P 002

Mapping of complex geology in Banskandi and north plunge of Teidukhan areas of Assam using high resolution 2D seismic survey

*H.N.Garg**

Summary

The Banskandi and north plunge of Teidukhan areas are part of Cachar fold belt. Gas is being produced from Banskandi doubly plunging anticline and gas has been found in northwest direction outside the north plunge of Teidukhan area. The 2D seismic surveys carried earlier in the vicinity of Banskandi anticline area could not locate structural and stratigraphic traps with high degree of confidence. The Teidukhan area is virgin as geological; GM or seismic surveys were not carried out due to forest and hilly terrain. The two areas fall in pre NELP block of Assam.

High resolution 2D seismic survey was carried out in Banskandi area during field season (FS) 2011-12 and the survey is being taken up in north plunge of Teidukhan area during FS 2012-13.

Two geometries with active channels 720 and 840 were compared and the attributes were evaluated by NORSAR modelling. It was found that geometry with 840 channels is better due to the availability of longer offsets up to 4195 m and uniform illumination of target zone. At the time of designing seismic survey the Group Interval was decided as 10 m, shot interval 50 m with symmetrical split spread shooting.

The geometry used in FS 2011-12 was selected for FS 2012-13 as the work is being carried out in the same block.
The stacks generated pertaining to Banskandi area have enhanced the confidence of mapping structural and stratigraphic traps in the area. The sections generated in north plunge of Teidukhan area has established the basin limits and helped in mapping of structural and stratigraphic formations.

Introduction

The Banskandi anticline produces gas from upper Bhuban pay sands from a depth of 2100 m. The pay thickness is 2 m to 6 m. 2D seismic data available in the area did not help in carrying out attribute analysis & preparation of maps at pay level.
The extension of the field could not be established based on the available 2D data. Therefore, high resolution 2D survey was planned

1) to evaluate strati-structural prospect within Bhuban sequences.
2) to demarcate structure building longitudinal & transverse faults for prospect generation in the area.

The target depth is from 1000 m to 4400 m. The dips are high on the both sides of anticline. The conventional 2D seismic campaigns could not properly map the strati-structural prospects and faults in the area.

Outside Teidukhan area in a well, gas was produced from Upper Bhuban sand, this sand produced gas at a rate of 79,726 m3 / day through 6mm bean in the interval 1748.5–1745.5 m during initial testing. In Teidukhan area the geological set up is same as that of Banskandi area, therefore geometry of FS 2011-12 is being used to evaluate strati-structural prospect in Renji, Bhuban and shallower plays.

GP 08, 3rd floor, Luit Bhawan, A & AA Basin, Cinnamara, Jorhat – 785 704,
garg_hn2006@yahoo.com

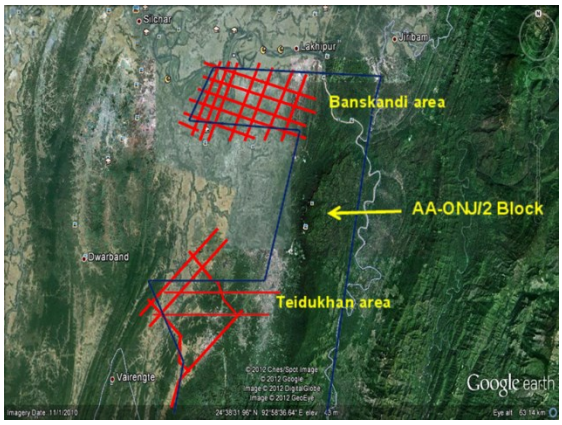

Fig 1: Google map of the operational area

Methodology

1. Study of Existing Data

In Banskandi area Gravity and magnetic surveys were conducted by Burma Oil Company during thirties. Extensive gravity and magnetic surveys and seismic surveys (reflection and refraction) by ONGC were taken up during the early seventies. Geological mapping was done by a number of geological parties. The operational area was earlier covered with conventional 2D surveys.

The acquisition parameters of some of the campaigns are tabulated in the Table 1. From the study of previous seismic as well as well data it is inferred that in Banskandi sediments are folded with varying sedimentary thickness from Tipam to middle Bhuban.

