geoconvention
Calgary • Canada • May 13-17 2019

Ultra-High-Density 3D Seismic in the Oil Sands with Near Zero Environmental Footprint

Allan Châtenay and Paul Thacker
Explor

Summary

This paper presents some results from the first 3D seismic survey to be acquired in the Western Canada oil sands play fairway using the PinPoint (Châtenay et al, 2017) seismic source technology. The results confirm the viability of acquiring high quality 3D seismic data in this area without the need to cut either source lines or receiver lines.

Method

An ultra-high-density 3D survey using the PinPoint seismic system was acquired in the oil sands during Spring break-up in Q2 2018. Field operations started in early April whilst the ground was still frozen, but by the end of the survey in early May the surface conditions had changed dramatically (Figure 1).

The PinPoint survey was acquired over an existing high density Vibroseis 3D that delivered trace densities of approximately 22 million traces per square kilometer with a 30m x 30m source and receiver line spacing, but with mulcher support for both the source line and the receiver line preparation. The Vibroseis 3D was acquired entirely with frozen ground conditions, immediately prior to the PinPoint 3D. The PinPoint 3D was acquired with no additional line cutting and could have been acquired entirely without line cutting had that been either an operational, or a regulatory, requirement.

The PinPoint survey was acquired using single, nodal, 3-component geophones on a 10m x 10m grid, with PinPoint sources being deployed also on a matching 10m x 10m grid. All receiver stations were live for all shots. The acquisition geometry delivered a maximum P-wave trace density of 100 million traces per square kilometer, which at a source-receiver offset of 350 meters resulted in a data processing trace density of about 42 million traces per square kilometer. The receiver node locations were defined using their internal GPS data (Châtenay, 2016) and the PinPoint source locations were determined in real time using RTK GPS, so that no conventional topographic survey operations were required for the PinPoint survey.

Conclusions

Despite the dramatic change in ground conditions during the acquisition of the PinPoint survey, the results from the PinPoint 3D and from the Vibroseis 3D are very similar. Figure 2 shows a comparison of two intermediate P-wave sections at the same location. The small differences that can be seen in the very near-surface part of these two intermediate sections were eliminated successfully during subsequent processing by modifying some of the data processing parameters, primarily the pre-stack mute function.

The final results from the PinPoint 3D volume (Figure 3b) confirm the operational and technical viability of acquiring reliable, high quality, 3D seismic data in the Western Canada oil sands without the need for any source line or receiver line preparation.

Acknowledgements

Explor would like to thank an anonymous client for approval to present this case study.

References

Châtenay, 2016: Deriving High Quality Horizontal Positioning of Seismic Receivers Directly from GPS Receivers Embedded in Wireless Seismic Receiver Nodes; GeoConvention 2016

Châtenay et al, 2017: A High Resolution, Low Environmental Impact, Impulsive Seismic Source for the Oil Sands; GeoConvention 2017

Figure 1 – Field conditions at the start (top) and at the end (bottom) of the PinPoint data acquisition

