



Seismic Data Acquisition & Processing In Tipam Sandstones: A Case Study from Tripura

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Summary

Tripura area lies in the heart of the tertiary fold belt that extends from Surma valley in the north and Bangladesh in the south. This area experienced several cycles of uplift and erosion due to late tertiary tectonic movements. The sediments are mainly sandstone, siltstone and shales. Seismic data acquisition in fold belt area has always been a tough task. Processing of seismic data in a logistically difficult area is as difficult as acquiring the same. In the present paper efforts have been made to discuss the problems faced during seismic data acquisition and pitfalls of it, taken care during the data processing. In addition to this, the effect of using surface consistent methods and controlling the frequency contents of the data will be discussed.

Introduction:

The objective of seismic data acquisition and processing was to delineate the prospectivity of Bokabil and Bhuban formations in the area. Depth of Bokabil in synclinal part varies from 600m to 1200m and depth for Bhuban formation varies from 1200m to 2000m. Tipam Group is exposed along both the flanks of the anticline. Tipam Group has been classified into five units, of which two units of this group have been demarcated from the image based on the topographic and tonal signatures. The Dupitila group is generally exposed along the synclinal valley like denudation mounds. In the anticlines Bokabil is exposed at most of the places and at the crest of the anticline Bhubans are exposed. (Fig. 1) The primary exploratory target in the area is Bhuban formation so the acquisition parameters were designed to map Bhubans up to the depth of 3000m. The problems faced in this area were mainly due to the presence of exposed Tipam sandstone. The shot hole depth chosen was 27 to 30m but this depth also could not give good shot records as there was no clay band present within the drilled shot hole so most of the shots were taken in the sandstone. In the sandstone energy dissipation is high so records were having majority of low frequency events due to which mapping of hyperbola of seismic event was difficult. The effect of frequencies was taken care by applying spectral whitening during the processing.

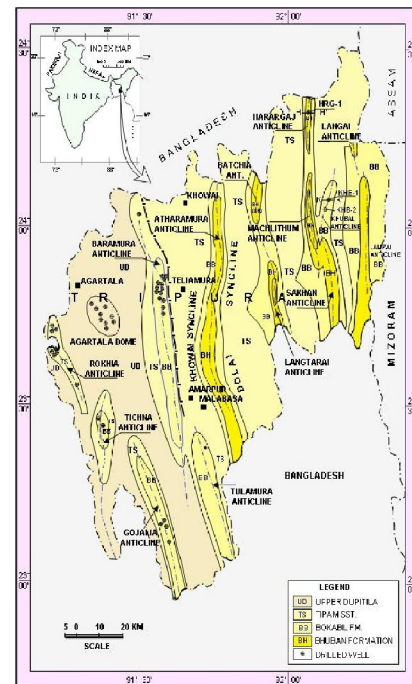


Figure 1: Geological Map of Tripura
(Source: DGH Data Package)



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Constraints in Processing:

The major problem faced during the processing was unavailability of uphole data and high elevation variations, which affected the application of the static corrections. Seismic data in the synclines is good but towards the anticlines data quality deteriorates due to high elevation variations of the range 40m to 100m with in small distance (Fig.2).

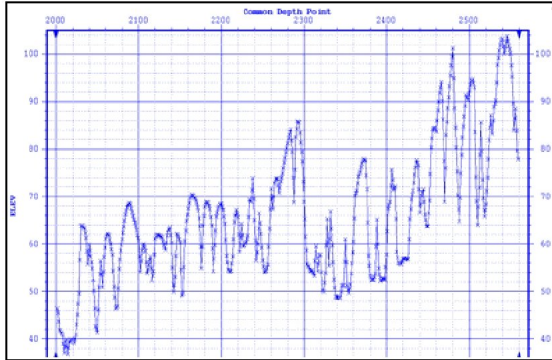


Figure 2: Elevation profile along one Seismic line

Methodology

The data quality in the synclinal area was good but as we approach the limb of the anticline it was difficult to map the substrata with routine processing. The efforts were made to improve the continuity on the flanks of the anticline it was improved by controlling frequency spectra using spectral whitening. The frequency spectra of the data shows that the general frequency range in the data varies between 6Hz to 60 Hz and the major frequency range falls in the range of 10-40 Hz (Fig.3). Controlling the frequency range by spectral whitening increased the continuity in the crestal part. In spectral whitening frequencies are given different weightage to contribute to the data, this way original frequencies are preserved in the data and can be recovered at any point of time as per requirement.

