9th Biennial International Conference
& Exposition on Petroleum Geophysics

"HYDERABAD 2012"

P-217

Use of Integrated Seismic Attributes for Paleo Geomorphic Insight - A Case study from OIL's operational area in Upper Assam Shelf Basin, India.

T.Ramprasad*, K.Dasgupta, Akshaya Kumar & B.J Reddy, *Oil India Ltd.*

Summary

Seismic geomorphology, the extraction of geomorphic insights using predominantly 3D seismic data, is a rapidly evolving discipline that facilitates the study of the subsurface using plan view images. A variety of analytical techniques are employed to image and visualize depositional elements and other geologically significant features. The seismic geomorphology technique is similar to back-stripping of a geologic sequence that represents a certain time-stratigraphic surface.

A 3D-seismic data set processed & conditioned pertains to Upper Assam shelf Basin is used in the present paper for case study illustrating use of combination of attribute extractions & mono frequency outputs of spectral decomposition tools analyzed through seismic horizon slices. The present study mainly focuses on time window of our reservoir target formation to bring out the geomorphologic subsurface features primarily buried stream channels and other sand prone deposits which may be charged with hydrocarbons for exploratory interest.

Keywords: *Geomorphology, Attribute, Spectral decomposition*

Introduction

Study Area

The area selected for the study is located in south western part of OIL's operational area in Upper Assam Shelf Basin, at the southern bank of Brahmaputra River, in north-eastern part of India (Figure- 1).

Figure.1: Location Map of the study area.

In the study area, 3D seismic data of approximately 370 sq.km quantum was acquired by Oil India Ltd during 2005-2008 in three different vintages. Before the acquisition of these surveys, several wells were drilled on the basis of 2D-seismic data interpretation in the area. The 3D surveys were planned and executed in the study area with a primary objective of geologically conformable imaging and identifying future prospects in Paleocene/Eocene to Oligocene age formations for exploration interest. In the 3D seismic data processing phase the above objectives were taken care of and the processed post stack time migrated seismic data in the block is of good quality with good mappability of continuous reflectors at target formations. The frequency content of the data varies from 10 Hz to 60 Hz range with a dominant frequency of about 20-45 Hz.

Geological Background

The selected study area lies in Assam-Arakan basin which is a polycyclic basin located in the North-Eastern part of India. The shelf part of the basin spreads over the Brahmaputra and Dhansiri valley, shelf to basinal slope part lies below the Naga Thrust and the basinal (geosynclinal) part is occupied by the Naga Schuppen belt and the Cachar-Tripura Mizoram-Manipur fold belts. This is a proven petroliferous basin covering about 116,000 sq km. About 7 kms thick sediments ranging in age from Paleocene to Recent are present in the shelf part and a huge thickness of more than 10 kms sediments ranging in age from Upper Cretaceous to Recent is present in the fold and thrust belt. Eocene-Pliocene sequences contain potential source, reservoir and cap rocks. The Upper Assam Shelf part is

Geophysics Department, Oil India Limited, Duliajan, Assam-786602. ramprasad.tuniki@gmail.com

predominantly a Tertiary Basin. Sediments of Palaeocene/ Eocene age were deposited in shallow marine to marine environment in this basin. Regional tilt/uplift prompted widespread marine regressions with an increase in the supply of sediments to this part of the basin during Oligocene. This is reflected by predominance of deltaic facies in arenaceous sequence of Barail formations. On the other hand, argillaceous sequence of Barail Formation (Mainly of Lower Oligocene age), seem to belong to coastal plain (especially carbonaceous shales and coal). The upper sequence is embedded with a number of fluvial channel sands. During Miocene, sediments were deposited under fluvial and lacustrine environment. (Figure- 2).

