Thin Sweet Spots Identification in the Duvernay Formation of North Central Alberta

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Summary

The Duvernay shale liquids play running along the foothills east of the Rocky Mountains, possesses all the prerequisites of being a successful unconventional play, and has gained attention of the oil and gas industry in Alberta, Canada. Even though, the net shale isopachs range between 25 and 60 m for the most part within the play, at places it thins out. Considering the poor vertical resolution of the available seismic data, it is not possible to identify and characterize the thin Duvernay sweet spot zones using seismically-derived attributes. In a case study taken up recently, we found it challenging characterizing the thin Duvernay reservoir zone, and consequently developed a workflow that successfully addressed the challenge and identified the thin sweet spots.

The workflow entailed extracting the P- and S- reflectivities from prestack seismic data using Fatti et al.'s approximation to the Zoeppritz equations, and then subjecting them to thin-bed reflectivity inversion. The latter process removes the time-varying effect of the wavelet from the data and the output of the inversion process can be viewed as spectrally-broadened seismic data, retrieved in the form of broadband reflectivity which can be filtered back to any desired bandwidth. This usually represents useful information for interpretation purposes. Filtered thin-bed reflectivity, obtained by convolving the reflectivity with a wavelet of a known frequency band-pass, not only provides an opportunity to study reflection character associated with features of interest, but also serves to confirm its close match with the original data. These P- and S-reflectivities with higher bandwidth were inverted into P- and S-impedances using model-based impedance inversion. This workflow, enabled us to differentiate between the Upper and Lower Duvernay intervals. Sweet spots were identified based on the constrained volume that was created using multi-attribute analysis.