Application of Modern Geophysical Tools to Mature Exploration Prospect and Reduce Risks and Uncertainties in an Oil Field Located in the Onshore Partition Zone (PZ) Between the State of Kuwait and the Kingdom of Saudi Arabia

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Extended abstract

Introduction:

The post-COVID-19 landscape has led to an increase in global fossil fuel demand, driving Exploration and Production (E&P) companies to explore advanced geophysical techniques to maintain reserve replacement ratios and enhance competitive advantage. This study focuses on the application of high-resolution 3D seismic data and various geophysical attributes to optimize exploratory drilling and reduce risks within the Wara clastic reservoir in the Partition Zone (PZ) between Kuwait and Saudi Arabia. The Wara reservoir, known for its complex stratigraphic traps and heterogeneous depositional environment, presents a challenging target for hydrocarbon exploration (Fig-1).

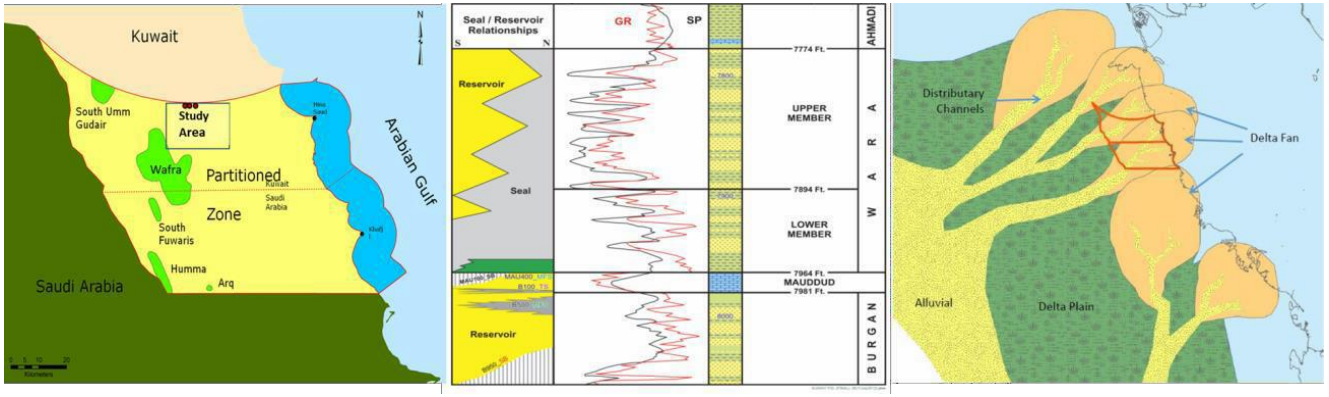

Fig 1: Location Map showing the study Area along with stratigraphy and depositional model of Wara Reservoir.

Methodology:

A high-resolution 3D seismic survey covering the entire onshore PZ was acquired and processed. The seismic data were analyzed using a workflow (Fig-2) integrating multiple geophysical attributes, including Relative Acoustic Impedance (RAI), RMS amplitude, Sweetness, and variance.