Table 1: Previous 2D data parameters of Banskandi area

SI No.	SI 1	SI 2	SI 3	SI 4	SI 5	SI 6
Technique	End -on	End -on	End On	End On Spread	SS Spread	SS Spread
Field Season	1989-90	1990-91	1991-92	1993-94	2006–07	2011-12
Foldage	48	48	48	96/48	60	84
Channels /RL	96	96	96	192/96	120 + 120	420+420
Near off set (m)	100	100	100	100/200	100	5
Far Offset (m)	2575	2575	2475	2475/2575	3075	4195
Gr interval (m)	25	25	25/10	25	25	10
Shot interval (m)	25	25	25/10	25	50	50
Shot depth (m)	5-30	20-30	20-30	5-30	17 – 36	18-25
Charge size (Kg)	1 – 3	1 – 3	1 - 5	1.5 – 5.0	2.5	2.5
RL (ms)	5000	5000	5000	5000	5000	6000

Few lines of previous investigations are falling partially within the north plunge of Teidukhan area. The lines from adjacent areas were studied to get idea about the general subsurface structure within the operational area.

Table 2: Parameters adjacent to Teidukhan area

Type/Parameter	2D				3D
SI No.	SI 7	SI 8	SI 9	SI 10	SI 11
Field Season	1991-1992	1997-1998	2001-2002	2003-2004	2008-09
No. of Channels/Fold	96/48	96/48	96/48	96/48	1344/42
Near off set (m)	100	300	240	240	45
Far Offset (m)	2475	2675	3090	3090	4501
Group interval (m)	25	25	30	30	40
Shot interval (m)	25	25	30	30	320
Av Shot depth (m)	20-30	15-30	10-30	15-30	21-31
Charge size (Kg)	1 – 5	1 – 5	2 - 3	2-3	1-2.5
RL (ms)	5000	5000	5000	5000	5000

2. Geometry Design

Various acquisition geometries have been designed and analyzed for assigned target and objectives using MESA software platform. Finally two acquisition geometries, Geometry-I and Geometry-II have been selected for detailed comparison (Table 3).

Table 3: 2D geometries for comparison

Type of Geometry /Parameters	Geom I	Geom II
Type of Geometry	SSS	SSS
Fold	90	84
CDP Interval (m)	5 m	5
Active Channels	720	840
Max OFF (m)	3595	4195
Near OFF (m)	5	5
SI (m)	40	50
GI (m)	10	10

3. Evaluation of geometry

The geometries were evaluated on fold test. Three residual stacks of foldage 24, 48 and 96 of vintage data show that 96 fold data is better in resolution as well as reflection

strength. Higher foldage will help in increasing resolution of different structural and stratigraphic features of the area.

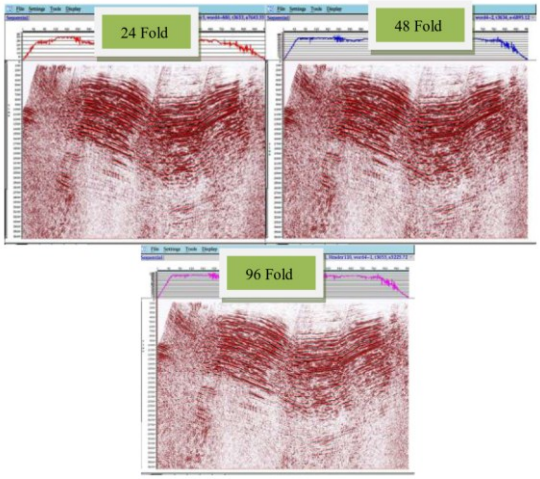

Fig 2: Fold test on residual stack of line AA

4. NORSAR modeling

2D modeling on NORSAR software was carried out to generate illumination maps for the deepest horizons in the area. Depth contour maps within Bokabil sands, top of upper Bhuban and top of middle Bhuban were used for modeling. Acoustic impedance was generated in the three layers using velocity and density data from VSP. The three geometries were superimposed on the model one by one and shots were fired. The synthetic seismic traces were recorded and processed to generate illumination maps for the three geometries.

