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Seismic facies classification by neuronal processing and block classification- NW of Geleki Field, North Assam Shelf, India

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Summary

Neuronal facies Classification using neural network technology (NNT) uses an artificial intelligence process that looks for recurring patterns of traces and builds a set of model traces that are representative of the entire dataset. It works by classifying seismic traces in an interval into seismic facies based on trace shape. Samples along the traces are quantified and the trace shape becomes a function of the rate of change (slope) from one sample point to another. The resulting seismic facies are distributed in a geologically meaningful order. The model traces are strongly correlated to their immediate neighbor .This paper attempts the use of neuronal facies classification on traces and seismic blocks covering an area between north of Geleki and south of Charali fields including Nazira low. Block classification classifies all the samples within an seismic interval detecting spatial and time variation of facies. The methodology is based on seismic facies analysis which is the description and geological interpretation of seismic reflection patterns including shapes, frequency, amplitude and continuity combined with litho seismic modeling from well curves to delineate distribution of facies in time and space with depositional environment of deposition.

Introduction

The Oligocene Barail group sediments in Assam shelf area have been deposited in a dominantly deltaic environment over a major part of Assam foreland. Presence of hydrocarbon in Barails have been established in North Assam shelf with the discovery of many structures like Geleki, Lakwa Lakhmani, Charali, Demulgaon etc.The primarily delta front lower Barail arenaceous unit corresponding to the Demulgaon and Disangmukh formation (also known as Barail Main Sand or BMS) consists of main pay sand and minor shales . The upper Barail group coal-shale unit (Rudrasagar formation) consists of interbedded coals , shales and discontinuous sandstone reservoir deposited in a delta plain environment. It is felt to know the major facies distribution within the Barail main sand in the NE of Geleki field (Figure1) including Nazira low. An attempt was made to know the facies distribution by neuronal facies classification within an interval of 124 m below BMS Top and assigning colors to the different facies from the well curves and lithology.

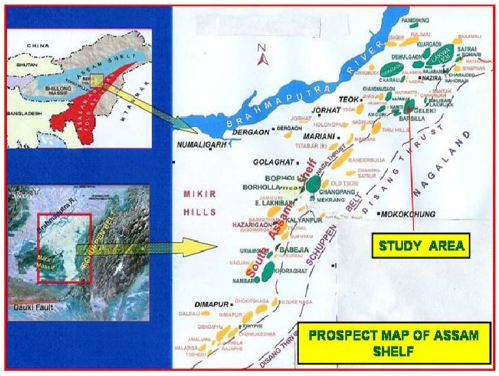

Figure1: Prospect map of Assam Shelf showing study area

Methodology

Post stack depth migrated volume is utilized for the present study covering an area between north of Geleki and south of Charali field including Nazira low bounding fault (FIGURE2). Correlation of a seismic reflector closer to BMS top was carried out after every

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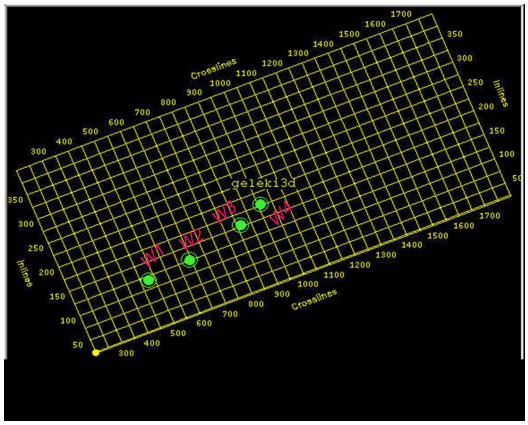

Figure2: Base map showing in-lines,cross-lines and well positions in the study area

tenth in-line and cross-line (FIGURE3 and FIGURE4). Seismic cube is created encompassing the total area

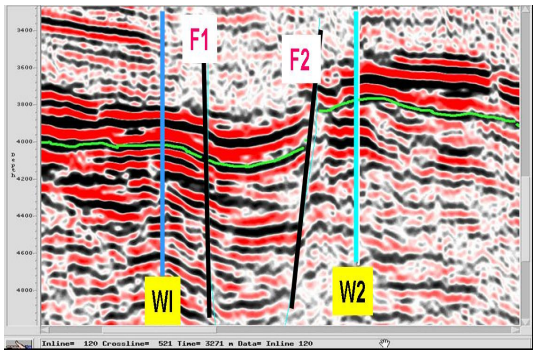

Figure3:Seismic section showing reflector close to BMS Top with well locations and faults

For allowing fast rendering in all directions for horizon interpretation with 3D propagator. Then the automatic picking utility (3D propagator) is used to pick surface for the reference horizon. Here edge propagator tracking mode is used which auto tracks using all picks with at least one unpicked neighbor inside the sub volume as seeds. Depth map is shown in Figure5.