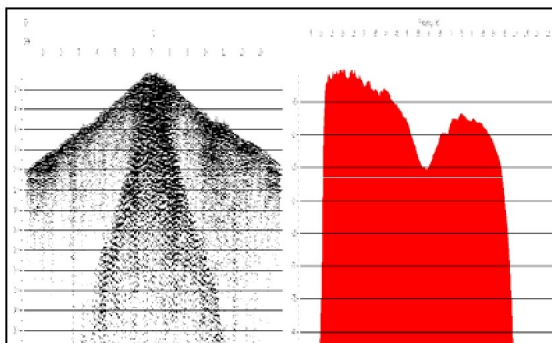


Figure 3: Frequency Spectra of one Shot Gather

Processing:

The basic processing sequence includes geometry creation using the observer logs and the SPS files. Before applying Geometry to the data QC was done by checking plots of fold distribution, offset distribution and elevation variation. The nominal fold of 35 is achieved and that looks sufficient for expected frequency variation. For editing, top mute was applied and by interactive picking bad traces were killed. Many tests were conducted to finalize the Processing parameters. For True Amplitude Recovery (TAR), time variant gain (TVG) with $1/t$ to the power 1.25 was found to be optimum. This was checked on various FFID's (Field File ID). Spectral analysis was performed to find out the frequency distribution in the data. Filter test was done with various filter windows and a window of 6-80 Hz was found to be appropriate so that we do not lose the required frequency range from the signal. Refraction statics is applied by picking the first breaks with weathering layer velocity of 1800 m/sec which was taken from the general information about the basin as uphole information was not available. Static was applied to the data to bring data up to a NMO datum. This was considered to be a single layer case after analyzing the shot gathers. For finalizing deconvolution parameters autocorrelation was done for various FFID's. After analyzing autocorrelation function, minimum phase surface consistent predictive deconvolution with operator (OP) length 160 ms, prediction distance (PD) 16 ms and white noise (WN) 0.1% was applied to the data. Two pass residual analysis with picking the velocity after first pass was done. Velocity analysis is done using constant velocity stacks and semblance plots. Spectral whitening with parameters 6 Hz with 0%, 10 Hz with 100% 40Hz with 100% and 60 Hz with 0% was applied before stacking. Results were analyzed with and without application of Spectral whitening. For post stack processing F-X Decon and Time variant filter was applied.

Results:

The results of processing before and after controlling the frequency range are shown in fig. 4 and 5. The results show that the imaging on crestal part has improved after controlling the frequencies. Significant improvement is seen in all the sections processed with present method. Reflections are continuous on the crestal part and can be mapped with higher confidence level. The method can be more effective if the constraints faced during acquisition can be overcome. The availability of uphole data may improve the results even better.

