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Abstract

Objectives/Scope: Imaging thin reservoir sands with the current conventional seismic data has been challenging due to the bandlimited nature of the data and the lack of vertical resolution. High frequency borehole seismic data (i.e., VSP) provides a solution to this limitation. The application of seismic inversion methods to the VSP data enhances the temporal resolution, thus increasing the likelihood to accurately image the thin sands. Therefore, a better imaging infer a better interpretation, a better reservoir modeling, an optimized drilling activity, and an enhanced reservoir assessment.

Methods, Procedures, Process: Seismic inversion is commonly used in the industry for improved reservoir characterization. Inverting VSP angle gathers for elastic properties such as acoustic impedance and velocity ratios may allow discriminating sands and other rock types, thus facilitating the characterization of the target thin reservoir. Combined angle stacks of both 3D borehole and 3D Ocean Bottom Cable Seismic (OBC) were inverted for acoustic impedance and the velocity ratio of compressional and shear-waves (Vp/Vs) using a simultaneous deterministic constrained sparse spike inversion scheme. The two elastic properties were selected based on a rock physics feasibility analysis.

Results, Observations, Conclusions: Unlike the OBC results, the sand intervals of the thin reservoir were successfully detected with the inverted Vp/Vs results from the VSP data. Nevertheless, the sands were only highlighted within an area of one kilometer due to the VSP data coverage. The VSP high resolution results improve the imaging near the borehole and can help with the interpretation of the OBC image away from the borehole.

Novel/Additive Information: We demonstrate how inverting high resolution borehole seismic may lead to better imaging, interpretation and reservoir characterization.