Evolution of a Field Scale Static Reservoir Model for a Steam Assisted Gravity Drainage (SAGD) Project in the Athabasca Oil Sands, NE Alberta, Canada

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The Athabasca Oil Sands of northeastern Alberta are thought to contain nearly 1.4 trillion barrels of bitumen. The majority of this resource is contained within the lower Cretaceous McMurray Formation. The McMurray Formation consists of a complex succession of unconsolidated sand and mud deposited in fluvial to marginal marine environments. Deposition was strongly influenced by paleovalleys that were eroded into underlying Devonian carbonates. McMurray sands are variably saturated with saline water, bitumen and natural gas. Reservoir sands typically have bitumen saturations in excess of 75%, in situ porosity greater than 30% and absolute permeability greater than 3 Darcies. In situ bitumen viscosities in excess of 1,000,000 cp require the use of thermal extraction processes such as Steam Assisted Gravity Drainage (SAGD).

The stratigraphic complexity of the McMurray Formation makes it very important to develop an in-depth understanding of the spatial distribution of lithofacies and associated reservoir parameters. This is done in a three dimensional reservoir model which is further used for optimizing reservoir delineation, horizontal well placement and field management. Reservoir models also form the foundation for dynamic modeling to quantify future production performance using SAGD.

Drill cores, high-resolution conventional petrophysical logs and borehole images were used to determine lithofacies logs for all vertical delineation wells. Petrophysical analysis was performed for all existing vertical wells for resolving Vclay, porosity, permeability and water saturation. Bedding and other sedimentary structures from image logs helped guide sand body orientation and geometry.

Several scenarios were tested to define the best modeling approach by using various combinations of well data and seismic attributes. One hundred stochastic realizations of the lithofacies were generated for each scenario and petrophysical parameters were stochastically simulated by lithofacies for each realization. Local and global uncertainties on reservoir parameters and volumetrics were computed and used to rank realizations and scenarios.

Using the best scenario, a series of models based on reduced numbers of delineation wells were created to test the predictive capability of the reservoir model. This will help plan and optimize delineation well programs for other projects in the earlier stages of field development.