Improving Reservoir Characterization Using 3D-CRS Stack Method

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Objectives. 3D ZO Common-Reflection-Surface stack data can improve the structural image and optimize the amplitude/phase control for quantitative seismic reservoir characterization, even starting from a low S/N dataset. This data-driven imaging method has been proven to accurately characterise events in the pre-stack domain. It takes advantage of data redundancy, using an 8-parameters stacking surface instead of single stacking trajectory (velocity). Fold is dramatically boosted, since traces lying in the projected Fresnel zone are used; therefore calculation robustness and reliability increase. Additional information are also recovered, i.e. very detailed NMO velocities, geometrical spreading, projected Fresnel zones.

Discussion. Processed log data from five wells were integrated to 100sqkm-sized seismic dataset. Starting from Petroacoustic approach, a Seismic-Lithology characterization of a giant oil field was achieved. High impedance sandstone and soft sealing shale defines the reservoir sequence. Internal seismic response is semi-transparent, while sealing/reservoir interface waveform varies according to both reservoir porosity and sealing shale type (dual nature). Initial analyses ascertained the reliability of CRS data, the appropriate high S/N and its zero-phase condition. Model-based seismic inversion was used to solve the reflectivity ambiguity, estimating physical rock property cubes, and virtually increase the resolution by removing the wavelet signature from CRS data. Results validation implied the inversion error estimate, also performing “blind tests” on additional wells. Results encouraged to proceed towards an Acoustic Impedance calibration to Effective Porosity. Neural-Network multi-attribute and Linear calibration of Acoustic Impedance transformed seismic into Porosity volumes. Prediction accuracy ranges from 2-4 PU, upon the used technique.

Conclusions. 3D-CRS significantly increases the S/N and amplitude/phase consistency when compared to conventional data; therefore it's a suitable input for reliable quantitative seismic and reservoir characterization.