Paradigm®

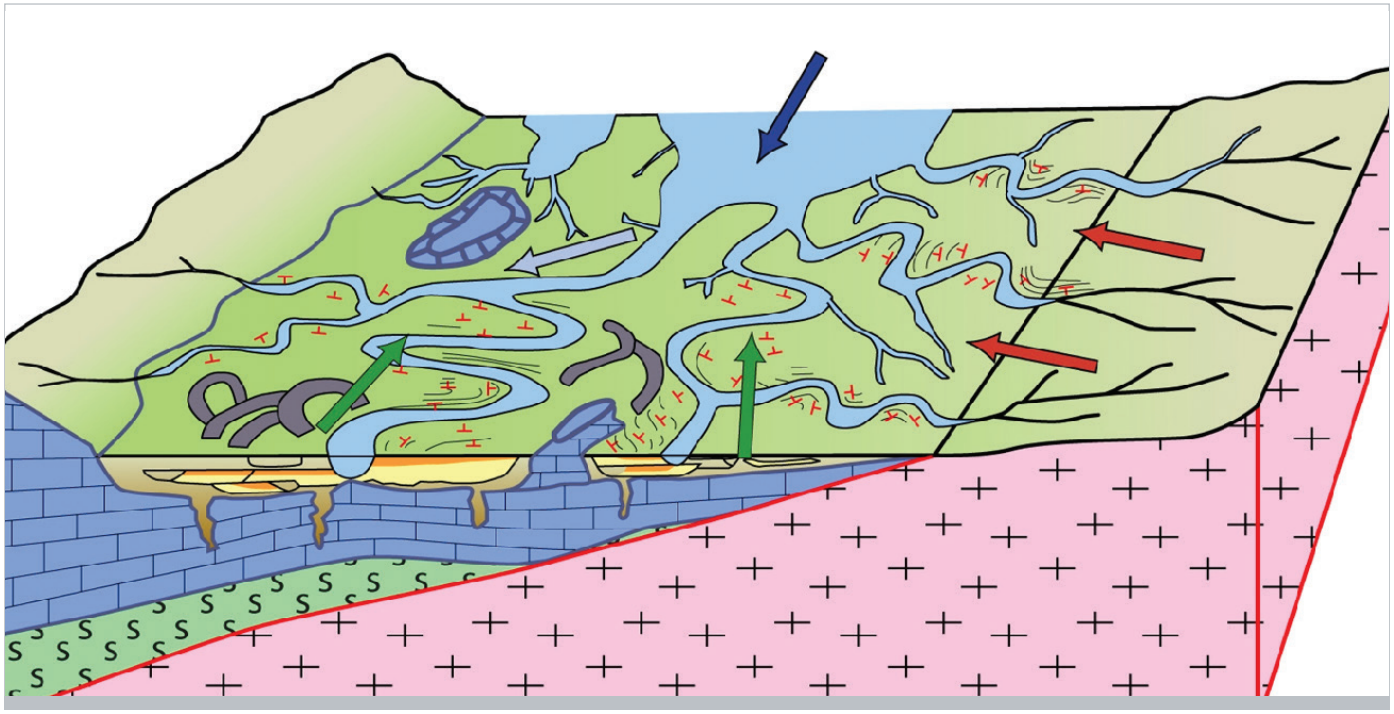
Object-Based Modeling in Heavy Oil Sands

The Challenge

Nexen, a Canada-based, global energy company, was experiencing difficulties with the placement of horizontal wells for Steam-Assisted Gravity Drainage (SAGD) in heavy oil sand formations. Lateral and vertical heterogeneities were not properly accounted for in their subsurface models. This resulted in uncertainty in the well planning process. With the cost of a well pair being in the $1M to $3M range, oil sand operators are always looking to optimize wells trajectories to penetate the best areas of a formation. To achieve this, a geocellular model that properly accounted for the stratigraphic and depositional variations was urgently needed.

The Assessment

A majority of Canadian oil sands reservoirs are characterized by swift changes in vertical and lateral lithology and associated petrophysical properties. In addition to rock heterogeneities, bitumen, water and gas display wide variations even between closely-spaced wells. Bitumen composition is also very heterogeneous, commonly showing big differences in viscosity within a single reservoir column.



