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# Mapping of concealed anticline in Banskandi area of Cachar, Assam

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***Summary***

*The Banskandi doubly plunging anticline is a concealed structure flanked by Silchar syncline towards west and Labak syncline towards east. A number of 2D seismic survey campaigns were carried out in the area but the structural and stratigraphic traps associated with Banskandi anticline could not be mapped with high degree of confidence.*

*A 3D seismic survey was planned during the field season 2010-11 to map the concealed Banskandi anticline. At the time of designing seismic survey the narrow azimuth and wide azimuth survey geometries attributes were evaluated by MESA software and NORSAR modelling. It was found that wide azimuthal geometries score over other geometries on many counts e.g., unique offset fold, foldage in zone of interest and uniform illumination of target zone.*

*The wide azimuthal geometry with asymmetric sampling was selected to acquire 3D seismic data. The brute stacks generated on Field Processing Unit using single velocity indicate that after final processing of data on mainframe computers using state of the art software will enhance the confidence of mapping structural and stratigraphic traps in the area.*

## 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. A well showing presence of hydrocarbons in the area falls in the low fold data of a 3D survey.

The extension of the field could not be established based on the available 2D data. Therefore, 3D survey was planned to map

1) Structural Disposition of Upper Bhuban Pays & prospects of deeper reservoirs.
2) Identification of Longitudinal & Transverse faults as well as Stratigraphic elements if any within Bhuban sequences

The target depth is from 1000 m to 3000 m. The dips are high on the both sides of anticline. The seismic campaigns on northern and southern sides of the operational area have used narrow azimuth survey design, which failed to record seismic rays coming from all direction.

The exercise of geometry design was done to record the seismic rays coming from 300 degrees. On evaluation of many geometries attributes on MESA software, Wide azimuth seismic survey design showed many advantages over other geometries.

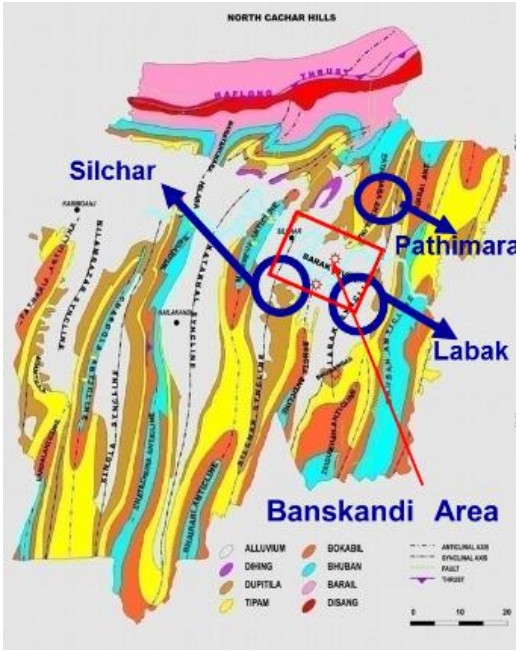


Fig 1: Geology of the Cachar Fold Belt

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## Methodology

### 1. Study of Existing Data

Gravity and magnetic surveys in the area 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 2D surveys and 3D survey data is available on the northern and southern side of the area.

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 the Banskandi structure is a concealed NE-SW trending structure with varying sedimentary thickness from Tipam to middle Bhuban.

Table 1: Acquisition parameters of 2D and 3D surveys

| Parameters | G! | G2 | G3 | G4 | G5 |
|---|---|---|---|---|---|
| | 2D | | | 3D | |
| Shooting technique | End - on | End - on | Sym Split Spread | Sym Split Spread | Sym Split Spread |
| Foldage | 48 | 48 | 60 | 10x4 = 40 | 10x5 = 50 |
| Channels /RL | 96 | 96 | 120+120 | 90+90 | 120 + 120 |
| Near offset (m) | 100 | 100 | 100 | 40 | 28 |
| Far Offset (m) | 2575 | 2575 | 3075 | 3560 | 3450 |
| Bin Size (m) | - | - | - | 20 X 40 | 12.5 x 25 |
| Grp intervl (m) | 25 | 25 | 25 | 40 | 25 |
| Shot int (m) | 25 | 25 | 50 | 80 | 50 |
| Shot depth (m) | 5-30 | 20-30 | 17 – 36 | 18 – 26 | 18 - 28 |
| Ch size (Kg) | 1– 3 | 1 – 3 | 2.5 | 1 – 3 | 1 - 3 |
| 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 three acquisition geometries, Geometry-I (FA G1), Geometry-II (FA G2) and Geometry-III (NA G3) have been selected for detailed comparison (Table 2).