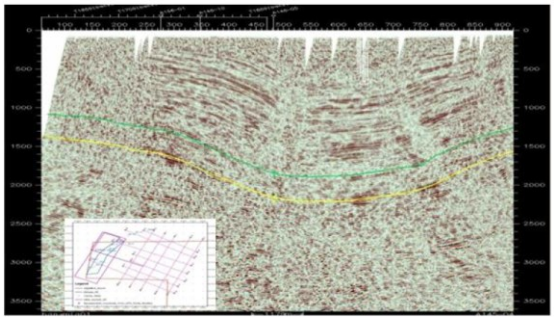

Fig 3: Time section map of Upper and middle Bhuban

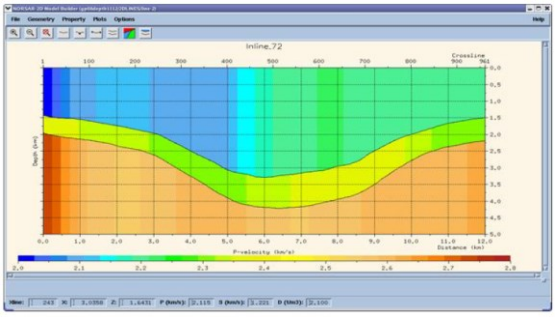

Figure 4: Depth Model

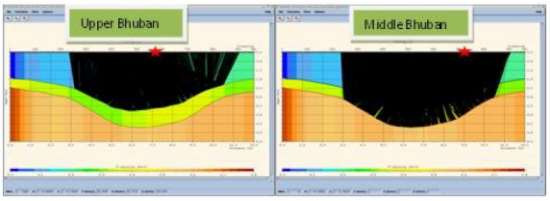

Figure 5: Ray Trace diagram

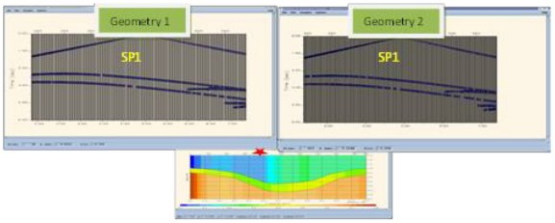

Fig 6: Synthetic Seismogram for shot at 5 km from start of profile.

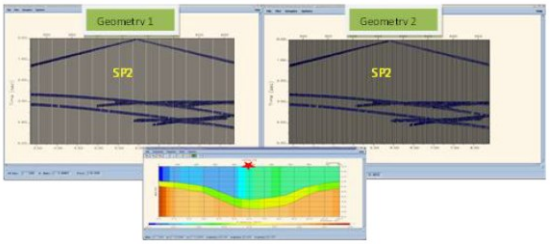

Fig 7: Synthetic Seismogram for shot at 6 km from start of profile.

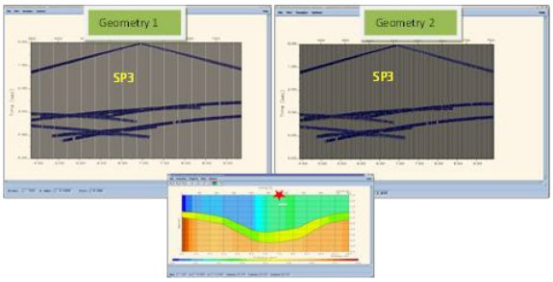

Fig 8: Synthetic Seismogram for shot at 7 km from start of profile.

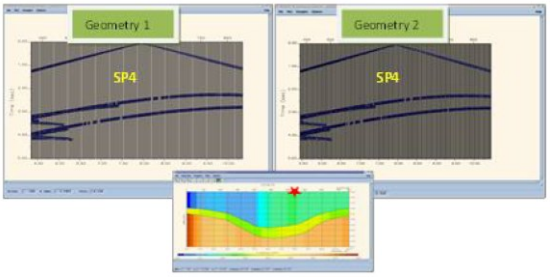

Fig 9: Synthetic Seismogram for shot at 8 km from start of profile.

Figs 6-9 show that Upper Bhuban and Middle Bhuban formations could be mapped with higher resolution using Geometry II. Based on the comparison of various attributes of the two geometries, Geometry-II is finalized for the ensuing field work in East Banskandi area. The advantages in selecting Geometry-II over Geometry-I is the availability of longer offsets up to 4195 m. In view of the fact that the operational area falls on the Labak syncline with dips rising on the both flanks, split spread type shooting is finalised. The final acquisition parameters are tabulated below.

Table 4: Parameters for seismic data acquisition

Type of Survey	High resolution 2D survey
Geometry	Symmetrical Split spread
CDP interval	5 m
Total active channel/shot	840 (420 + 420)
Receiver Interval / Shot Interval	10 m / 50 m
Spread Length	4195 m + 4195 m
Near offset	5 m
Foldage	84
Shot Depth	Model based
Recording Instrument	UL-408
Recording format	SEG-D
Low cut filter	Out
High cut filter	Out
Notch filter	Out
Polarity	Normal
Record length	6.0 Sec
Sample rate	2 ms

5. Data recording and analysis

Stringent quality measures within the available resources were taken to improve the data quality. Figs 10 to 17 pertain to Banskandi area. Figs 18,19 belong to Teidukhan area.

