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2D Marine Seismic Acquisition for Sub-salt Objectives in the Red Sea

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SUMMARY

SAUDI ARAMCO recently acquired a very large regional 2D reconnaissance marine seismic program in the Red Sea. The objectives of the project were to identify and map potential leads both above and below salt bodies in the Red Sea basin. Streamer length and depth were tested for their impact on low frequency data recovery and imaging of deep objectives. Prestack depth migration results show improvement in deep imaging as the maximum offset is increased from 7200 meters to 10,330 meters. The greatest improvement in depth image quality occurs when offsets of up to 9200 meters are included. New solid streamer technology proved valuable for acquiring the long offsets required by this project while maintaining continuous operations.
SAUDI ARAMCO recently acquired a very large regional 2D reconnaissance marine seismic program in the Red Sea. The objectives of the project were to identify and map potential leads both above and below salt bodies in the Red Sea basin. Until this acquisition, no modern marine seismic data was available from the Arabian side of the Red Sea. Previous marine 2D data had been acquired in the 1960s and 1970s with relatively short analog streamers (~3 km streamer lengths) and a variety of sources, including explosives, Aquapulse™ and airgun arrays.

Based on experience from other areas characterized by salt structures, key acquisition parameters for sub-salt objectives are large airgun source arrays, long offsets and deep towing configurations to optimize low frequency data recovery. The seismic industry has learned over the past several years that the structural complexities of salt bodies require wide azimuth 3D sampling for illumination and accurate imaging. Nonetheless, regional 2D data can play a pivotal role in basin-wide mapping of salt bodies for optimal placement of focused wide azimuth marine 3D surveys.

Due to operational constraints, the source capacity and towing depth for the current 2D project were limited. Streamer length and depth were tested for their impact on low frequency data recovery and imaging of deep objectives. Time processing shows little to no difference between prestack time migrated (PreSTM) sections with offsets up to 7200 meters and those that included the full range of offsets up to 10,330 meters. Prestack depth migration (PreSDM) results, however, show improvement in deep imaging as the maximum offset is increased from 7200 meters to 10,330 meters, even with the relatively small airgun source. The greatest improvement in image quality occurs when offsets of up to 9200 meters are included in PreSDM, with some additional improvement observed as offsets of up to the maximum streamer length are included.

The seismic acquisition was conducted with a careful balance between maximum offset for sub-salt imaging and streamer length constraints in acquisition operations. Due to environmental and operational challenges, including shark attacks on the streamer and swell noise due to marginal weather conditions, new solid streamer technology proved to be extremely important for acquiring the long offsets required by this project while maintaining continuous operations.