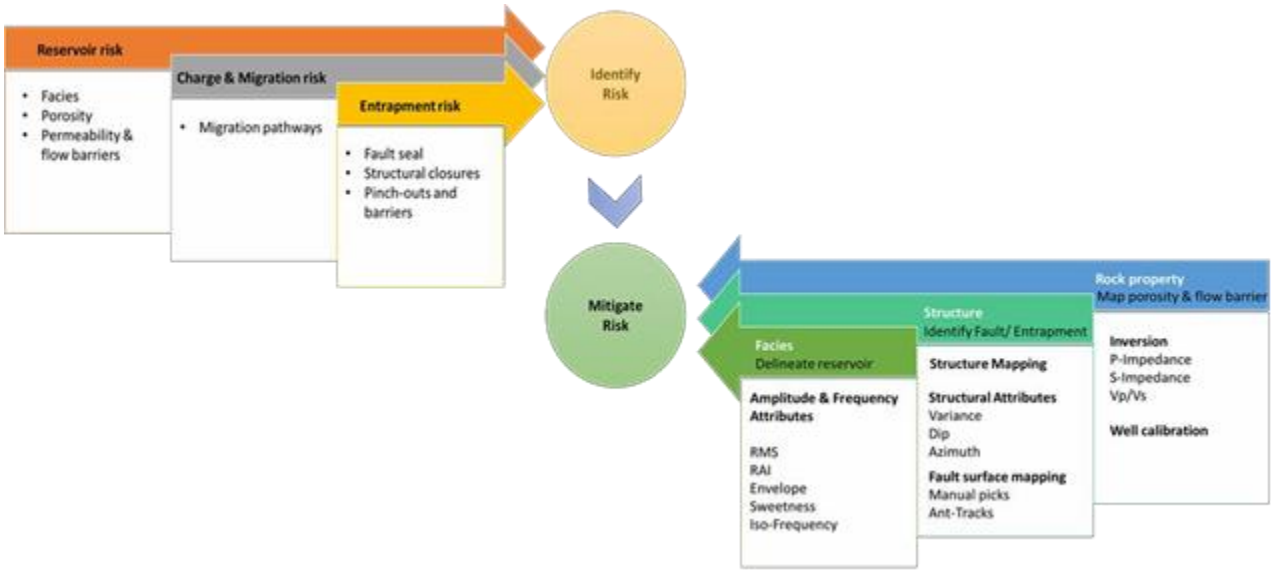

Fig 2: Risk identification and mitigation in prospect maturation process

These attributes were calibrated with well logs, core data, and production records to develop a multi- layered 3D petroleum systems model (3DPSM). This model was utilized for identifying reservoir porosity, facies distribution, structural features, and migration pathways to identify the risks associated with various components of the petroleum system. This study highlights the significance of seismic attributes in reducing the risk associated with reservoir facies and porosity and entrapment aided by several faults with subtle throw (Fig-3).

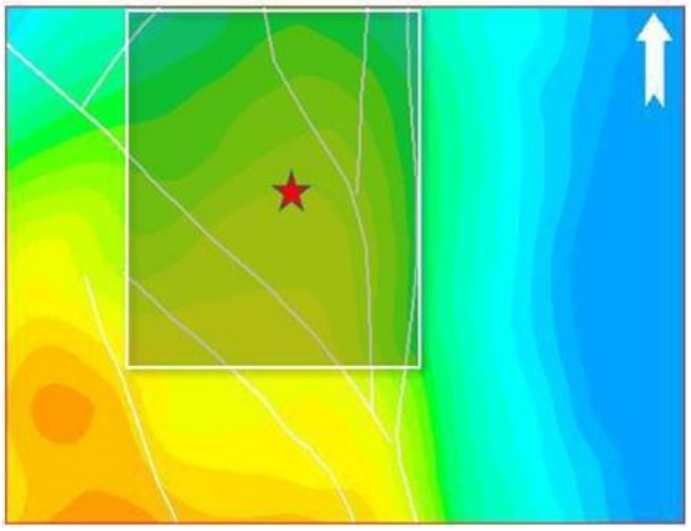

Fig 3: Structural map showing entrapment aided by faults.

Results and Discussion:

The integrated analysis revealed significant insights into the stratigraphic and structural framework of the Wara reservoir. Seismic attributes such as RAI and Sweetness were instrumental in delineating channel sands and mapping porous sand bodies (Fig-4a and 4b), while variance and fault likelihood attributes helped in accurately identifying subtle faults and reducing structural uncertainty (Fig-3). The results enabled the identification of prospective hydrocarbon locales with reduced exploration risk as illustrated in the methodology.

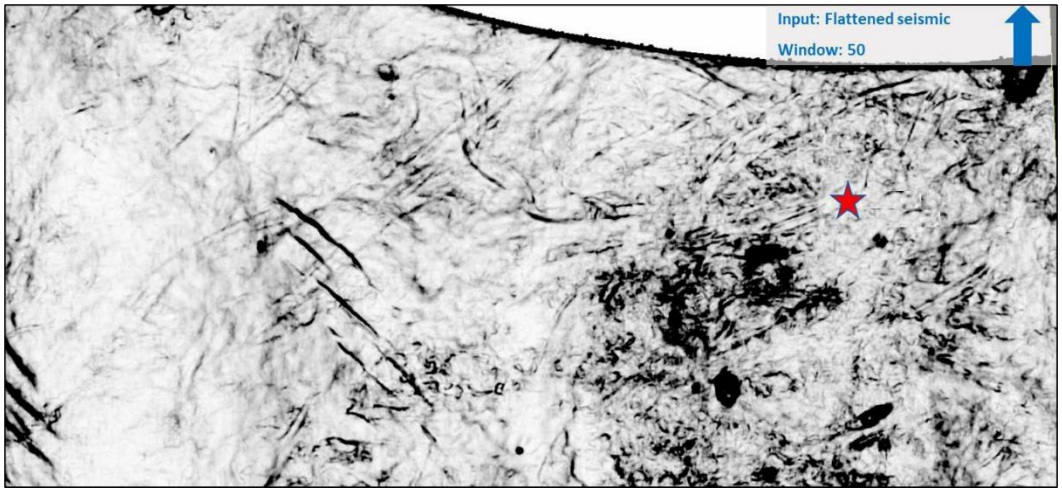

Fig 4a: Sweetness attribute near the top of reservoir layer (Flattened volume) visualizing channel features.

