Unlocking Quantitative Seismic Reservoir Characterization Potential Through Robust High Channel Count Seismic Data

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Abstract

Objectives/Scope: Quantitative seismic reservoir characterization is crucial for developing hydrocarbon fields. Therefore, a new trend in seismic acquisition is becoming more prevalent in the oil and gas industry to replace conventional seismic data with high channel count (HCC) seismic. Advancements in seismic acquisition are accompanied with relative amplitude processing workflows that are quality checked with well-driven AVO modelling and inversion. Optimized processing parameters are enablers to estimate subsurface reservoir properties based on rock physics transforms.

Methods, Procedures, Process: The HCC acquisition was designed with wider azimuth parameters compared to the existing conventional acquisition. Additionally, the HCC seismic data had 6.5 extra active channels, finer shot point, receiver point, receiver line, and shot line intervals compared to conventional data. Furthermore, the HCC dataset had a better fold compared to conventional seismic by an increase of around 275%. This new acquisition had also a broader frequency sweep bandwidth.

Results, Observations, Conclusions: An intensive testing of ten processing workflows was initiated. Seismic interpreters highlighted a number of potential amplitude distorting elements to the processing group, which included noise and physical related items. The seismic processing team with an intensive testing ended up with multiple processing workflows that required evaluation. All processing workflows were quality checked for wavelet stability in terms of phase and frequency; as well as imaging of targeted zones of interest, and AVO friendliness. Furthermore, elastic attributes were generated for all ten workflows to examine their power of predicting the in situ elastic properties. Ultimately, the optimal processing workflow was selected after performing a holistic statistical analysis with normalized weighted score. The analysis showed a superior result for a unique processing workflow where the uplift was attributed to the implementation of modules such as super gathers sorting, inverse-Q, sweep designature, full wavefield dealiasing, super gather QC stacks, deterministic deconvolution for denoising, and azimuthal moveout. The normalized weighted score was based on combined quality criteria such as AI, VpVs, and various extraction windows.

Novel/Additive Information: Overall, robust high channel count seismic data with a suitable relative amplitude preservation workflow is essential for mapping structural and stratigraphic features. It is important to quality check processing workflows with well-driven AVO modelling and inversion for quantitative seismic interpretation of subsurface reservoirs.