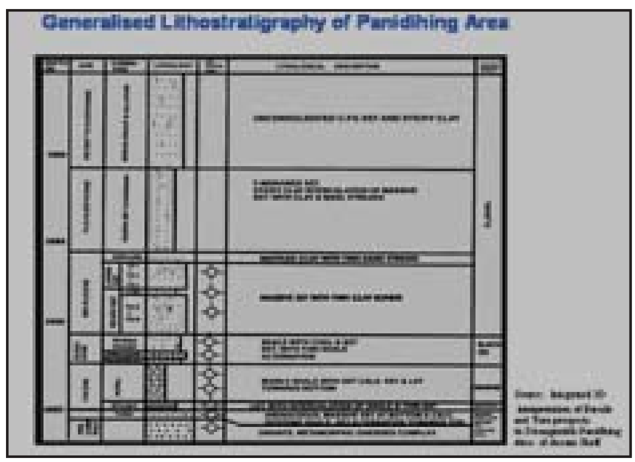

Fig 2

The earliest known rocks in this part of the basin are Tura sandstone (Paleocene to Early Eocene) lying unconformably over the Granitic - Gneiss complex (Pre-

Cambrian Basement). Its thickness varies from 73+to 114m (Fig 3) with a tendency to increase to the east and southeast. The sandstones with porosity 14-17 % are rich in calcareous cement.

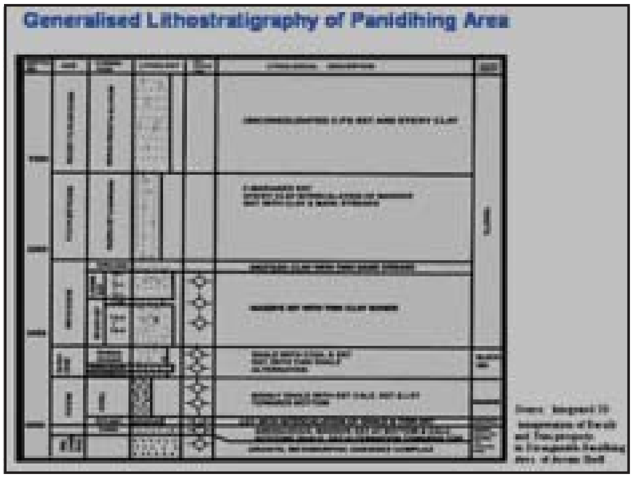

Fig 3

The Tura is overlain by Sylhet Limestone during Eocene, probably after a brief hiatus. The formation is characterized by almost uniform thickness of about 150m to in the area.

In the study area 3D seismic data was acquired as phase I (X) and phase II(Y and Z) over three field seasons from 1996-97, 1998-99 and 1999-2000, Fig. 1B. The total volume of the data is about 180 sq km with bin size 25 x 50, group interval 50 m, shot interval 100m, fold 15 x 2, with DFS V. The shooting geometry and acquisition parameters were

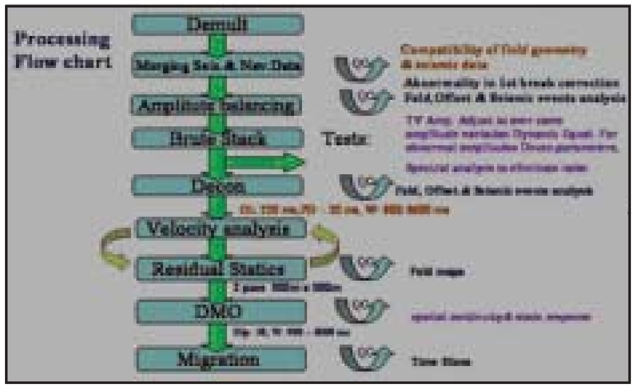

Fig 4

maintained the same for all the campaigns. Optimum overlapping between the individual campaigns was maintained to attain uniform fold. 3D seismic data processing of phase I and phase II, were carried out at GEOPIC. However, Post stack merging of phase I and phase II 'was carried out at RCC, Jorhat. The processed data was lacking continuity and resolution at deeper levels.

