IMPROVED WORKFLOW TO BUILD REPRESENTATIVE AND COST-EFFECTIVE EARTH MODELS: A CPI-SUMATRA CASE STUDY

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ABSTRACT

Improved time-saving workflows using state-of-the-art technologies were deployed to build an earth model for a heterogeneous clastic reservoir located in one of the Chevron Pacific Indonesia (CPI) concessions in Sumatra. A 3-D geostatistical modeling approach was used to capture detailed stratigraphic information. Sequential Indicator Simulation (SIS) with variable azimuth and probability maps were chosen as an alternative to standard modeling techniques which excludes the use of variable azimuth and probability maps combined with SIS to define complex geometry, continuity and heterogeneity. Three facies derived from stratigraphic interpretations were populated and constrained by variable azimuth and probability maps over a stratigraphic grid of 115 layers, consisting of six reservoirs and two shale bodies across the Bekasap Formation. The petrophysical properties were geostatistically populated in 3D space guided by facies distributions. Field data showed that this technique was able to characterize the field’s stratigraphic complexity, providing a realistic and comprehensive model of field.

Modeling a faulted reservoir involves mimicking structure and stratigraphy that can be easily translated to representative cost-effective simulation models. To avoid the distortion of geologic properties due to areal up-scaling, the earth model grid size was designed to be directly integrated into the simulation model.

Production data, heterogeneity quantification and experience from previous history matches were employed to construct the static model. Production Attribute Maps (PAM) were generated and compared to sedimentological models to understand and assess the facies distribution. Heterogeneity maps built from streamline simulations, using a new Chevron approach, were constructed and compared to PAM, and sedimentological models across the major sand intervals. History matching experience was utilized to validate major faults. Knowledge about naturally fractured areas identified during a previous history match was used to improve the permeability model. RFT history matches helped to identify effective flow corridors. This article will highlight the synergy developed among different team disciplines to create a robust earth model that can be promoted to a reliable business model.

INTRODUCTION

The subject field is one of several major oil fields within the prolific Central Sumatra Basin, Indonesia. It is now producing with a near stable plateau. Companies are seeking to maintain production through improved recovery of known reserves and by finding new reserves within established fields. A great number of wells have been drilled, and the data from these wells contain important information on the distribution and quality of the reservoir rocks and their pore fluids. However, this does not often provide an understanding of the continuity or change in quality of the reservoir at the flow unit scale between the wells. An earth model was used to capture the architectural complexity of the reservoirs in a 3D model. Sequence stratigraphic techniques were employed where lateral variations of reservoir distributions could be visualized and studied. A 3-D geostatistical modeling approach was used to capture detailed stratigraphic information. Sequential Indicator Simulation (SIS) using variable azimuth and probability maps was the approach chosen to define the complex geometry, continuity and heterogeneity. This method provided a reasonable model of the fine-scale description of cell geometry, porosity, permeability, and initial water saturation in 3D volume.

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