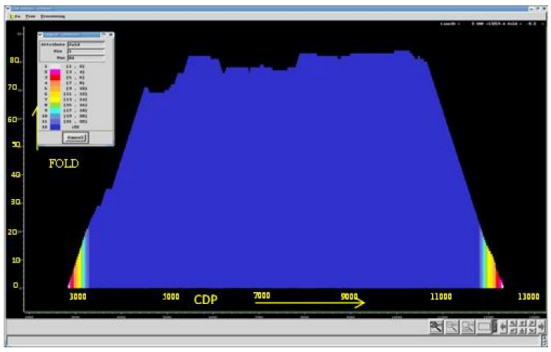

Fig 10: Fold map of a line BB

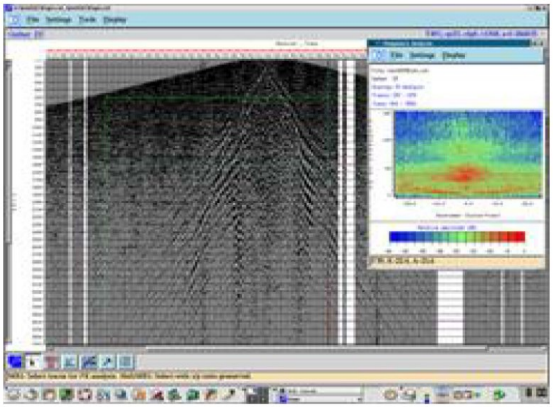

Fig 11: Raw gather with FK analysis

The brute stacks generated at the camp with FPU are reproduced below.

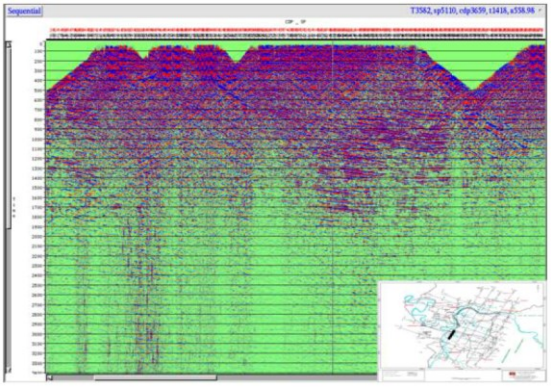

Fig 12: Brute Stack of Southern part of profile CC

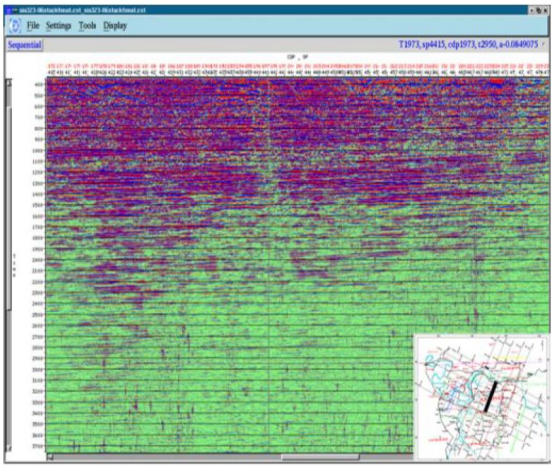

Fig 13: Raw Stack of Central part of 2D profile DD

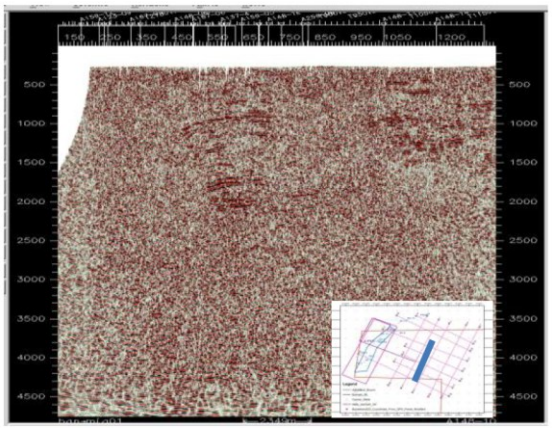

Fig 14: Raw Stack of 2D vintage data at profile DD

The data acquired using Geometry II has better continuity and resolution of events (figs 13, 14 and 16,17). The seismic sections generated at Regional Computer Centre, Jorhat are given below figs 15 to 17.