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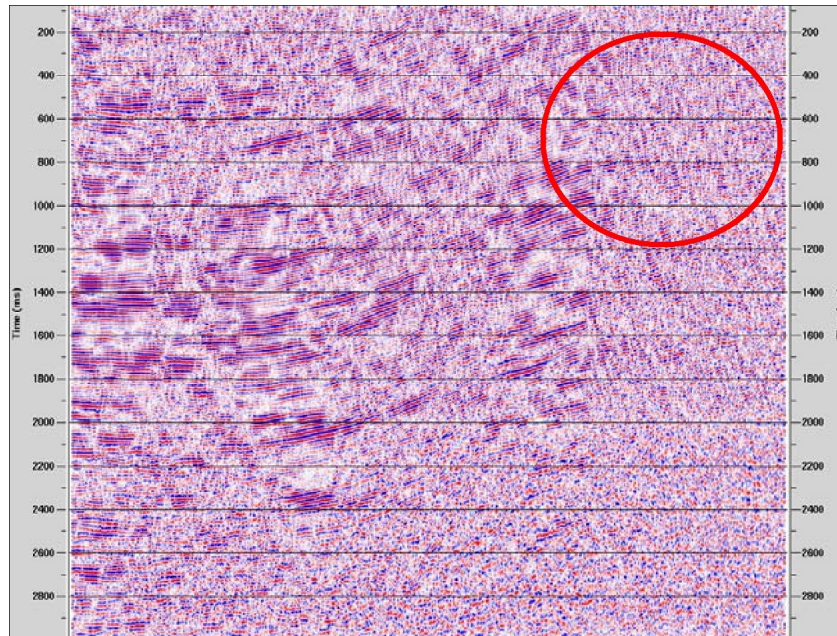


Figure 4: Output of normal processing shows poor continuity on crestal part

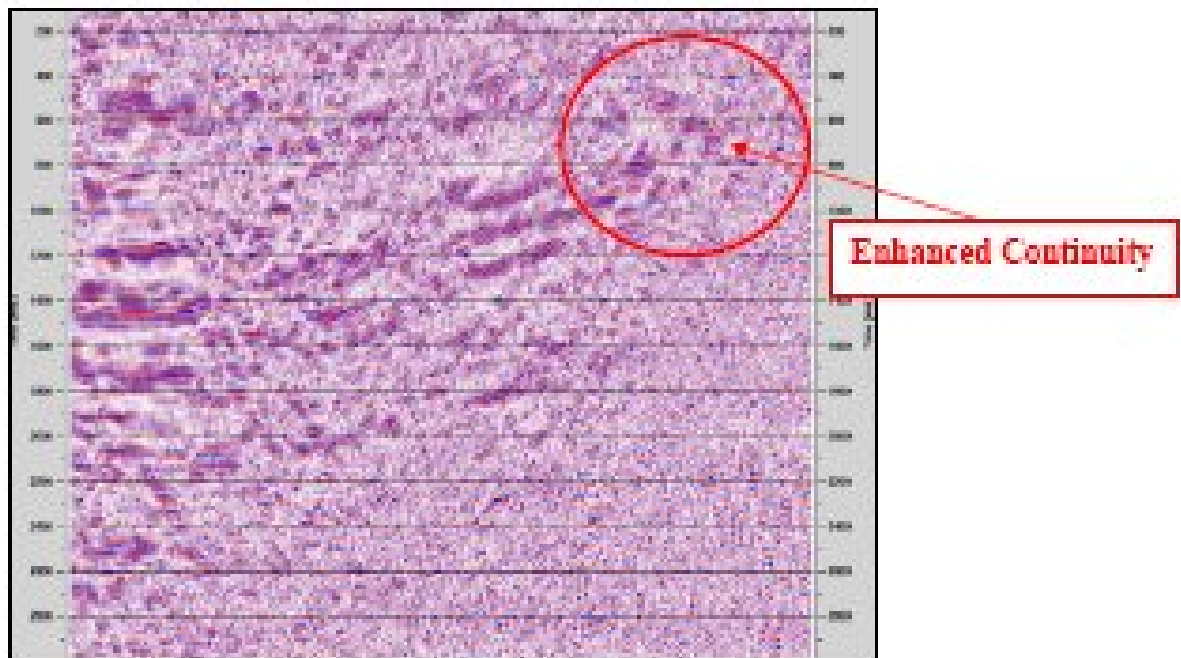


Figure 5: Output of processing after controlling the frequency shows increase in continuity on crestal part



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