8th Biennial International Conference
& Exposition on Petroleum Geophysics

"HYDERABAD 2010"

P-367

Thin Bed Resolution Using Seismic Spectral Blueing Method: A Case Study from East Coast of India

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Summary

Observed behaviour of reflectivity data obtained from wells shows that higher the frequencies the higher the amplitude. This spectrum is referred as blue spectrum. During the processing of seismic data the amplitudes are often whitened. Various authors have shown that boosting the more greatly attenuated higher frequencies (blue part) within the seismic band in order to match well-log-derived reflectivity can improve the resolution of seismic data. This method, known as spectral blueing includes designing and applying one or several operators to post-stack seismic data in order to enhance attenuated high frequencies within the frequency band. In present study we showed that application of spectral blueing improved seismic resolution in tuned part of thin Miocene wedges and thereby helped in horizon picking.

Introduction

Since conventional seismic data is band limited, it provides limited subsurface geological information. Moreover, higher frequencies within the band are more attenuated. Spectral blueing matches the average seismic spectrum to the shape of the well log reflection coefficient spectrum, which is rich in high frequencies and hence blue. This effectively whitens the seismic wavelet to enhance seismic resolution and ensures that the blued seismic data show the true reflectivity of the subsurface (Lancaster and Connolly, 2007). Although these methods enhance spectra only within the seismic band and do not go beyond the band limits, it has been shown that it can improve seismic resolution by recovery of attenuated frequencies within the band (BlacheFraser and Neep, 2004).

Geology

The area of study lies in East Coast of India which is Deep water Passive margin basin having 2000 meter water depth and without any major structural component. The objective comprises Mid Miocene frontal splay complex appearing as onlaping wedges against the Lower Miocene shale with overburden of more than 2200 meter.

Objective

To improve the seismic bandwidth so that reservoir top and base can be marked accurately in the presence of tuning.

Data Used

The seismic data used, have been processed through a flow including PreStack Time Migration. Perfect recovery of seismic bandwidth was not possible so the seismic bandwidth decreases gradually with increasing depth and at reservoir level dominant frequency of seismic decreases as low as 24 Hz. For designing of spectral blueing operator an exploratory well drilled upto Miocene level was used.

Method

Input seismic data was converted to reflectivity by over sampling and generating a new sparse spike reflectivity series weighted by the interpolated amplitudes at all of the maxima and minima (Young and wild, 2005). An operator (Blueing Operator) was designed by matching the spectrum of seismic data with well data. This blueing operator was convolved with input data to create enhanced volume. This enhanced volume was further processed using trace mixing (3X3) and Bandpass filtering (1-10-60-125 Hz) for lateral continuity, high s/n ratio and minimization of high

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frequency noise.

Following schematic diagram shows process used for spectral blueing of input data.

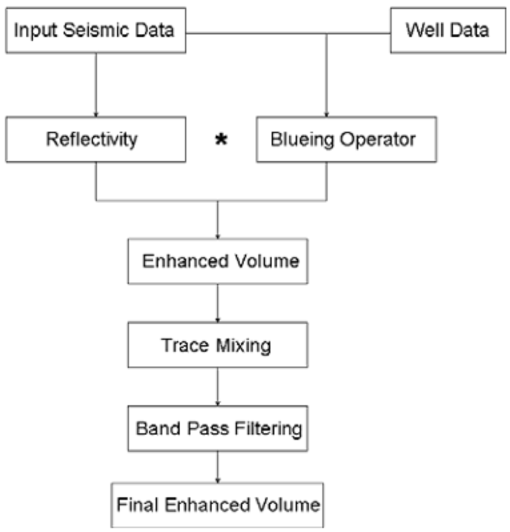
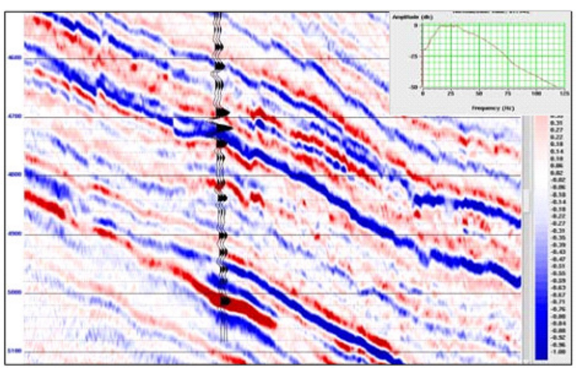


