



Girujan Stratigraphic exploration potential untapping by advance geophysical interpretation workflows: Assam basin, India

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Abstract

Assam Arakan basin is one of the major onland producing basins of India. Commercial hydrocarbons are known to occur in Tipam, Barail, Kopili and Sylhet formations. The occurrence of hydrocarbons in Girujan formation is known since long and some small to mid-size fields are producing gas majorly. Almost 80% of reserves proved in Assam basin are from Tipam and Barail formations only ~0.7 % reserves proved so far in Girujan. Huge exploration potential is still there in Girujan to prove substantial number of reserves & resources in Assam basin. The challenge is that Girujan is dominantly clay rich formation, reservoir sands are thin and discrete in nature. Hence identification of these stratigraphic controlled sand bodies in structurally complex and highly dipping supra thrust fold beds being impossible in conventional seismic interpretation workflows.

The present paper suggests suitable methodology for identifying subtle stratigraphic sand bodies in structurally complex Schuppen fold thrust regime for maturing hydrocarbon prospects within Girujan formation and mitigating the exploration risk. The area of study falls in the northeastern part of Assam & Arakan Basin, in the vicinity of proven Girujan fields like Kharsang, Dirok and Kherem.

Introduction

The area of study falls in northeastern part of Assam & Assam Arakan Basin, India near to Digboi-area within Cairn OALP block. The basin has reached a moderately matured stage of exploration after continuous explorations for more than forty years (Figure-01). This is a proven oil province with stratigraphic levels producing from Paleocene to Miocene age. Prolific production till date has been

achieved from Tura, Barail and Tipam reservoirs of Eocene, Oligocene and Miocene age. There are commercial oil pools reported from Girujan sandstone from Kharsang field. The untapped shallow gas of Girujan Formation is a missed opportunity in the basin and requires attention for its exploration and exploitation. Sands within Girujan formation are thin and discrete in nature and located in structurally complex and highly dipping supra thrust fold beds. Conventional interpretation techniques are not found suitable to map thin clastic reservoirs with confidence due to inherent problem of seismic resolution.

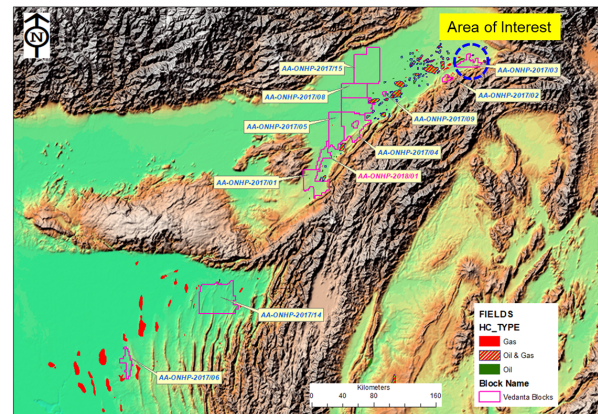


Figure-1: Location Map

Challenges & Methodology

1. Identification of channel responses in amplitude scale on seismic data.
2. Mapping of those channel bodies in highly dipping supra thrust sloping strata.
3. Analyzing identified channel geo bodies in terms of stratigraphic trapping setup with structural conformance for exploration targets.



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To address the above three challenges adopted below methodology. To extract stratigraphic bodies on highly dipping beds used iso proportional horizon slicing within formation interval and advanced spectral decomposition for identifying channel sands. This iso proportional slicing has two methods.

1. Iso proportional to conformable beds (Fig-2).
2. Iso proportional with truncation beds (Fig-3).

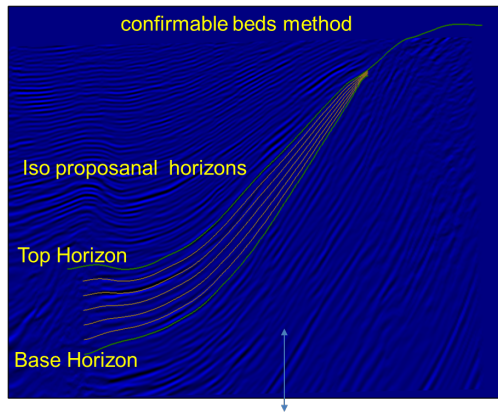


Fig-2: Iso proportional with conformable beds

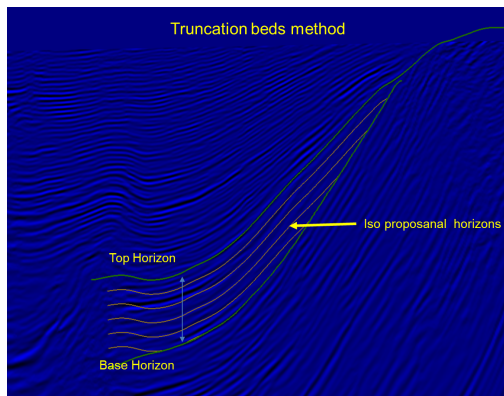


Fig-3: Iso proportional with truncation

As per depositional setting of formation we can choose appropriate method to extract the spectral decomposition results along these horizon slices to map the stratigraphic complete feature without cuts due to structural dipping.

Seismic attribute analysis on stratal slices:

RMS seismic attribute generated within Girujan interval top and base of horizon (Fig-4) and extracted

along the stratal slices from bottom to upper side within study zone. Lower interval depicted the several closely spaced meander channel morphologies clearly (Fig-4). Subsequently extracted RMS attribute response along middle iso proportional slice and identified another set of channel morphologies with widely spaced and aligned in same direction (Fig-5). Finally upper most section iso proportionate stratal slices used to extract the RMS attribute response along with them and found no channel morphologies in this level (Fig-6). It has interpreted as of flood plain shale section on top of channel beds. Hydrocarbon entrapment point of view this shale might act as top seal for lower-level channels.