Therefore, Pre stack merging was attempted at RCC, Jorhat to improve imaging at deeper levels.

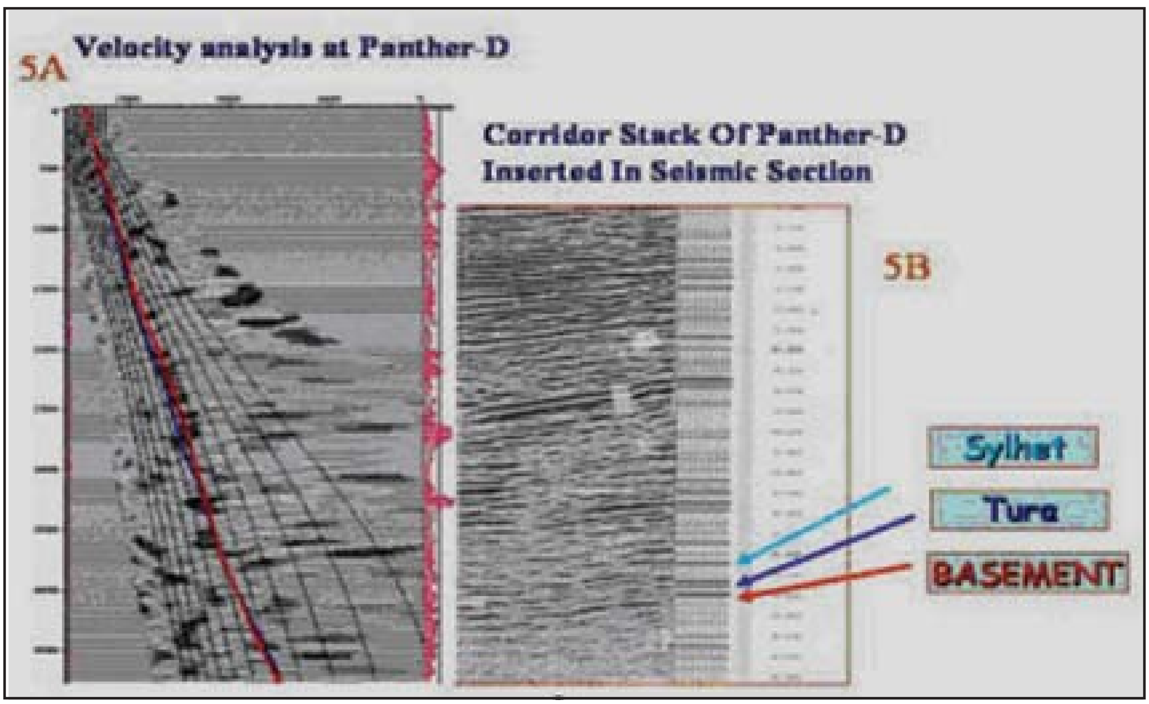

Fig 5

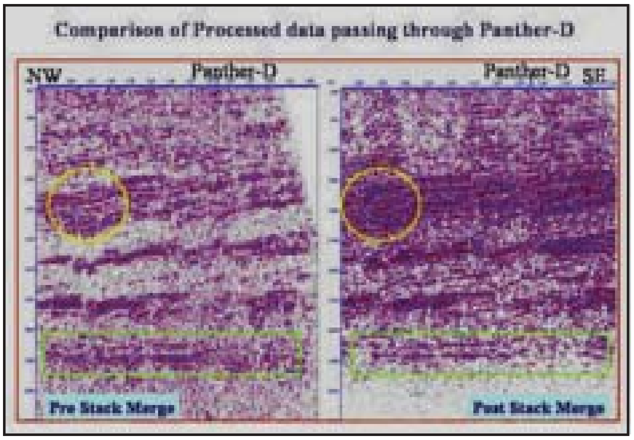

Fig 6

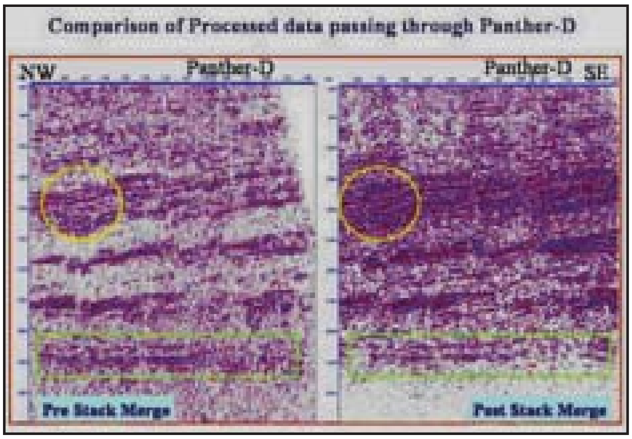

Fig 7

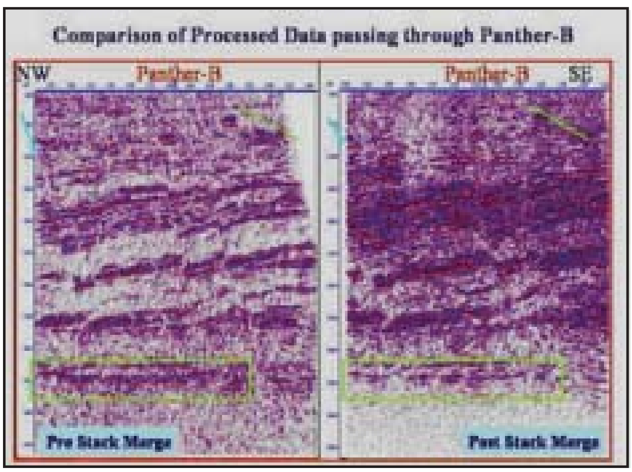

Fig 8

Methodology adopted

The pre stack merging of three 3D volumes was performed at RCC, Jorhat in September 2004. The total volume comprises of 58 swaths from three investigations (21 swath

