AAPG Search and Discovery Article #90172 © CSPG/CSEG/CWLS GeoConvention 2010, Calgary, Alberta, Canada, May 10-14, 2010

3D geological modeling for SAGD application at Surmont

Weishan Ren, Grant Byerley, Bryan Vandal, JeanPierre Fossey

Abstract

Steam assisted gravity drainage (SAGD) is the most popular thermal bitumen recovery technology used in western Canada. It is common that a variety of data are available for detailed oil sands reservoir modeling. These data include core, FMI, conventional logs data, 2D, 3D and 4D seismic data, and conceptual geological models. Integrating all available data into a subsurface 3D model can be very complex because these data provide direct or indirectly information measured at different scales with different reliability. Numerous modeling decisions must be made during the full circle of geomodeling process. The data and information we trust to a relatively high degree can be used deterministically, such as well data, structural surfaces derived from seismic data and well makers; the data and information that have more uncertainty or are unknown have to be dealt probabilistically with geostatistical data integration methods. The advantage of geostatistical data integration is both certain and uncertain pieces of information are appropriately accounted for in the modeling. Moreover, the geological uncertainty can be quantified by multiple geostatistical realizations.

SAGD performance is highly influenced by shale barriers, thin mudstone layers in “Inclined Heterolithic Stratification” (IHS), thief zone (or top water, top gas, bottom water intervals). We consider the information is certain at well locations. Great uncertainty lies between wells. Although 8 wells per square mile (about 500m well spacing) is the minimum regulatory requirement for SAGD pad planning considering 3D seismic, short scale heterogeneity is still difficult to model accurately within 500m well spacing. Although 3D seismic data provides indirect coarse scale information on lithofacies distributions, it is valuable data for facies trend modeling. Geostatistical modeling methods such as Sequential Indicator Simulation (SIS) with locally varying mean can easily incorporate trend model with well data in fine scale 3D geomodels. The geomodels will honor well data exactly, contain short scale heterogeneity, follow the trend model at large scale, and honor statistics of input data. With a reliable facies model, petrophysical properties and permeability can be subsequently modeled within each facies.

Presumably, integrating multiple sources of data can reduce uncertainty and improve geological realizations. However, the complexity of integrating a variety of data of different types and different scales could cause misuse of data or introduce biases into the model. Model QC is necessary. In this paper, an example from Surmont geomodeling will be presented. Different QC methods will also be discussed.