SG04

Seismic Acquisition, Processing and Interpretation for an Unconventional Basin in Saudi Arabia

A. Alghamdi* (Saudi Aramco) & H. Alsahfy (Saudi Aramco)

SUMMARY

With the increasing demand for more oil and gas, the exploration for unconventional reservoirs has been escalating in Saudi Arabia over the past few years. This new step in exploration is requiring new technologies, equipment, computers capabilities and expertise. Seismic acquisition and processing play a major role in the exploration of unconventional reservoirs. For this study, we will be discussing the impact of different acquisition design/efforts and processing flows of two surveys, acquired independently, on interpretation over a basin in Saudi Arabia. The first survey was a sparse 3D survey, acquired in 2002, initially intended for conventional exploration. The second survey was acquired in 2013 with wide azimuth and broadband acquisition design for the purpose of unconventional exploration.

With the increasing demand for more oil and gas, the exploration for unconventional reservoirs has been escalating in Saudi Arabia over the past few years. This new step in exploration is requiring new technologies, equipment, computers capabilities and expertise. Seismic acquisition and processing play a major role in the exploration of unconventional reservoirs. In this presentation, we will be discussing the impact of different acquisition design/efforts and processing flows of two surveys acquired independently on interpretation over a basin in Saudi Arabia. The first survey was a sparse 3D survey, acquired in 2002, initially intended for conventional exploration. The second survey was acquired in 2013 with wide azimuth and broadband acquisition design for the purpose of unconventional exploration.

The legacy survey was acquired with source and receiver interval of 60m. The source and receiver line spacing was 480 meters. An additional secondary source line was shot parallel to every other receiver line. Each source station had five vibrators (over 48 meters in the inline direction) where the sweep frequency was 8-96 Hz with 12 seconds sweep length. The source density was 84.635 VPs/km². Each receiver station had a squared array type (zig-zag pattern) with 55 meter dimensions in-line and cross-line. The maximum in-line offset was 5730 meter with nominal fold of 60.

The new acquisition survey design has a source and a receiver interval of 10m. The receiver line and the source line spacing are 100 meter and 70 meter, respectively. The sweep frequency is 2-72Hz with 12 seconds sweep length. Because of the high source density (i.e. 4286 VPs/km²), it was acquired using the managed near-simultaneous sweep method based on time and distance rules. The nominal geophysical design patch comprises of 28 receiver lines for a total of 22,736 channels at 812 channels per receiver line. The maximum in-line offset is 4055 meter with a nominal fold of 2436 with 5x5 bin size.

The two datasets from each acquisition design were processed separately with different processing flows and parameters. For noise attenuation, the legacy data had the advantage of the source and receiver arrays that were spatial filters for coherent and incoherent noise. The new dataset is more challenging in the ambient and the cross-talk noise. It was processed with the consideration of anisotropic flow unlike the sparse 3D.

Analysis of the new reflection seismic data volume shows an increase in bandwidth with improved signal-to-noise ratio when compared with the legacy 3D data. Simultaneous pre-stack inversion was prepared from a small fast track “pilot” volume and compared with the legacy simultaneous conventional 3D volume to help understand the uplift in the prediction of reservoir properties.