

Geology of A Major SAGD Bitumen Development - A Case Study from Long Lake, Northeastern Alberta

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Nexen Inc. and OPTI Canada Inc. implemented an integrated SAGD operation to recover a portion of the billions of barrels of bitumen in place on oil sand leases in northeastern Alberta. This SAGD scheme is recovering and upgrading bitumen trapped within the Aptian McMurray Formation. With billions of dollars required to acquire land, delineate deposits, drill SAGD well pairs, build steam generation facilities and an upgrader, it is critical that geological and geochemical aspects of the reservoir be fully understood. Early regional stratigraphic studies showed the McMurray Formation to be comprised of three or more episodes of incision, valley creation and subsequent infill with fluvio-estuarine sediments, which are, by their nature, heterogeneous. This resulted in a complex amalgam of reservoir and non-reservoir strata locally creating stratigraphic compartments across the basin. Since project inception there has been a major commitment to develop a thorough understanding the deposits through integration of detailed geological, geophysical and geochemical data sets. Subsequent to routine delineation of oil sand deposits through core-hole drilling, core analysis, petrophysical logging, and seismic surveys, a major effort focused on numerous geoscience studies. These include sedimentology, stratigraphy, sequence stratigraphy, palynostratigraphy, ichnology, chemostratigraphy, geochemistry, seismic-attribute analysis, geomechanics, and comparisons with modern analogs. The integration of these data sets allowed mapping of individual valley fills on regional and lease scales. On a more detailed reservoir development scale, mapping of depositional facies elements and fluid characterization allows for production optimization of existing and future SAGD well pairs. Resulting 3-D object-based model and baseline bitumen characterization studies (physical properties and molecular composition) have reduced reservoir uncertainty, improved reservoir visualization, and are used for reservoir simulation and history matching. Monitoring steam chamber growth is the next step to be undertaken to understand the reservoir, involve 4D seismic interpretations and technologies.