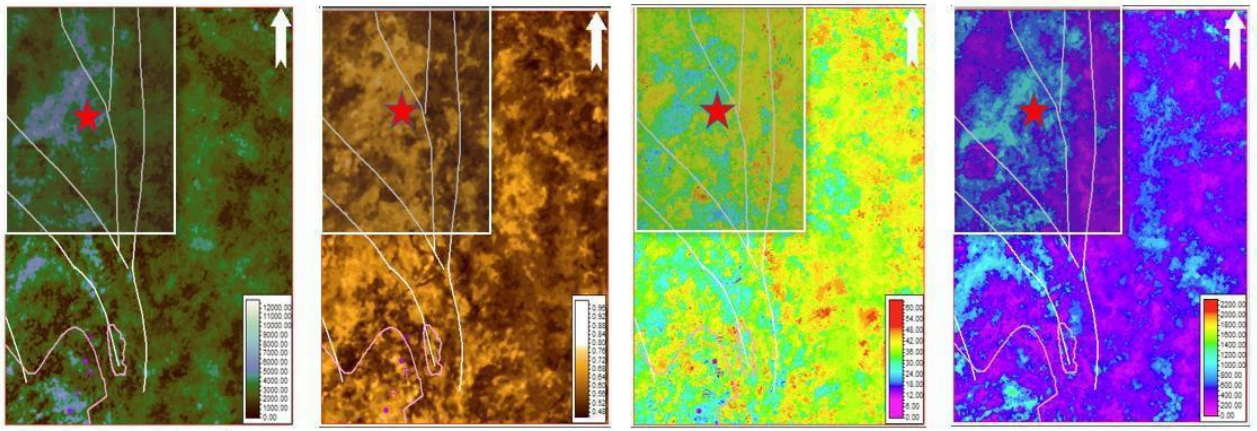

Fig 4b: Geophysical attributes in study area indicating probable reservoir quality. Cooler colors indicating likelihood of better reservoir facies.

The prospect area identified from the above study is further enhanced by carrying porosity modeling workflow (Fig-5) to identify sweeter spots within prospect area for drilling location optimization. A recent exploratory well, drilled based on this study's findings, confirmed the presence of hydrocarbons, validating the effectiveness of the applied workflow.

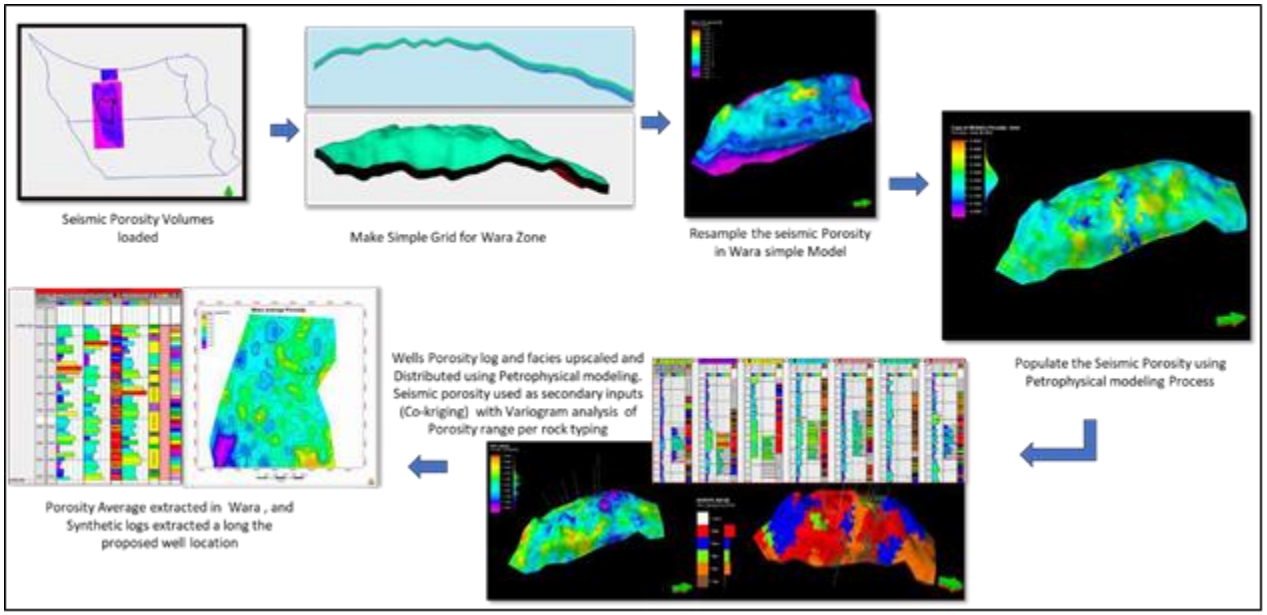

Fig 5: Porosity modelling workflow integrating geophysical result and offset well data to optimize drilling locations.

Conclusion:

The success of this study highlights the value of integrating seismic attributes with well data for de-risking exploration in complex geological settings. The integrated workflow developed here effectively reduces risks associated with reservoir and structural uncertainties, ultimately enhancing exploration success. The positive results from the drilled exploratory well underscore the robustness of this approach, which can serve as a model for future exploration efforts in similar challenging environments.

References:

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