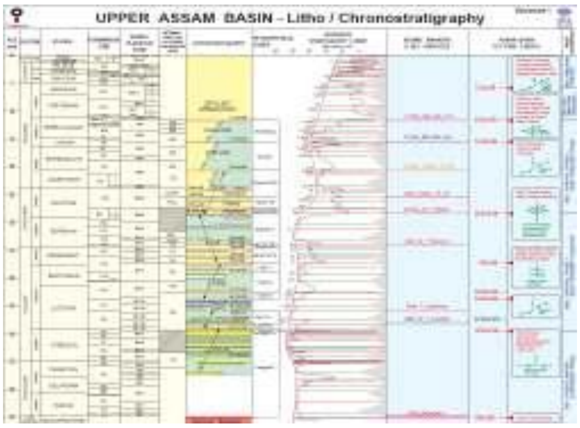

Figure.2: Lithostratigraphy of Upper Assam Basin

Method

Study initiatives

The study area is having an established field situated at south eastern part with number of wells producing from upper/lower pool of Barail formation and very few wells producing from Paleocene/Eocene formations. Taking in to the consideration of depositional history of the basin, the upper barails are embedded by stratigraphic channels with sedimentsdeposition under fluvio-deltaic clastic environment possibly forced by a major relative sea-level fall perhaps related to the first collision of the Indian craton with the West Burma Block. Lower (Classic) Barails were deposited in a delta front/delta plain setting with more marine intrusion and are predominantly clastic.

With above apriori knowledge of depositional geology, the study area was selected for additional analysis to extract stratigraphic features from seismic data after completion of conventional structural seismic interpretation.

As a part of conventional seismic interpretation, reflectors were mapped on seismic data and are conformable with geological sequence boundary in the study area. The reflectors were finalized according to proven hydrocarbon bearing formations in the OIL's operational area of Upper Assam basin. Identification of key reflectors well established after well to seismic calibration in key well locations (Wells A, B, C & D) where log data and check shot/sonic were available (Figure-3).

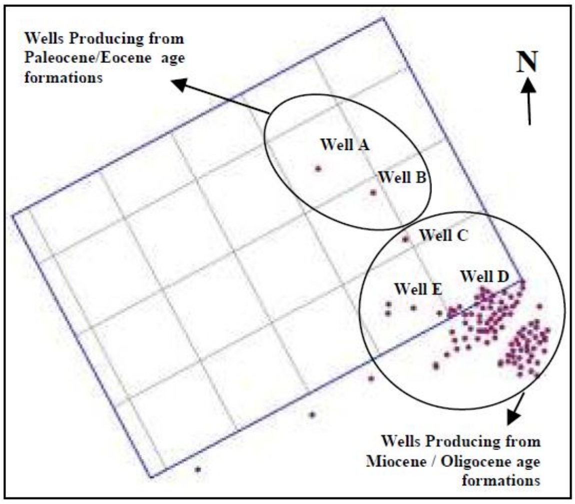

Figure.3: Base map of the study area showing seismic coverage and well locations.

As an initial reconnaissance step after completion of structural interpretation of seismic data, the data was re-looked and scanned in holistic manner through a 3D seismic volume by in-line, cross-line, and time slices to derive stratigraphic insights and anomalous seismic features from 3D seismic data. On review of Amplitude Horizon slices close to upper Barail formationsome channel like features predominantly running from north to south of the study area were observed (Figure-4).

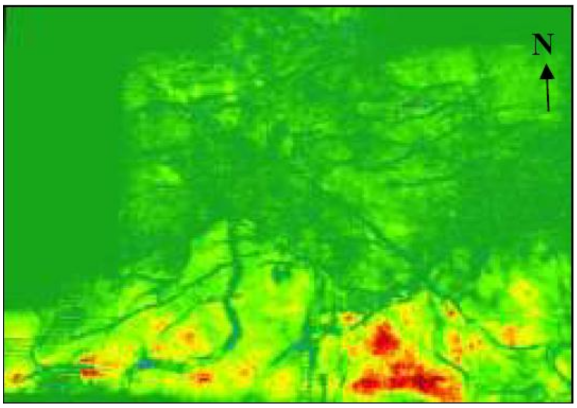

Figure.4: Amplitude Horizon slice close to upper Barail formation.

Above findings were further augmented with seismic attribute analysis by optimal number of seismic attributes viz. integrated reflection strength, integrated seismic amplitude, coherency and energy. These attribute maps were generated close to upper Barail formation with varying volume windows to discern geological features of interest. While analyzing the result of attribute maps, some spatially discontinuous features were observed which may be possibly channel geometries spreading from north to south in integrated reflection strength map (Figure-5), coherency (Figure -6) attribute maps.

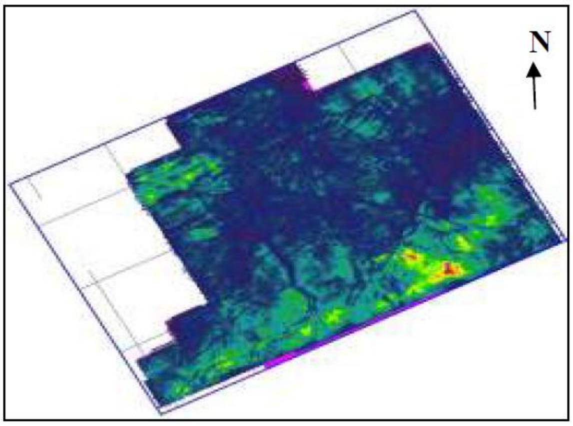

Figure.5: Integrated reflection strength attribute map close to upper Barail formation.