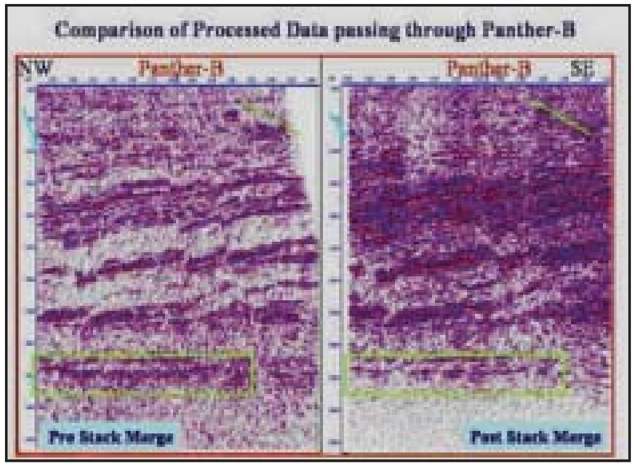

Fig 9

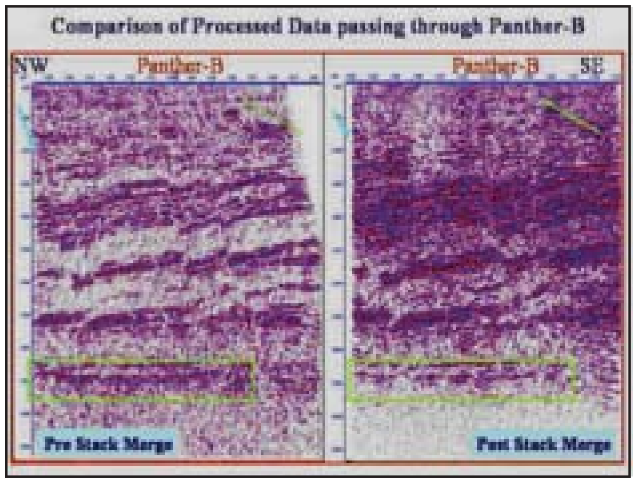

Fig 10

from X, 21 swath from Y and 16 swath from Z). The individual data sets were meticulously examined and the geological data regarding formation boundaries, the borehole seismic data, were thoroughly analyzed to be incorporated as and when required during processing sequence. The processing sequence in Fig 4

