Case Study: Maximizing seismic input in geomodelling by using PP-PS pre-stack joint inversion, Birch, N.E. Alberta

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Evaluating the prospectivity of oil sands projects involves collaboration between geology, petrophysics, engineering and geophysics in order to create the most realistic geomodel for reservoir simulation. Typical seismic inputs for geomodels include: depth converted surfaces, inversion volumes and neural network volumes. In this case study we show that by incorporating PS data in the inversion, the density volume product is improved as are subsequent derivative products incorporated into the geomodel.

Birch is located 95 kilometres northwest of Fort McMurray within the Athabasca Oil Sands deposit. Reservoir sands in the project area are made up of the Early Cretaceous McMurray Formation and Wabiskaw Member. The McMurray Formation is comprised of interbedded sands and shales. It was deposited in an estuarian environment, with deposition controlled by paleo valleys. The McMurray Formation ranges from 9 to 32 metres thick. The Wabiskaw Member consists of interbedded fine to coarse grain sands and shales deposited in a marine setting. Wabiskaw thickness varies from 18 to 38 metres.

A ~52 km^2 3C-3D seismic survey was acquired in 2012 in conjunction with a delineation drilling and coring program. Both PP and PS components were processed. With high quality PP and PS volumes, the goal was to generate a PP-PS pre-stack joint inversion and to assess the benefit, if any, provided by incorporating both PP and PS pre-stack data in the inversion process.

Geologic features are not differentiated with a high degree of confidence in stack data (Figure 1a). Consequently, a PP pre-stack inversion was first generated and used to test the model and input parameters for all subsequent inversions (Figure 1b). Secondly, the PP pre & PS post stack joint inversion was used to test domain conversion and event matching between PP and PS surfaces (Figure 1c). Finally, a PP-PS pre-stack joint inversion was generated (Figure 1d). These results were used for subsequent training of neural network volumes of key reservoir parameters and produced superior results. The maximum impact of 3D seismic data on the geomodel in the study area was reached using both PP and PS pre-stack data in the inversion workflow.

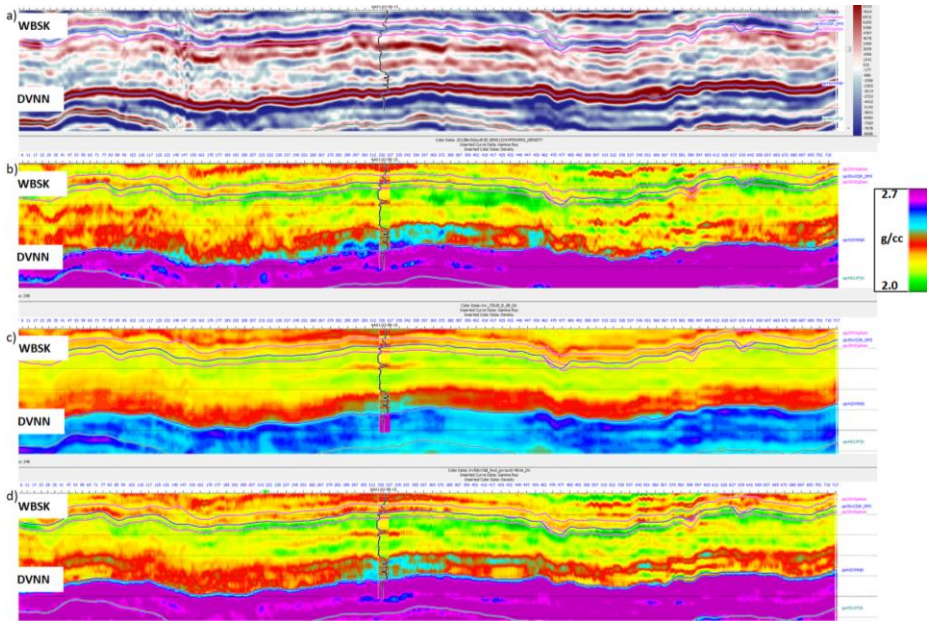

Figure 1: North to south Cross-line section through AA/01-02 well for a) Stacked PP data, and density volume from b)PP pre-stack inversion, c)PP pre & PS post-stack inversion and d) PP-PS pre-stack inversion.

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