

A Holistic Approach towards Sedimentological and Stratigraphical Characterization of the Permo-Carboniferous Strata, Saudi Arabia

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Abstract

An integrated reservoir characterization study was undertaken to understand the Permo-Carboniferous siliciclastic deposits in Saudi Arabia. The objective of the study was to reduce uncertainties and accommodate geological complexities through applied sedimentology. The workflow and the principal results achieved from a subset of the regional study are presented here. Cores from 32 wells were described in detail and analyzed for biostratigraphy (palynology). The overall lithofacies characteristics and associations aided in identifying sedimentary processes and depositional environments that were further grouped into gross depositional environments (GDE). The core-derived data were then integrated with core gamma, wireline and image logs to refine/expand core-based depositional environments and stratigraphic tops. Image logs proved very helpful in complementing the core data and complete missing sections in the core. In the next phase, neural network modeling was performed to predict facies or depositional environments for uncored wells as well as uncored intervals of the cored wells utilizing the finalized GDE, stratigraphic tops and wireline log suite. Finally, multiple cross-sections were created across the study area for all wells to correlate stratigraphy and visualize facies distribution. This integrated sedimentological workflow has generated advanced insights into the depositional environments and established a robust stratigraphic framework in the study area that places GDE in their architectural context. This in turn helped creating regional paleogeography and conceptual depositional model, which are crucial for undertaking reservoir modeling. Commonly occurring GDE include glacio-fluvial, glacio-lacustrine as well as fluvial, coastal dunes, tidal bars and flats. The conceptual model has further assisted in predicting facies along horizontal wells, thereby enhancing reservoir characterization.