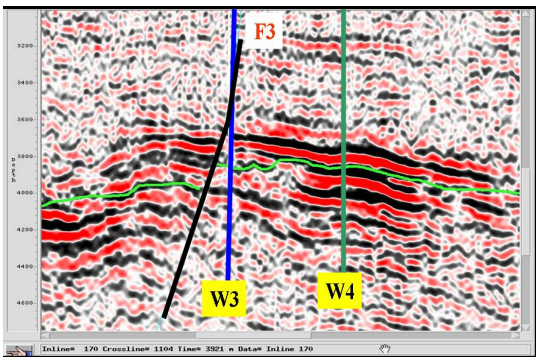

Figure4: Seismic section showing reflector close to BMS Top with well locations and faults

Seismic interval was created from BMS top to down 124 m for attribute calculation and seismic facies classification. Neuronal Processing and classification creates a series random trace shapes that grade from one shape to another for the number of twelve classes that was selected.

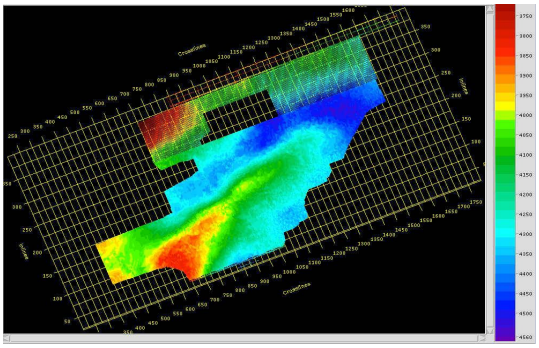

Figure5: Depth map of BMS Top in the study area

These are the model traces (Figure6). It then compares from the subset of data to the random model traces. The model trace that mostly matches the actual trace is modified slightly to add the shape of the selected trace. The neighboring model traces are also modified slightly. So the model traces are organized in a meaningful order with one facies grading into the next in a meaningful way than random clustering. The resulting model traces represent the trace shape variability in the data set. Each model trace is assigned a seismic facies class number and color based on maximum correlation within the interval analyzed. (Figure7). The correlation map shows how well the picks correlate to their original seismic

facies (Figure8). Areas with high correlation indicate that picks are strongly correlated to the seismic facies in that area. Then each trace as per the assigned model trace is projected in the seismic section to get the major lateral variation of facies displayed as ribbon. (Figure9, Figure10). In Block facies classification, the data from each sample in each block are stacked to form a pseudo trace which classifies all the samples within a seismic interval.. (Figure11, Figure12)

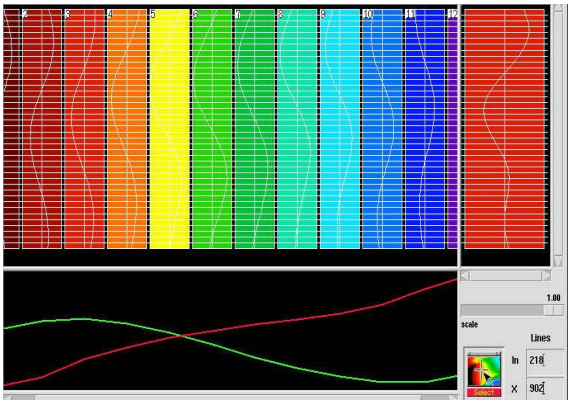

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Figure6: The neurons window with the Correlation curve

