Identifying Nisku Porosity with Geostatistical Inversion: A Field Example

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Abstract
In Geostatistical Inversion, the traditional ideas of Geostatistical Simulation have been combined with the concepts of Bayesian Inference and Markov Chain Monte Carlo to produce a set of high resolution simulation tools for reservoir properties and lithologies. This set of simulations can then be used to infer uncertainty or create probability density functions for the occurrence of properties of interest (eg porosity) at each voxel. This represents a powerful tool to risk future drilling as it gives an indication of the potential variation of the reservoir model, given the a priori input data.

Geostatistical simulation can be also be used to investigate reservoirs that are thinner than can be examined with deterministic methods. In this field example, the Geostatistical Inversion is used to identify porosity within the Nisku shelf edge reservoir (Upper Devonian) in Alberta. Existing wells are producing from porous intervals in the reservoir, with thickness of 5-10m. Those are often not clearly identifiable on seismic, due to limits in resolution. The goal was to identify a subtle Nisku porosity trend in which non-productive wells are intermixed with high porosity, high productivity wells.

The Geostatistical Inversion algorithm accepts or discards simulations at individual grid points, depending upon whether they imply synthetics which agree with the input seismic. The simulations can be done at arbitrary sample intervals. Close to wells, resolution beyond the seismic band can reasonably be inferred. Away from wells, the uncertainty in the estimation of reservoir properties naturally increases while remaining consistent with the input seismic.

Geostatistical Inversion resulted in the best tool for identifying "sweet spots" for carbonate porosity, combining the understanding of rock properties (e.g. impedance, porosity) with higher resolution (compared with seismic or traditional sparse spike inversion). The inversion is used in guiding a horizontal well through the optimum Nisku porosity.