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Advanced Wide-Azimuth Processing of Dukhan Field Ultra High-Density Seismic Survey for Optimal Reservoir Characterization

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SUMMARY

Acquisition of ultra high-density wide azimuth seismic data was successfully completed over QP's Dukhan Oil Field early in 2011. The objective for this state-of-the-art, 850 sq km 3D survey was for improved data quality and resolution to allow the imaging of small faults and fracture zones as well as improved structural imaging of deeper reservoirs. Optimal preservation of amplitudes was important for the reliable prediction of reservoir properties away from well control.

The acquisition design consisted of orthogonal cross-spreads with very dense point-source and point-receiver sampling (7.5 m interval). Such dense sampling was designed to properly sample ground roll and industrial noise allowing their elimination in the subsequent data processing. Furthermore, the design allowed the pre-stack data volume to be split into approximately 500 Common Offset Vector (COV) cubes, each of which can be imaged separately for the detailed analysis of subsurface properties (e.g. reflectivity, velocity) as a function of offset and azimuth.

Acquisition was extremely challenging including industrial areas, sabkha and transition zone (0-16 m water depth). The acquisition bin size of 3.75 x 3.75 m and fold of 500 presented a formidable data management task with daily data acquisition volumes up to 3.5 terabytes.

The philosophy applied to the data processing was to perform intra-array statics, surface-consistent processing and ground roll attenuation prior to Digital Array Forming (DAF). Preconditioning was required to help with the picking of first breaks for very noisy elementary traces as well as ensuring spectra for surface-consistent deconvolution were signal driven rather than noise driven. Once all short wavelength surface waves and other short wavelength distortions such as statics had been eliminated it was safe to perform DAF on to a 15 x 15 m bin size.

A pilot area of 85 sq km was processed through a full processing sequence. After all pre-processing had been completed in the cross-spread domain the data was split into COV volumes each one of which was migrated independently. After migration, each of the migrated COV cubes was then re-sorted into 3D offset vector Common Image Gathers for subsequent 3D parabolic Radon filtering and azimuthal velocity model update. All these correspond to a true one-pass WAZ processing and imaging workflow. Final products for the pilot volume show spectacular improvements compared to the 1998 legacy data especially comparing the respective bandwidths (Seeni et al, EAGE 2011).

This paper will present the latest results and findings from the ongoing processing and imaging tests.