Modern and Ancient Analogs Provide Geological Control and Scale for Reservoir Layering and Property Distribution in a 'Wet' Eolian Depositional System, Saudi Arabia

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Four distinct depositional facies have been identified namely: dune, sandsheet, playa and paleosol. The depositional lithofacies identified on image logs were compared against detailed core descriptions which demonstrated the reliability of the image-log interpretation.

From core and image log studies, the eolian reservoir was classified as a 'wet' transverse dune depositional system. The reservoir was then layered based on a 'wet' eolian depositional model using the Permian Cedar Mesa formation outcrop in Utah as an ancient analog. In well log cross-section, the 'wet' and 'dry' depositional cycles were recognized and incorporated into the geocellular model layering scheme as 'time lines', based on field observations from Permian age wet eolian deposits in Utah.

An object-based modeling technique was used to condition the size, shape and orientation of the objects assigned to each lithofacies. The transverse dune facies 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 3D objects with a N-S orientation paralleling the transverse dunes. This dune-interdune relationship is recognizable on satellite images of modern-day transverse dune fields here in Saudi Arabia.

The resulting geocellular model was viewed in a flattened cross-section, which displayed the characteristic alternating 'wet' and 'dry' cycles observed in the Cedar Mesa outcrop. The 'wet' inter-dune deposits behave like permeability baffles within the reservoir, while the more extensive playa deposits act like barriers across the reservoir. In map view, the facies distribution in the geocellular model captured the look we see in satellite images from a transverse dune field today.