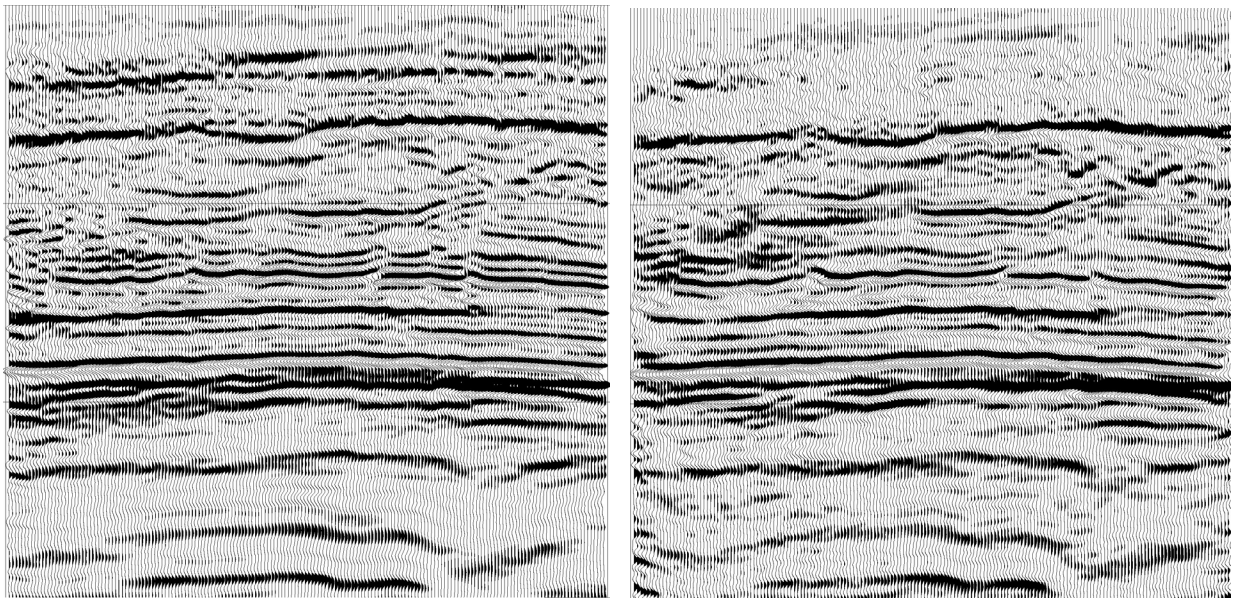

Figure 2 Intermediate processing results from the Vibroseis (left) and PinPoint (right) 3D volumes