Apart from above, integrated seismic amplitude attribute map (Figure-7) was also generated which showed another channel like feature at south eastern part of the study area. At same spatial location, phase reversal in seismic signature is observed close to upper Barail marked horizon on a profile along Well E (Figure-8). It may be noted that Well E is producing from the same upper Barail formation. The low value of Gamma ray curve at well E close to the observed anomalous signature on seismic section provides probable indication of existence of sand package.

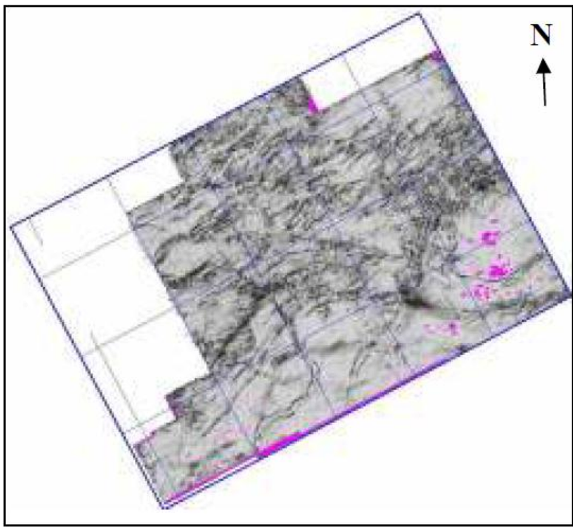

Figure.6: Coherency attribute map close to upper Barail formation.

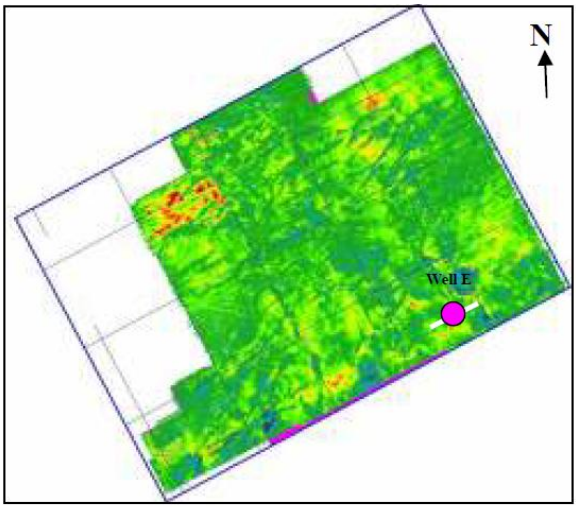

Figure.7: Integrated seismic amplitude attribute map close to upper Barail formation.

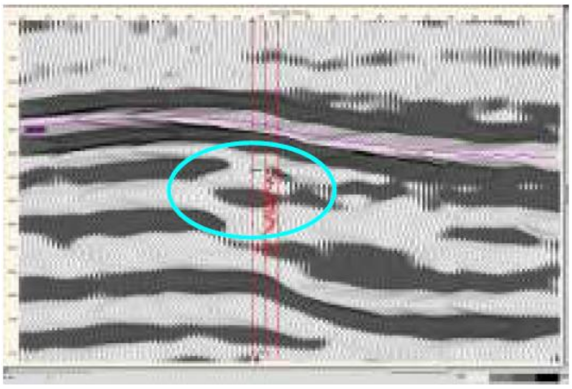

Figure.8: Seismic section showing possible channel close to upper Barail formation

After intensive use of conventional seismic attributes in discerning the possible channel like features coupled with the back ground of location of producing well E within possible channel feature prompted present further study for similar features in other parts of the study area. Spectral decomposition analysis was also taken up around the zone of interest i.e. close to the mapped horizon of top of upper Barail formation. The essence of this tool is to create a set of data cubes or maps, each corresponding to a different spectral frequency, which can be viewed through animation to reveal spatial changes in stratigraphic thickness over 3D seismic covered areas. The successive Spectral decomposition images reveal different parts of a reservoir with varying thickness in an area; Partyka et al, (1999 & 2003).