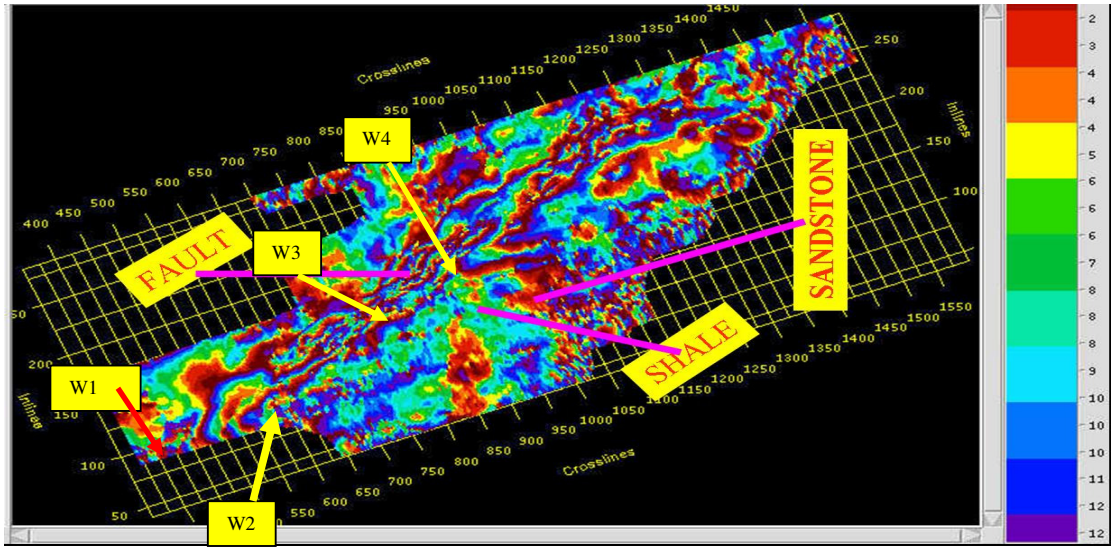

Figure7: Seismic facies classification map showing major facies distribution

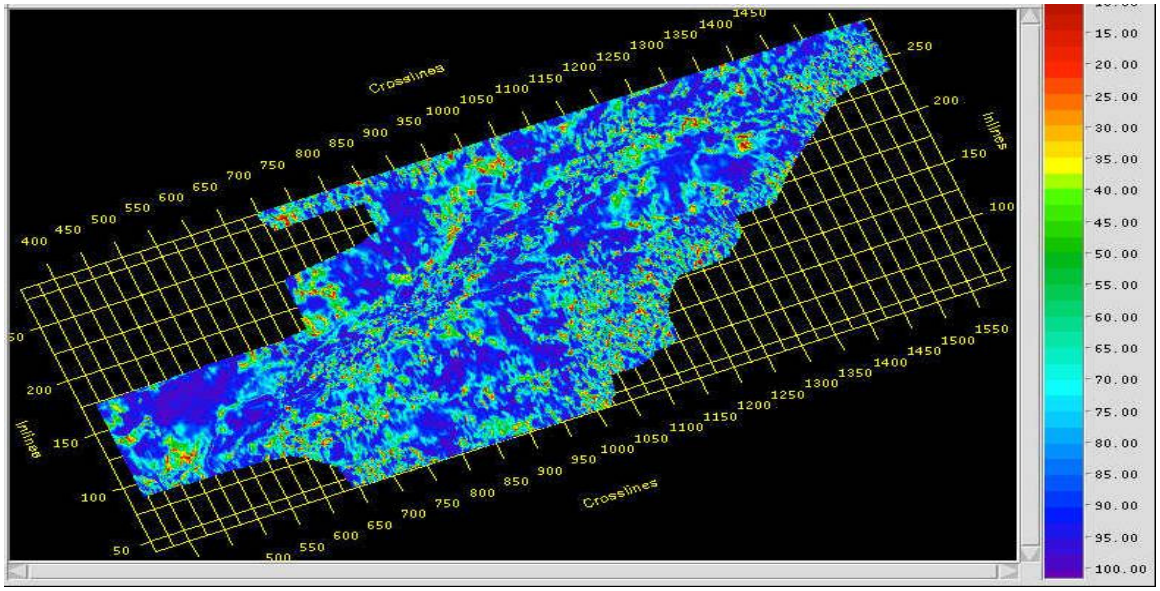

Figure8: Correlation map showing picks correlation

The correlation map reflects the correlation values along the track the propagator took to generate each pick. Each pick is colored according to this minimum value that the track went through to generate the pick