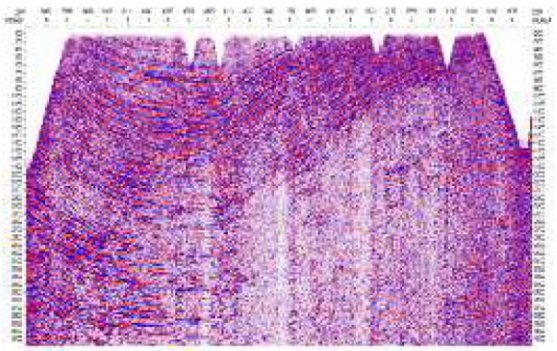

Fig 15: Seismic section across line EE

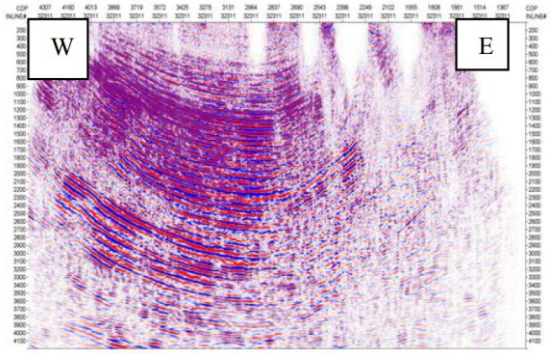

Fig 16: Seismic section of vintage data across line FF

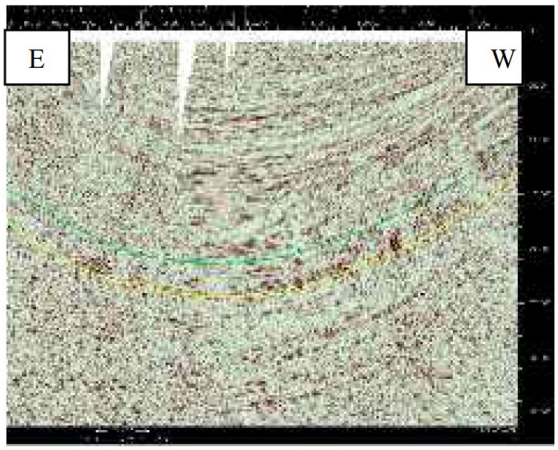

Fig 17: Seismic section of vintage data across line FF

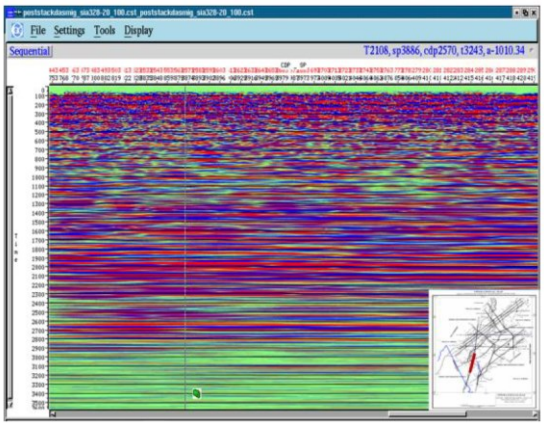

Fig 18: Raw stack of part of line GG processed on FPU

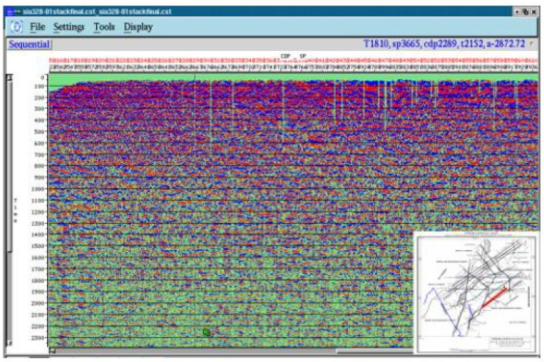

Fig 19: Raw stack of part of line HH processed on FPU

Conclusion

Good quality data has been recorded with 2D high resolution survey geometry. Data is being processed on main frame computers using state of art processing software and processing techniques. The improvements seen in seismic sections of Banskandi area will facilitate in mapping structural and stratigraphic traps in the area with higher degree of confidence.

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* Geophysical Services, A & AA Basin, ONGC, Jorhat, Assam, India, garg_hn2006@yahoo.com