Assessing the Success of Pre-Stack Inversion in a Heavy Oil Reservoir: Lower Cretaceous McMurray Formation at Surmont

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Abstract

Shales influence steam-chamber development during steam-assisted gravity drainage. Reflection seismic should be able to detect such shales, facilitating optimal well placement, but highly variable seismic velocities give a poor correlation between lithology and acoustic impedance. Petrophysical analysis indicates that density inversion should be a good shale prediction tool in the McMurray Formation. In this paper, we present three approaches to the assessment of the results of a pre-stack inversion for density, using angle stacks with up to 45° of offset.

1) Qualitative interpretation, based on visual inspection of wells and seismic together with detailed visualization and volume interpretation, indicates that density inversion gives localized insight into likely shale body dimensions and geometries. 2) Quantitative crossplotting is aimed at finding global relationships between rock properties and seismic parameters. We applied three methods: calculating rank correlations between inversion products and well logs; crossplotting the best of these relationships; crossplotting first derivatives to capture correlations between vertical trends. Small rock property contrasts between sands and shales in the reservoir limit these quantitative approaches in predictive power. 3) Geostatistical synthesis nevertheless allows us to incorporate the weak quantitative relationships into a facies model.

We show that density inversion is a useful aid to lithologic interpretation, but that quanititative analysis and discrimination may not be possible with offset angles up to only 45°. Notwithstanding this, even weak relationships between wells and inversion products can enhance facies prediction.