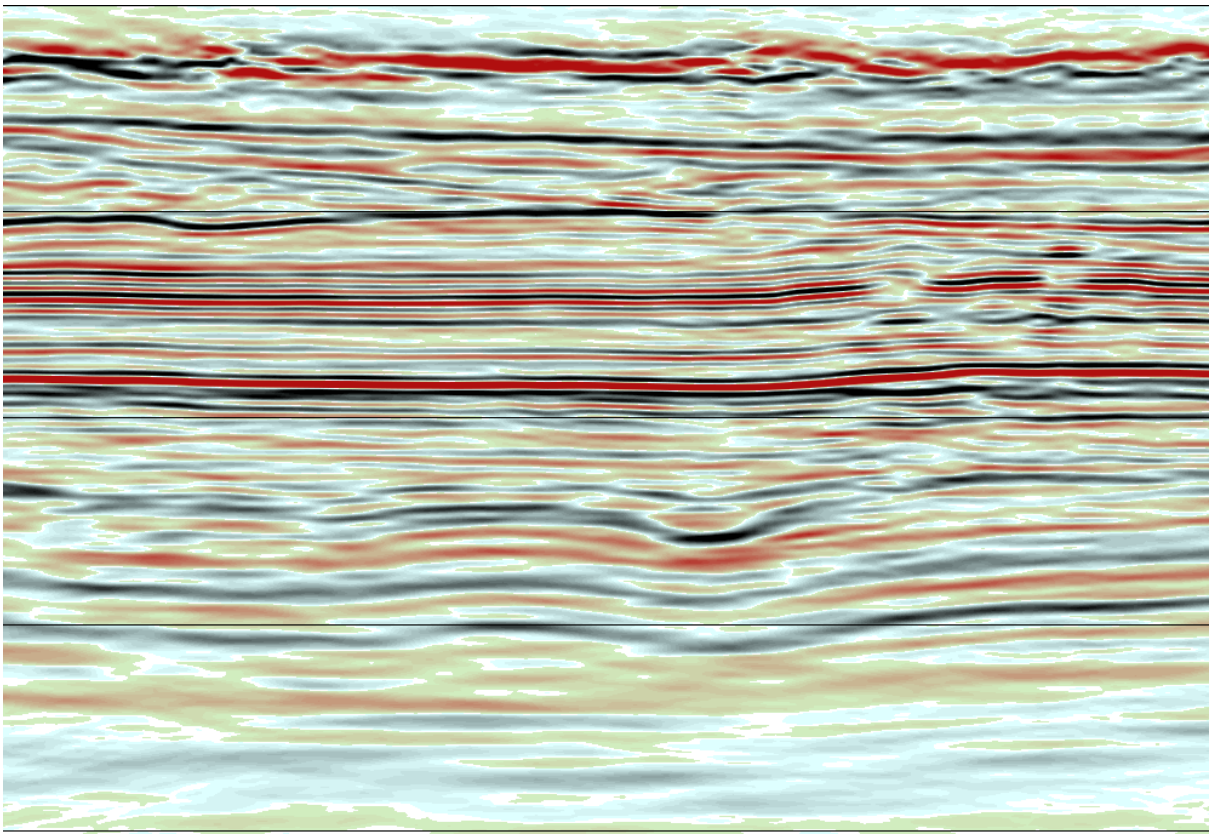

Figure 3a : Vibroseis 3D – Final migrated volume

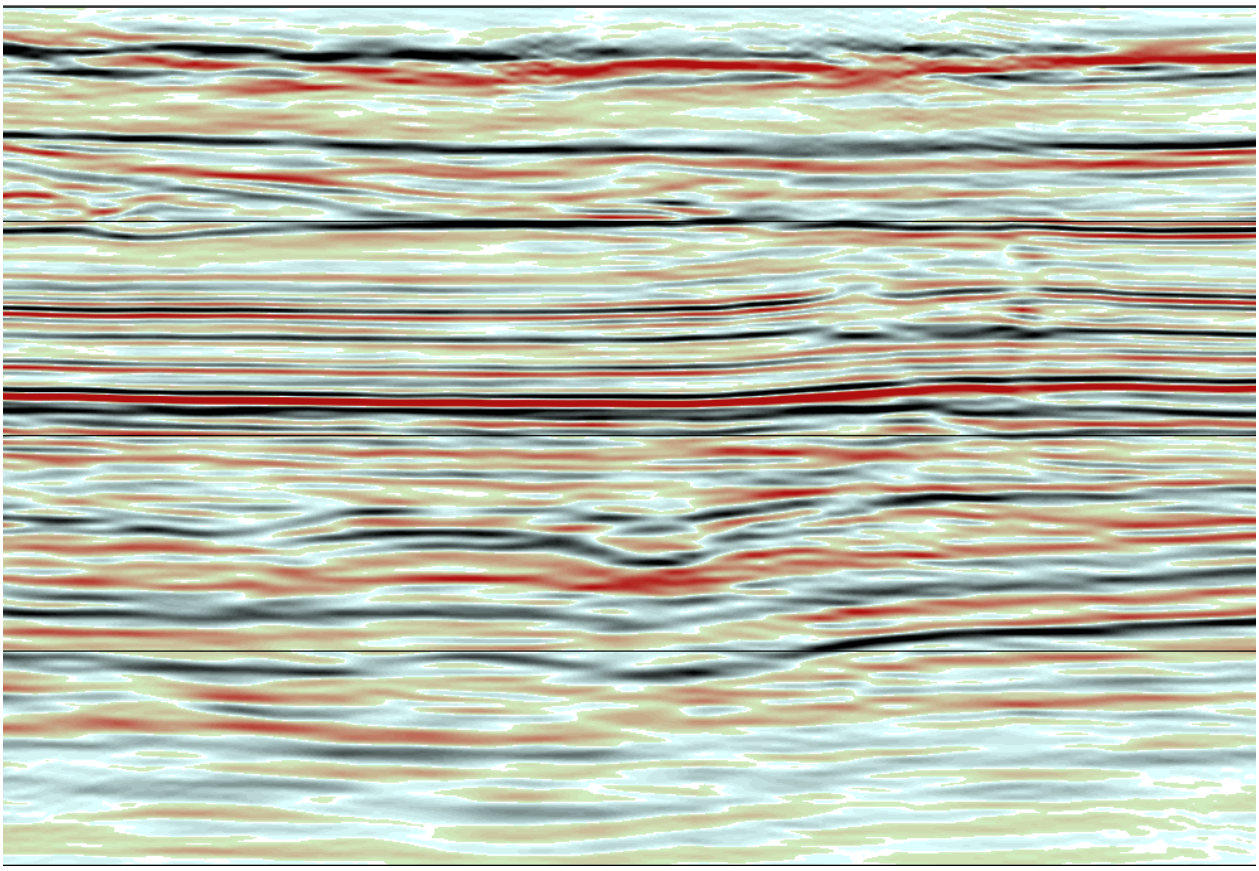

Figure 3b : PinPoint 3D - Final migrated volume