Integration of Log and Core-Based Sequence Stratigraphy and 3D Attributes for Defining Stratigraphic Traps in the Eastern Rub' Al-Khali, Saudi Arabia

Darryl Green[1], Sean Rahati[1], and Mohammed Salim[1]

[1]Aramco, Dhahran, Eastern, Saudi Arabia.

ABSTRACT

The Rub' Al-Khali basin in southern Saudi Arabia hosts a variety of reservoir formations. The Middle-Cretaceous Wasia Formation carbonates have proven to have complex petroleum systems elements. Unravelling potential in stratigraphic traps of this unit requires the integration of well-log and core data along with pre-stack elastic inversion seismic data for characterization away from well control. This study focused on building a 3D seismic chronostratigraphic framework by integrating key well and seismic data to evaluate the gross depositional history of the mixed carbonate-clastic system. Three main third-order sequences and five main parasequences (members) were distinguished. This work suggests the existence of a carbonate-dominated rimmed shelf bordering an intrashelf basin, which persisted through the Wasia time, influenced by pre-depositional topography. Utilizing time-correlative parasequences, well-defined systems tracks were recorded. Within these systems tracks five facies/rock types with unique reservoir properties were documented by integrating core and borehole data with supervised neural nets. The data indicates that Maximum Flooding Surfaces (MFS) generated good source rock potential associated with anoxic mudstones (basinal environment), while High-Stand Systems Tracks (HST) yielded aggradational shoals with high porosities. Seals can be demonstrated, associated with the MFS and within Transgressive Systems Tracks (TST) (foreshoal/mid-ramp facies) and Back Bank/Lagoon facies of the HST. Acoustic Impedance (AI) results demonstrated good correlation to porosity and neural-net log facies. The use of pre-stack inversion (VP/VS) improved the accuracy of the facies (seal and reservoir) prediction; the elastic properties further characterized the physical parameters that define the facies type. Therefore, 3D attributes of both AI and VP/VS have been used as good indicators of potential reservoir, seal, and source areas (facies types) away from existing well control. Potential stratigraphic traps can been screened efficiently with these 3D attribute volumes and existing well data.