

Oil sands reservoir characterization using 3D P-SV converted wave data in Athabasca, Canada

Toru Nakayama[1]; Akihisa Takahashi[1]; Ayato Kato[2]

[1] JAPEX; [2] JOGMEC

Reservoir characterization was conducted using 3D P-SV converted wave data in the Japan Canada Oil Sands Limited (JACOS) Hangingstone steam assisted gravity drainage (SAGD) operation area, Alberta, Canada. The objective of the study was to characterize oil sands reservoir properties affected by steam-injection using the 3D P-SV converted wave data along with 3D P-P seismic data.

Sedimentary environment of the target zone was interpreted as fluvial to upper-estuarine channel fill deposits. Oil sands reservoirs were formed as the vertically stacked incised valley fill sands and their distribution is very complex vertically and horizontally. It is important to understand oil sands reservoir zones affected by steam-injection for increasing bitumen productivity and for optimizing the deployment of the new SAGD well pairs.

At first, P-wave and S-wave velocities of oil sands core samples were measured under various pressures and temperatures, and the laboratory measurement results were then combined to obtain a rock physics model that can predict velocity changes induced by steam-injection.

Both P-SV converted wave and P-P seismic data processing were then conducted with three-component 3D seismic survey acquired in March, 2006. Average V_p (P-wave velocity), V_s (S-wave velocity) and V_p/V_s ratio of the reservoir interval were calculated at each CMP bin using the seismic interpretation horizons which were picked on the P-SV converted wave and P-P seismic data sets. The maps of the average V_p , V_s and V_p/V_s ratio show their values varied from place to place, and especially the V_p/V_s ratios around high productivity SAGD well pairs were lower than the ones in low productivity SAGD well pairs. After reviewing our oil sands rock physics model and the maps of the average V_p , V_s and V_p/V_s ratio, the combination of the average V_p and V_s maps, or the V_p and V_p/V_s ratio maps can be used to estimate pressure and temperature effects on reservoir properties.

In conclusion, the S-wave velocity information from the P-SV converted wave data is very useful for the oil sands reservoir characterization in the field.