Figure 1 Schematic Diagram showing Workflow used for Seismic Spectral Blueing

Results



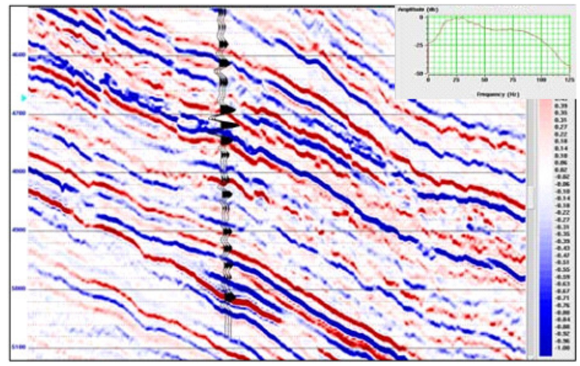


Figure 2 (a) Input Seismic Data (b) Spectral Blued Data, Inserted curves are zero offset synthetic traces using ricker 30 Hz wavelet. Normalized am plitude spectrum (in dB) is shown in Inset.

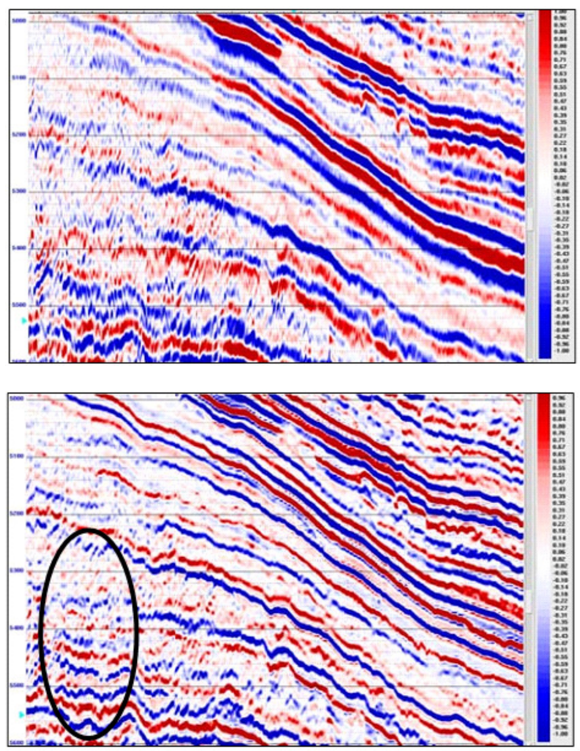


Figure 3 (a) Input Seismic Data (b) Spectral Blued Data, Better definition of Reflections in noise dominated zones.

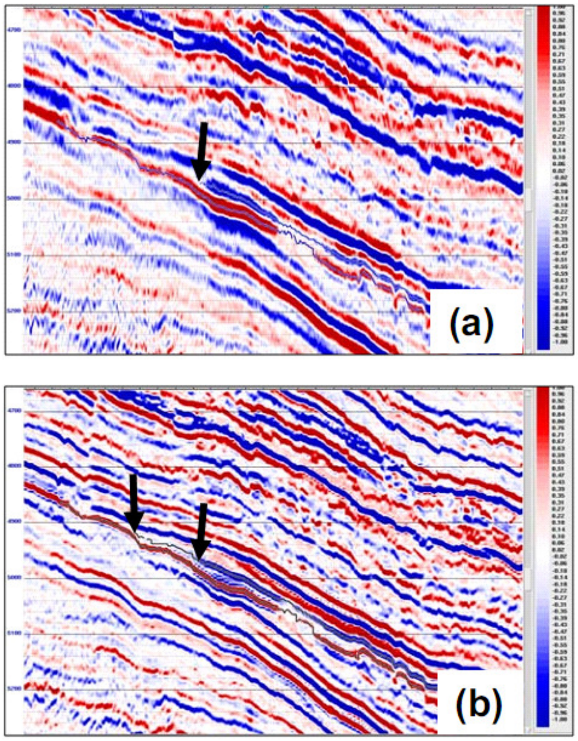


Figure 4 (a) Input Seismic Data (b) Spectral Blued Data, Wedge Top and Base were picked with same auto tracking parameters, Wedge top get resolved further 1.5 km in up dip direction.

Conclusions

Results showed that implication of SSB method had increased the seismic bandwidth, resolved thin part of tuned wedge, improved signal to noise ratio in noise prone zones. Beside that this method is rapid, easier for implementation and interpretation.

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Acknowledgment

Authors like to thank Reliance Industries Limited for granting permission to publish this Paper.