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An investigation of Middle to Late Jurassic Reservoir, Source Rocks and Seals near the Gotnia Intrashelf Basin Margin, Saudi Arabia

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ABSTRACT

The Middle to Late Jurassic sequences located at the Gotnia intrashelf basin margin in Saudi Arabia are associated with prolific carbonate reservoirs, which are generally sealed by overlying evaporites. At the basin margin, different trapping styles exist owing to complexities related to local basin growth including synsedimentary deposition associated with tectonics and eustacy. An integrated 3D seismic chronostratigraphy technique was introduced to investigate the basin depositional history and to assess the spatial distribution of the carbonate depositional systems- — salt and anhydrite seals, coupled with organic grainstone, packstone, wackestone reservoirs, and related source rock systems.

To generate a 3D earth model, seismic 3D chronostratigraphy cubes were constructed using mapped seismic horizons in the late Triassic and late Jurassic formations to guide a semi-automatic mapping process. Using Wheeler transform models, the seismic horizons were interpreted to define key basin hiatus events, unconformities, transgressions and regressions. Selected horizons were extracted from these cubes using well picks and subjected to RMS amplitude, RGB blended frequency decomposition, seismic facies classification, isopach thickness and structural attribute analyses.

The results from this investigation revealed a complex basin depositional history beginning with an initial fairly stable carbonate platform during the Minjur (Bajorcian) to Dhruma Shale (Bathonian) period. After the Dhruma Shale period, the Gotnia intrashelf basin margin experienced localized subsidence with associated tectonic activity which continued up to the Tithonian. Localized tectonics created graben-like features that controlled sedimentation in the Middle Jurassic sequences adjacent to the basin margin. In the Gotnia Basin, salt beds from the Kimmeridgian-Tithonian revealed successive recession towards the intrashelf basin due to eustatic changes. Seismic attribute assessments highlighted well-defined shelf edges with source rock equivalents basin-ward, along with well-defined fracture systems.

The use of an integrated seismic chronostratigraphy technique provided an understanding of the complex depositional history within the Jurassic with its localized structural growth and eustatic changes that allows an interpretation of reservoir, seal and source rock trends in the study area.