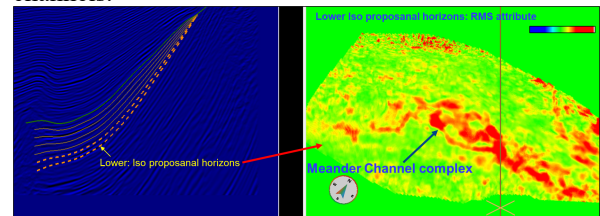


Fig-4: Iso proportional slices lower horizons RMS attribute extracted channel bodies complex.

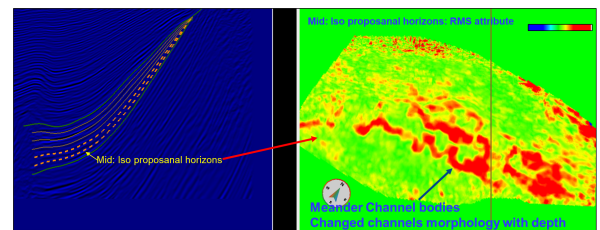


Fig-5: Iso proportional slices mid horizons RMS attribute extracted different channel bodies complex.

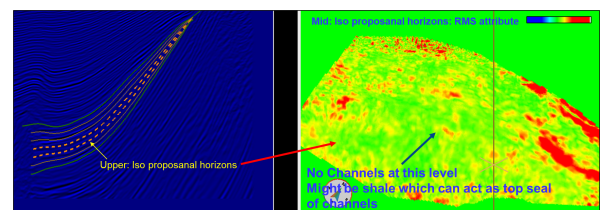


Fig-6: Iso proportional slices upper-level horizons RMS attribute showed no channels (Flood plain shale).

Spectral decomposition

Spectral decomposition is a proven technology to extract channel bodies using frequency cubes so,

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continuous wavelet transform (CWT) was applied on the seismic data to generate frequency cubes from 12Hz to 48 Hz with an interval of 4 Hz. Subsequently, stratal slices of the frequency cubes within Girujan interval were extracted and analyzed. Some frequency slices from 12Hz, to 36 Hz showed interesting stratigraphic morphologies. The RGB blending of three different frequencies was used to enhance the geomorphic features, which helped in identifying and interpreting meandering channels in the lower part of Girujan interval. After multiple iterations of analyzing the RGB blended volumes, a final cube with 12 Hz, 24 Hz, and 36 Hz was generated and used in identifying channel fairways in different strata slices horizon levels within Girujan interval. (Figure-7).

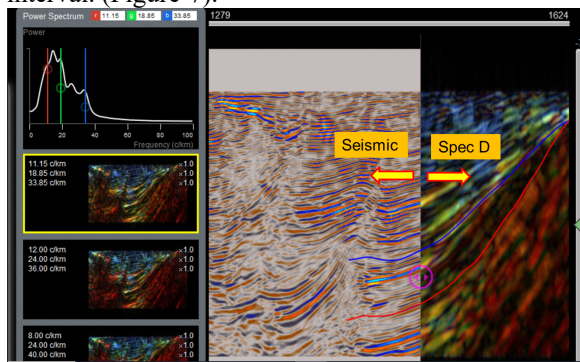


Fig-7: Spectral decomposition CWT method applied and generated 12 to 36 hz volumes.

RGB blended volume at the iso proportional slice showed further enhanced definition for channel stratigraphic bodies (Fig-8).

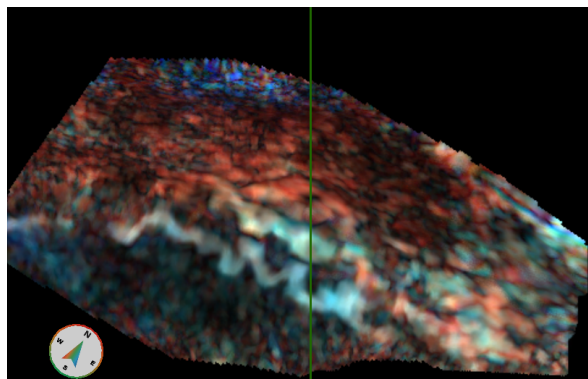


Fig-8: RGB blended iso proportional slice of 12hz, 24Hz and 36Hz showed enhanced definition of channel bodies.

Summary

The primary objective of this study is to identify the subtle stratigraphic channel sand reservoirs in highly dipping thrust beds of Girujan formation. Iso proportional slicing with conformable beds method used to nullify the structural impressions on stratigraphic bodies. Different levels of iso-proportional slices depicted different channel morphologies as they deposited with time. In the study area extracted channel bodies at two lower levels and at upper level showed no channel morphology. It indicated that the upper level might be flood plain shale covered on top of channel bodies. Hydrocarbon entrapment point of view the upper-level flood plain shale act as top seal. Spectral decomposition CWT method used for enhanced definition for channels at lower levels. RGB blended maps clearly showed that meander channel bodies and those were laterally encased by shales which might act as lateral seals to trap the hydrocarbon.

This study identified the potential exploration targets in stratigraphic channel sands within clay dominant Girujan formation. Iso proportional slicing of seismic attribute extraction and spectral decomposition geophysical methods helped to identification potential channel sand reservoirs and hydrocarbon entrapment definition to mitigate the exploration risk.

Reference

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