**Oil India Identifies Deep Exploration Targets Using Petrel Platform’s Integration of Seismic and Well Data**

Integrated exploration workflow quickly delivers accurate exploration study of complex deep play in upper Assam basin

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<td>Identify deeper reservoir prospects at subseismic resolution in a structurally complex area with limited well and seismic data.</td>
<td>Perform integrated exploration workflows using the Petrel E&amp;P software platform to improve the resolution and impedance contrast of poor-quality seismic data and integrate it with limited well data to construct a seismic-guided depositional model.</td>
<td>Resolved exploration challenges to identify prospects in the new deep play by using the model built on seismic and well data integration to understand reservoir heterogeneity.</td>
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Limited data for deep reservoirs at subseismic resolution

Oil India Limited (OIL), one of the major oil producers in India, has continually conducted exploration and development activities in the upper Assam basin since making India’s pioneer oil discovery there at Digboi field. Recent hydrocarbon shows indicate a deeper prospect, but the deep reservoirs are generally thin, multilayered, and below seismic resolution, making traditional mapping methods ineffective.

An additional exploration challenge is the basin’s structural—and hence seismic—complexity. Seismic resolution is reduced and seismic noise increased. The proximity of multiple stratigraphical and lithological seismic sequences further complicates interpretation. Autotracking is ineffective for the thinly interbedded sandstone-shale formations, nor is manual 3D correlation practical at reservoir scale across the basin.

OIL asked Schlumberger to demonstrate the capabilities of the Petrel E&P software platform for exploring the deep new play and identifying prospects. A pilot project was initiated for establishing a workflow in a small field in the basin.

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**Software**

The integrated exploration workflow in the Petrel platform proposed for addressing the challenges of sparse, low-resolution data in a structurally complex setting in identifying the deeper prospects.
Advanced interpretation from integrated well and seismic data workflows

The pilot project’s exploration approach in the Petrel platform integrated available data to deliver an advanced interpretation from which geoscientists could rapidly interpret, map, and model from basin to prospect scale. The vital connections of data to interpretation are preserved throughout the assessment into prospect generation. The correlation of primary sequences from logs generated in the Petrel platform was the basis for isochore maps that gave OIL a holistic view of the depositional pattern and geological setting.

An integrated seismic-to-well-tie study was completed, and the sonic data calibrated with the vertical seismic profile (VSP) data for conditioning before use. In consideration of the challenging acoustic impedance contrast, a combination of analytical (Ricker) and statistical wavelets was used to generate synthetic seismograms for key wells that made it possible to identify seismic events that were undifferentiated in initial studies.

Structural delineation was achieved with a computational combination of conventional and advanced seismic attributes. The patented ant tracking edge-detection method helped identify the main and minor fault systems, which were not readily visible on raw seismic.

Frequency-based seismic data enhancement improved event resolution for seismic interpretation. Seismic attributes such as the median filter and graphic equalizer were used to increase the data’s signal-to-noise ratio. This zone-specific application of the seismic attributes further resolved initial identification challenges for seismic events. Signal enhancement and autotracking further increased confidence in the interpretation.

Model-based approach for confident prospect identification

The latest structural modeling technology was used to assemble a structural framework of this complex area. The fault modeling process helped in understanding the geometry and relationship of the faults. Accurate structural maps were generated from the volume-based modeling.

Because of the sparsity of wells, the velocity model was built using stacked velocity data calibrated to the few VSP data available. The structural framework was then depth converted multiple times. The process was iterated till a reasonable match was found between the depth horizons and well tops, removing any residual drift between them.

To understand reservoir heterogeneity, an acoustic impedance cube was generated using the Petrel platform’s quantitative interpretation tools. The Simultaneous Seismic Inversion plug-in performed the inversion quickly and accurately from the limited data. A genetic inversion-guided low-frequency model was built using the Inversion Property Builder plug-in and a deterministic wavelet extracted from key wells to guide the inversion process. These steps better delineated the sand and shale bodies.

A seismic-guided depositional model was then built. Geostatistical analysis of the upscaled well data and acoustic impedance cube was used to estimate the statistical parameters for the population of facies, which was accomplished with the sequential indicator simulation technique, a kriging-based stochastic method in the Petrel Facies Modeling module. Using the train estimation model in the Petrel platform, probability volumes for the occurrence of sand, shale, and shaly sand facies were generated from the combination of seismic attribute volumes (envelope and sweetness) and the acoustic impedance cube. An iterative workflow using these probability volumes as trends on top of the initial facies model produced the final depositional model for the study area.

The seismic-guided model constructed by Schlumberger experts with the Petrel platform’s integrated exploration workflow made it possible to understand the heterogeneity of the deeper reservoirs in the upper Assam basin for delineating potential reservoirs. This insight significantly mitigated the exploration risk posed by the limited well and seismic data for the deeper prospects.

CASE STUDY: Integrated exploration workflow delivers accurate exploration study of complex deep play in upper Assam basin

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