Illustrates the necessary processes which were applied to multiplexed field data of Panidhing area. The salient features of reprocessing were amplitude balancing and model based velocity analysis.

Fig 5A shows the velocity trend of seismic data. Fig 5B the corridor stack inserted in the seismic section at Well P-D bringing out the target horizon.

Processing results

The final result is the Post stack Time Migrated 3D data volume with Pre stack merge. The improvements brought

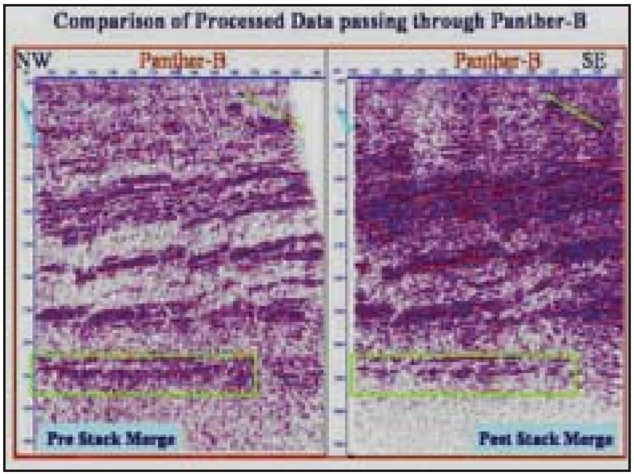

Fig 11

out by the integrated approach are obvious on the sections especially at the well locations as shown in Fig 6 to 10.

A comparison between the earlier processed seismic section (post stack merge) and the present (pre stack merge) are shown in Fig 6, Fig 8 and Fig 9.The improvement of seismic events at Tura level on the seismic section passing through the well P-D and R-J is clear on the zoom section Fig 7 and Fig 10.

These figures illustrations the shallow events at 700ms and deeper events at interval 3100- 3250ms have good continuity shown in green colour. The section also depicts the faults, Fig 6(yellow colour) and Fig 8(blue colour),which are better defined. Similar improvements have also been achieved on the cross lines. From the sections the basin tilt, Fig 9, shown in white colour is very clear.

Later, since the focus was to improve the continuity and resolution of events at Tura level an attempt was made to carry out prestack time migration (PSTM).

Fig 11 shows the improvement on a line passing through the well (P-D) on the PSTM section. The events are better imaged, positioned and resolved, even the faults are more clear. These efforts have given more confidence in structural and stratigraphic interpretation.

The seismic events as well as the faults are much better defined on the PSTM section. The processed lines as well as entire volume are giving a better fault definition, adding resolution and more confidence in the structural interpretation/ risk assessment of the complex area.

Conclusions

Seismic reflector imaging and position through PoSTM is extremely challenging due to complex geology and lateral velocity variations in Panidihing, Upper Assam. Conventional 2D and 3D time processing have allowed the processors to image the seismic events in this area. The deeper events occurring at TWT interval of 2900ms to 3400ms corresponding to Tura formation of Paleocene- Early Eocene age were discontinuous and difficult to map. However, 3D processing of three volumes with post stack merging gave a solution to the problem of imaging of deeper events but was not satisfactory in terms of continuity of events and resolution. Therefore reprocessing of three 3D volumes, with pre-stack merging, amplitude balancing and model based studies during processing illuminated the subsurface at deeper levels. The improvements were in terms of continuity and resolution of events, faults and structural features which were less clear on the earlier processed data. The prestack time migration has further succeeded in better imaging and positioning of the subsurface.

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