Squeezing every last drop out of a coarse 3D oil sands dataset for refining 3D survey design – a case history

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Abstract

The Alberta oil sands form one of the largest bituminous hydrocarbon reserves in the world (ERCB 2011). Most of the oil sands properties are too deep for traditional open mining techniques and require the application of in-situ thermal recovery processes such as Steam Assisted Gravity Drainage (SAGD). In SAGD, 8 to 10 pairs of horizontal wells, 100m apart and a kilometer long, are drilled parallel to each other. The well on the top of the pair is used to inject steam, which melts the bitumen by heating. The bitumen seeps down towards the bottom producing well, which pumps out the bitumen to the surface. As bitumen is produced, a steam chamber grows around the well pair. The growth of the steam chamber is non-uniform and mainly controlled by the stratigraphy of the reservoir (mud bodies acting as baffles or barriers), the pre-existing structural framework (faults, joints, etc.), the respective fluid saturations and mobility, and the local in-situ stress field. To understand the geological setting, the burial history, and to characterize the reservoir and monitor the growth of the steam chambers, 3D (and 4D) seismic surveying is the method of choice.

Numerous papers have been published regarding the extraction of the petrophysical properties of the oil sands reservoirs from seismic data (Xu and Chopra 2009, Gray 2011, Roy et al 2008, Solano and Schmitt 2004), the very near surface effects (De Meersman 2009), or the geomechanical effects of the thermal recovery processes (Kendall & Wikel 2012). However limited material has been published regarding the design of 3D (and 4D) seismic surveys in the oil sands.

In this case history, we demonstrate the cyclical process of seismic survey design, data acquisition, data processing and quantitative interpretation, followed by a survey design refinement.