Table 2: 3D geometries for comparison

| Parameters | Full Azimuth SSS | | Narrow Azimuth SSS |
|---|---|---|---|
| | (FA G1) | (FA G2) | (NA G3) |
| Fold | 80 | 64 | 40 |
| Bin Size | 20mx40m | 20mx40m | 20mx40 m |
| NR/L | 80+80 | 80 + 80 | 90 + 90 |
| NRL | 8 | 8 | 4 |
| TAC | 1280 | 1280 | 720 |
| MO | 3200 | 3200 | 3600 |
| RLI | 240 | 40 | 320 |
| SLI | 320 | 400 | 320 |
| SI | 80 | 400 | 80 |
| GI | 40 | 40 | 40 |

### 3. Evaluation of geometry

The geometries were evaluated on unique offset fold, azimuthal coverage, percentage of bins falling in the zone of interest. (figs 2-6)

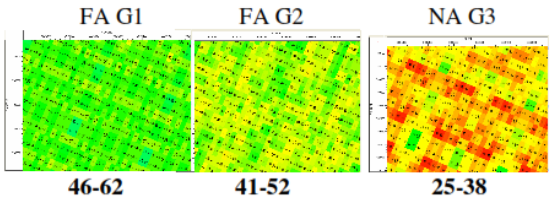


Fig 2: Unique Offset Fold

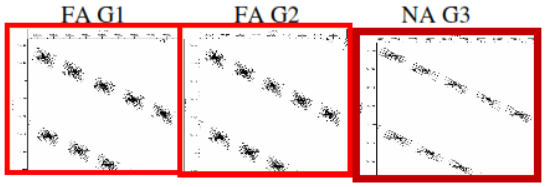


Fig 3: Azimuth coverage

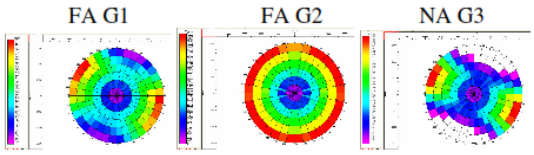


Fig 4: Rose diagram for 3000 m

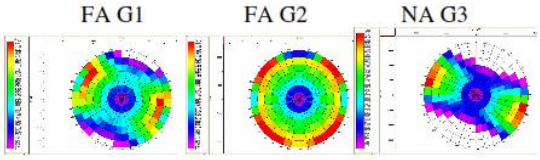


Fig 5: Rose diagram for 3500 m

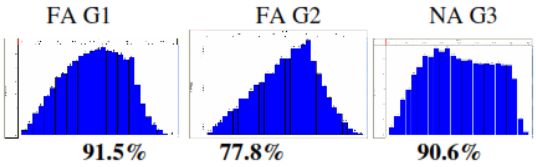


Fig 6: Percentage values for Offset distribution of 3200 m

## 4. NORSAR modeling

3D 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.

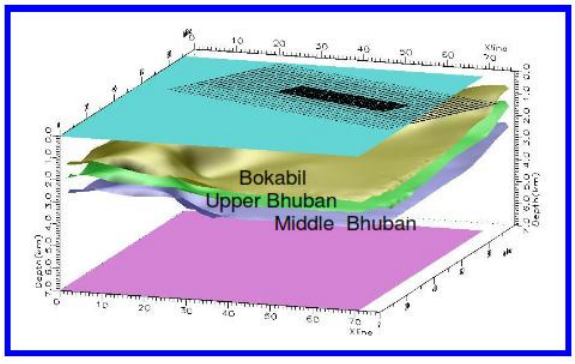


Fig 7: Three layer model

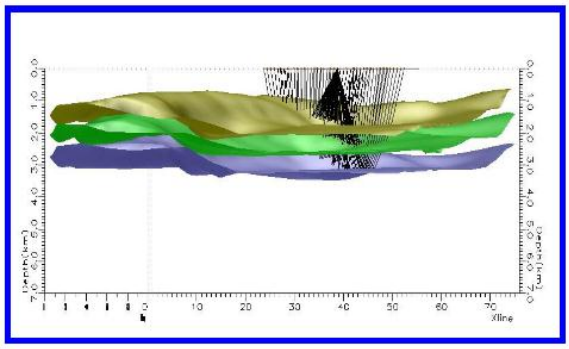

Fig 8: Ray Trace model

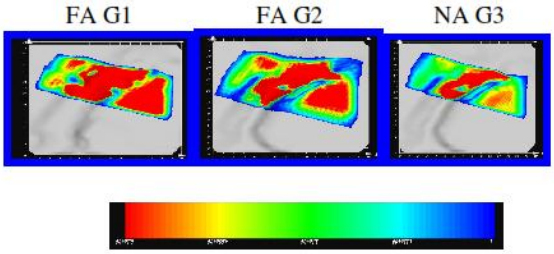


Fig 9: Illumination maps for three geometries

Illumination map for Geometry I (FA G1) is best amongst the three maps (fig 9). Table 3 shows that geometry FA G1 scores better on three attributes and hence selected for regular seismic production work.