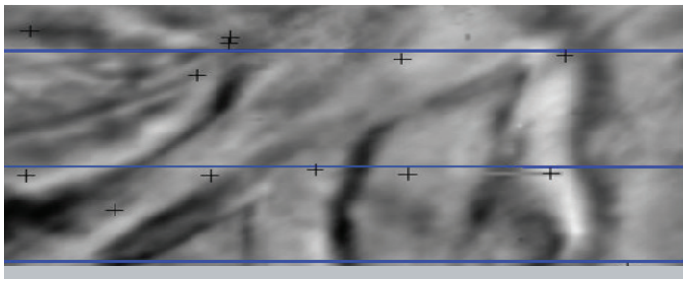
▲ 3D schematic stratigraphic model.

The Solution

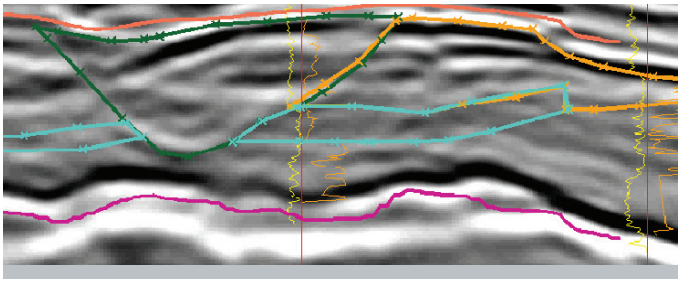
To accurately produce a true geological 3D model of the reservoir, Paradigm™ GOCAD® was utilized to create a geological grid that honored the heterogeneities by applying geobodies concepts built into the software. 3D geocellular models were then created that respected the specific geostatistical parameters for each one of the geobodies in terms of petrophysical or fluids properties. Finally, reserves evaluations were processed using Paradigm Jacta® to generate multiple realizations into the complex geocellular model to produce P10, P50, and P90 models.

The workflow

- Conceptually upscale lithofacies into depositional elements
- Conceptually interpret geobodies in 2D (cross-section)
- Create 3D depositional elements
- Apply statistics within geobodies



▲ Interpreted geobodies, well and seismic data correlation



▲ Discretization of geobodies in a geological model.

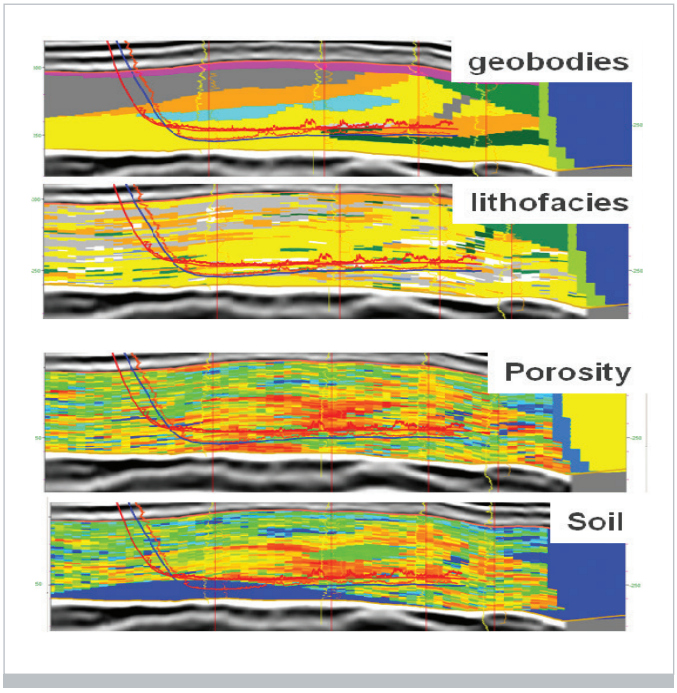
The Results

Favorable implications for reservoir development

- Placement of the well pairs in the best areas in termos of formation quality and bitumen properties
- Optimization of the number of horizontal wells
- Conduct production allocation studies using molecular markers

Realistic production optimization studies

- Process and history matching in a proper geological context
- Reduced exploration and production costs and maximized recoveries
- P10 / P50 / P90 reserve estimations taking into account reservoir heterogeneities



▲ Reservoir characterization and reserve estimation.