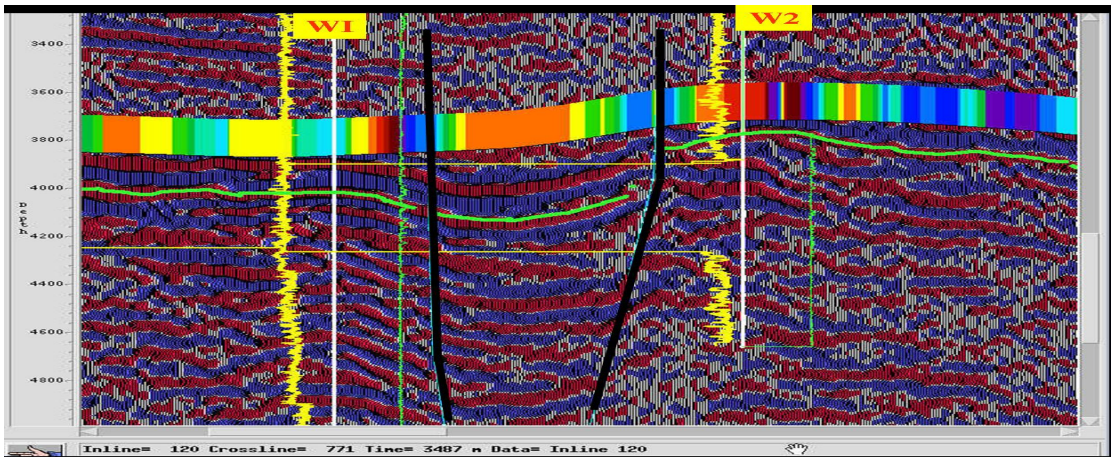

Figure9 : The seismic facies color assigned to each trace 124 m below the correlated horizon are displayed as ribbon with Gamma ray and sonic log

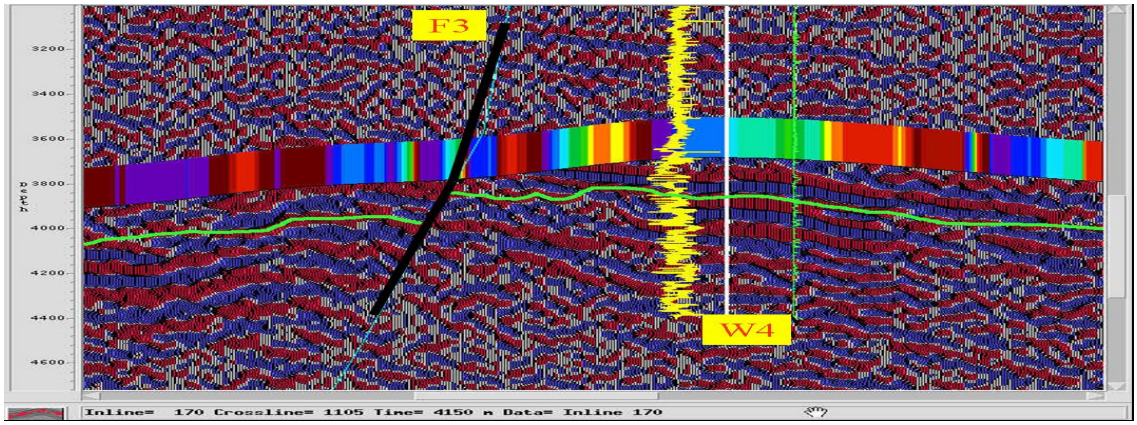

Figure10: The seismic facies color assigned to each trace 124 m below the correlated horizon are displayed as ribbon with Gamma ray and sonic log

Conclusion

Reservoir facies distribution pattern of Barail group is variable as response to their fluvio- deltaic environment of deposition. Sand distribution pattern indicate a fluvial dominated constructive deltaic depositional environment prevailing during deposition of Barail group with occasional marine influence. The facies in the interval studied (Demulgaon formation) is essentially a sandstone dominated sequence with few intercalation of shale, siltstones or infrequent coals. Sandstones (red color in Figure7) are thickly bedded. The shale (the green color in Figure7) are moderately hard, compact and occasionally carbonaceous. Blue color is attributed to siltstones or coal. In well no 2 the red color is attributed to sandstones as evidenced from well litho logy. (Figure-9) So probable area of sandstone facies can be interpreted in the lateral directions. In well no 2 and 4 the color light green to light blue represent mainly sandstone facies , siltstones and alternation of shale and silty sandstones. In Block facies classification in well no 1 and 4 brown color is attributed to shaly sandstone, red to shale and coal , yellow to sand with the shale laminae, blue to shaly sandstone and green color to shale.(Figure11 and Figure12)

