

SAGD Well Planning Using Stochastic Inversion

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Inversion techniques are frequently used as a bridge to bring seismic information - namely elastic attributes derived from seismic amplitudes - into geologic models. However, classical deterministic inversion techniques are band limited and provide only a single inverted model. Thus thin shale layers that can have a very strong impact on production in heavy oil reservoirs may not be resolved.

Stochastic inversion, on the other hand, generates a large number of equally probable high-frequency models that are constrained to reproduce the observed seismic data (within some noise-dependent tolerance limits) and honour the conditioning well data. The multiplicity of models from stochastic inversion more realistically represents the inherent non-uniqueness of the inverse problem, and opens the door to uncertainty analysis. In particular, it is possible to characterise uncertainty in terms of facies probability or probability of connectivity between given well locations. This also allows ranking the inverted models and extracting a few cases that are deemed representative of the overall variability (for example: P10, P50 and P90 estimates).

In the heavy oil context, it is possible to take advantage of the multiplicity of high frequency results from stochastic inversion in order to better characterize the reservoir. After generating multiple facies volumes, continuous sands and continuous shales were tracked on each volume. A close attention was paid to thick continuous basal sands, required for optimal SAGD well positioning, by outputting properties such as probability of continuous bitumen, or the uncertainty in the position and the thickness of the reservoir sands. Using potential well locations, it is also possible to assess the vertical connectivity and compute the probable producible bitumen volume. This approach not only provides higher precision when integrating the seismic and the well data, but also quantifies the uncertainties associated with the reservoir characterization process.