

Impact of Image-Log-Derived Lithofacies on Eolian Reservoir Layering and Geocellular Modeling, Unayzah 'A' Reservoir, Hawtah Formation, Tinat Field, Saudi Arabia

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The borehole image log is a critical tool for facies recognition in the Permian eolian reservoirs of Saudi Arabia. Four distinct depositional facies have been identified on image log and confirmed by detailed core description namely: transverse to barchan dune, sand-sheet, wet interdune/playa and paleosol.

Depositional lithofacies picked on image logs were compared with detailed core descriptions from two wells, which demonstrated the reliability of the image-log interpretation. Image-log-derived lithofacies from three additional wells without core were inserted into a correlation panel to demonstrate lateral facies variation. The reservoir was then layered based on a 'wet' eolian depositional model. For each layer, lithofacies were distributed laterally based on the sequence-specific proportions of each lithofacies defined from the wells. An object-based modeling technique was used to control the size, shape and orientation of the objects assigned to each lithofacies. Transverse dunes were modeled as 3D objects oriented with the dune crest striking N-S based on image log data. Wet interdune/playas were modeled as elongate 2D objects with a N-S orientation paralleling the transverse dunes. This dune-interdune relationship is recognizable on satellite images of modern-day analogs. Sand-sheets and paleosols were modeled as isotropic 2D objects. Their shape and orientation are difficult to see in modern analogs.

'Wet' and 'dry' depositional cycles were identified and incorporated into the geocellular model layering scheme. In a 'dry' cycle, 3D dune objects were distributed first, followed by wet interdune, paleosol and sand-sheet. In a 'wet' cycle, dune objects were distributed first, followed by, sand sheet, paleosol and playa. The last facies distributed filled the remaining space in the modeling grid.