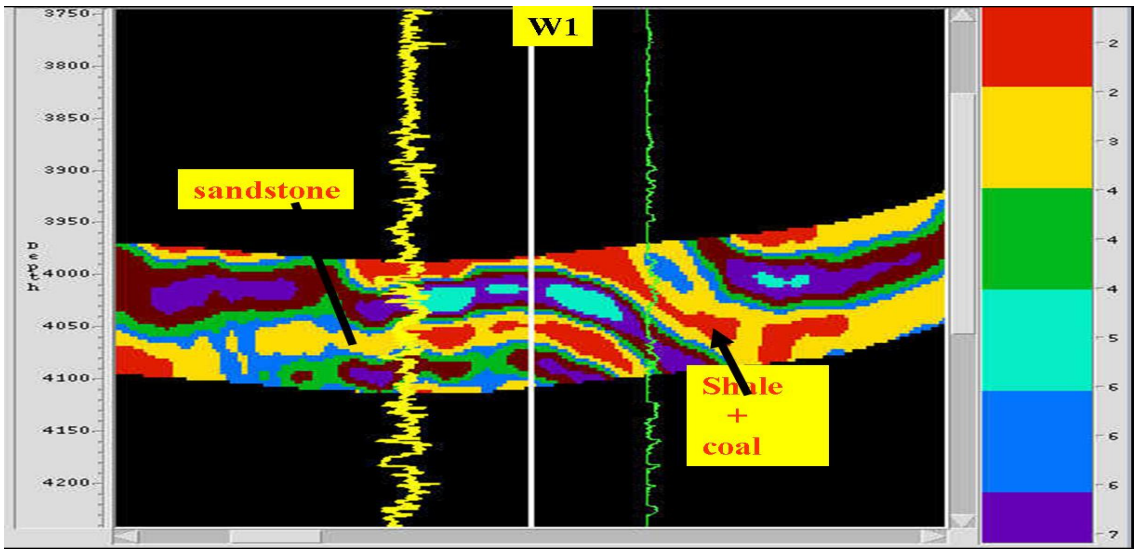

Figure11: Block classification within the given interval showing distribution of facies in time and space

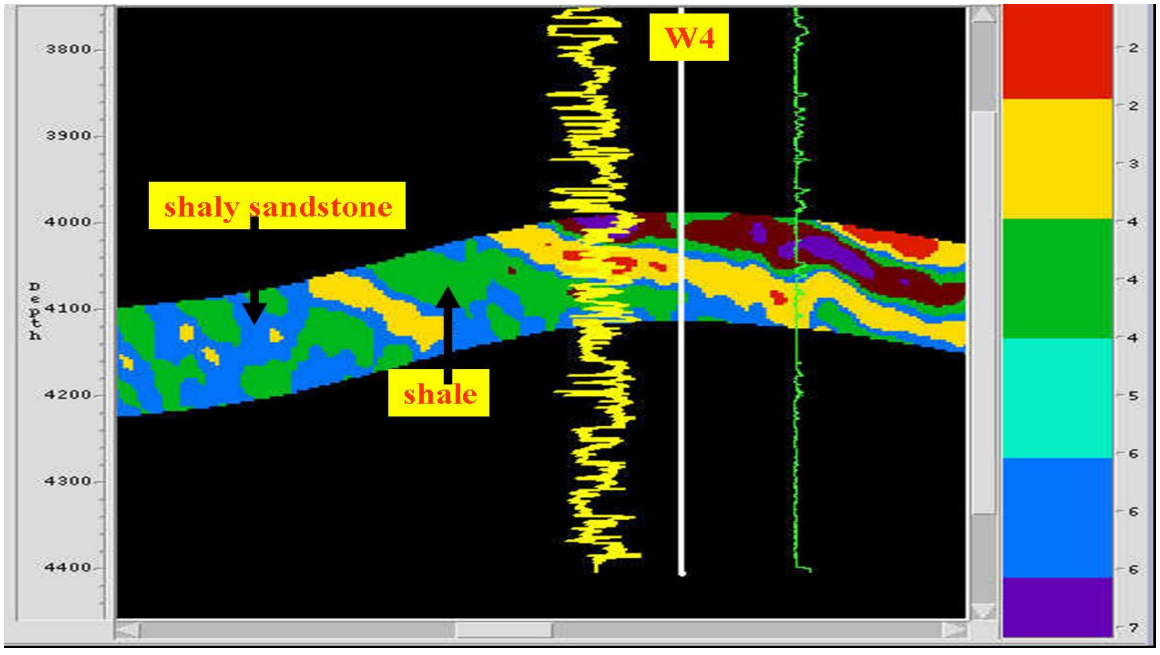

Figure12: Block classification within the given interval showing distribution of facies in time and space

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The views expressed in the paper are solely of the author and not necessarily of the organization in which he is working.

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