Table 3: Comparison of three geometries

| Type of geometry | Full Azimuth | | Narrow Azimuth |
|---|---|---|---|
| | FA G1 | FA G2 | NA G3 |
| Fold | 80 | 64 | 40 |
| Unique Offset Fold | 46 - 62 | 41 - 52 | 25 - 38 |
| Foldage in O R 1200 – 2400 m | 36 - 39 | 18 - 25 | 12 - 18 |
| Max Offset requirement | 3200 m | 3200 m | 3200 m |
| Full Azimuth Survey for Offset Distribution | 3200 m | 3500 m | 2000 m |
| % of bins filled upto 3200 m Offset | 91.5% | 77.8% | 90.6% |
| Illumination map - middle Bhuban | Best | Better | O K |
| Aspect Ratio | 0.6 | 1 | 0.4 |
| No of shots | 6492 | 6144 | 5920 |

## 5. Data recording and Analysis

Stringent quality measures within the available resources were taken to improve the data quality.

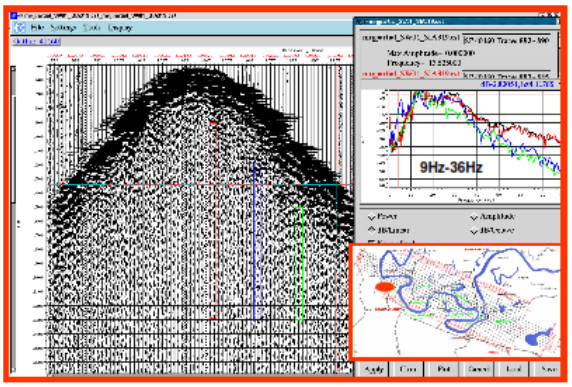


Fig 10: Single line raw data on western part of SW1

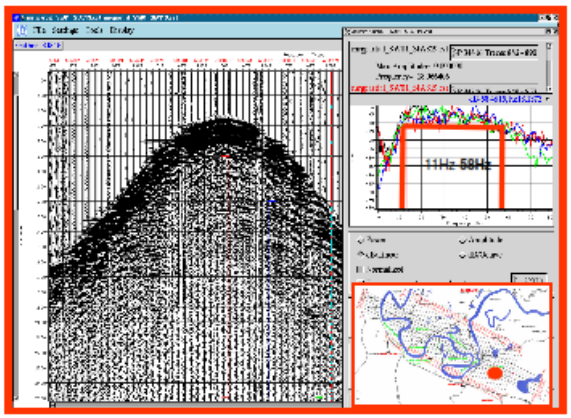


Fig 11: Single line raw data on eastern part of SW1

The brute stack generated at the camp with FPU is reproduced below.

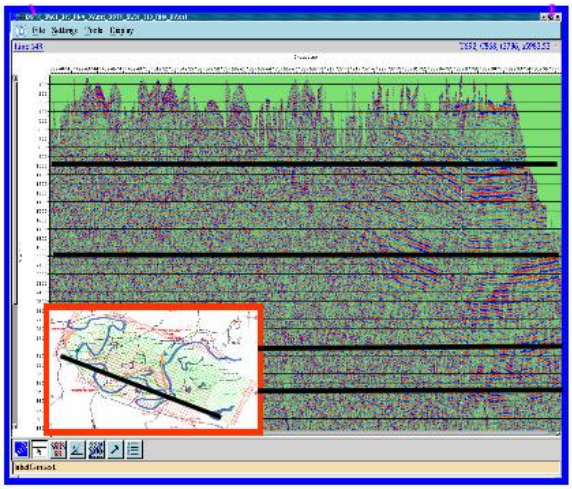

Fig 12: Brute stack generated at the camp with FPU

## 4. Conclusion

Good quality data has been recorded using Wide azimuth survey geometry. Data is to be processed at main frame computers using state of art processing software and processing techniques. It will generate seismic sections which will facilitate in mapping structural and stratigraphic traps in the area with higher degree of confidence.

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## References

Mark Girard et al 2008, Operational implementation of full-azimuth, high-density land acquisition survey in Algeria, First Break, Volume 6, 61-67

Vermeer, G. J. O. [1998] 3-D symmetric sampling in theory and practice. The Leading Edge, 1514-1519.

Mike Hall et. Al., 2008 Fracture Detection and Reservoir Property Estimation using Full-Wave, Full Azimuth Seismic Data, CSPG CSEG CWLS Convention