

Stratigraphic Trap Potential and Reservoir Distribution of the Upper Shu'aiba Reservoir Based on Newly Acquired Data in the Underexplored Eastern Rub' al-Khali Basin, Saudi Arabia

Kenri Pomar¹

¹Saudi Aramco

Abstract

The Shu'aiba Formation was deposited during the Aptian stage of the Lower Cretaceous on the southern part of the Arabian Plate, in and around the intra-shelf Bab Basin. Based on a synthesis of regional well and seismic data, the Shu'aiba Formation is formally subdivided into the Lower Shu'aiba and Upper Shu'aiba. The Lower Shu'aiba consists of four, third-order sequences: Aptian 1 to 2, representing a transgressive phase, and Aptian 3 to 4, a highstand phase of deposition. Time equivalent Lower Shu'aiba basinal deposits are recognized as prolific source rocks in the region and the Lower Shu'aiba Aptian 3 and 4 succession has productive reservoirs as proven by a major oil field in the eastern Rub' al-Khali.

A recently discovered field in the eastern Rub' al-Khali is located over the Shu'aiba "platform-to-basin" transition zone, and on test, was productive from reservoir intervals in the Upper Shu'aiba (Aptian 5). The Upper Shu'aiba succession represents the lowstand period of deposition prograding into the intra-shelf Bab Basin. Cores acquired from a number of recent exploration wells exhibit a shallowing upward, vertical stacking pattern within the Upper Shu'aiba interval, capped by bioclastic packstones and grainstones with good reservoir potential. Input of terrigenous clays into the system during a drop in sea level is also evident from cores and wireline logs. Lateral variation in reservoir quality is observed to occur over distances of only a few kilometers, and is strongly influenced by both initial rock fabric and secondary diagenetic processes, predominantly leaching and cementation. The latter is believed to be localized to areas where post-depositional channels cut across and through the Upper Shu'aiba carbonate platform.

Seismic interpretation and multi-attribute analysis of recently acquired 3D seismic data were used to identify and map key stratigraphic surfaces, together with the geometry of the prograding clinoforms that are developed within the Upper Shu'aiba interval. Four to five prograding clinoforms within the Upper Shu'aiba Formation have been identified on 3D seismic data. Comprehensive integration of core, wireline logs, pressure and seismic data indicates that individual clinoforms acts as separate compartments, which are not in pressure communication with adjoining clinoforms. The clinoform boundaries appear to act as permeability barriers to fluid flow and potentially create combination structural stratigraphic traps for large hydrocarbon accumulations.