In the course of the study different frequency slices were generated over a wide array of frequencies ranging from 15Hz to 45Hz. Animating through these frequencies, the best definition of the seismic anomaly was observed at 20Hz (Figure-9) and all channel features were delineable with the blending of different frequencies viz.20, 30 &45 Hz in Miocene / Oligocene age formations (Figure-10).

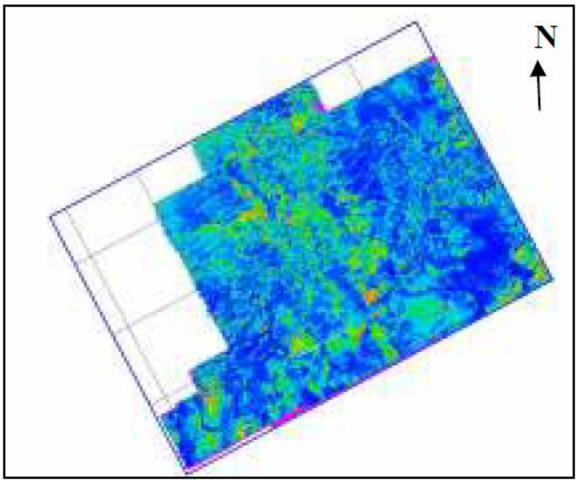

Figure.9: 20Hz frequency slice close to upper Barail formation.

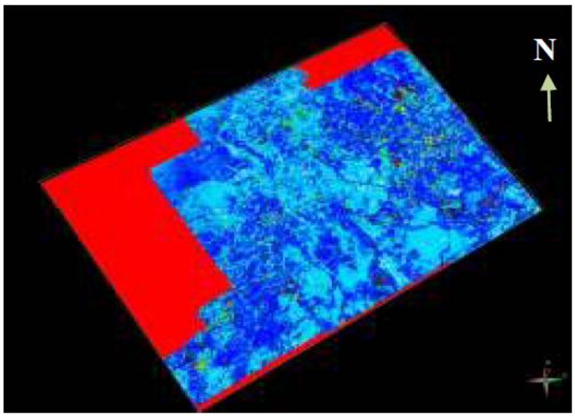

Figure.10: Blending of frequency slices 20, 30 &45Hz close to upper Barail formation.

Results

The channel like feature of south western part of the study area have shown same type of seismic signature (Figure-11) that was also observed at seismic section through Well E . As because there was no sufficient well information in western part of the study area, the channel like signatures derived from present study are expected to be same anomaly as noticed near Well E and may be hydrocarbon charged sand bodies.

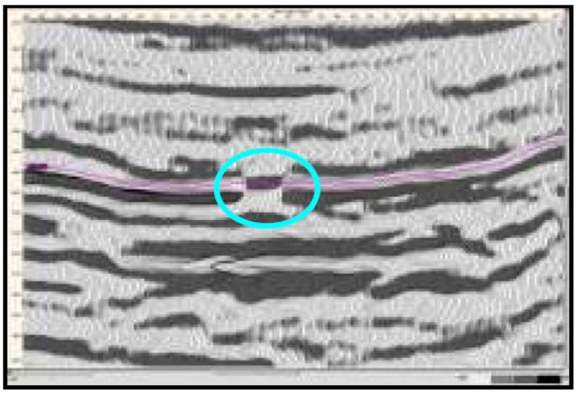

Figure.11: Seismic section showing possible channel close to upper Barail formation

Conclusion

Horizon slice, attribute analysis &spectral decomposition tools in combination provided the whole subsurface picture to understand the paleo-geomorphology close to Barail formation. The results of the study are expected to be used to lower down the risk of continued development of reservoir and to support & locate additional prospects in the area.

References

Seismic Geomorphology – an Overview Henry W. Posamentier, Richard J. Davies, Joseph A, Cartwright, Lesli Wood

Unpublished internal report of Oil India Ltd. on Upper Assam Basin modeling by M/s. Exploration Consultants Ltd, UK.

Interpretational applications of spectral decomposition in reservoir characterization. Greg Partyka, James Gridley, and John Lopez, Amoco E&P Technology Group, Tulsa, Oklahoma, U.S.

Acknowledgements

Authors thank Oil India Ltd. for giving permission for presenting the paper. We also sincerely thank GM (Geoservices), OIL for valuable suggestions and guidance offered for present paper.

Views expressed in this paper are that of the author(s) only and may not necessarily be of OIL.