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Facies-Based 3D Reservoir Model Construction from Well Log Data: A Novel Process guided by Depositional Concepts

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ABSTRACT

Building a representative reservoir model from sparsely distributed data is a common challenge. This study aims at introducing a novel process to construct a 3D reservoir model using interpreted facies from well log data. The workflow integrates openhole logs, image logs, and core data to define a facies model that is populated using statistical modeling guided by a derived depositional model.

The first step of the process is to interpret the image log for bedding interfaces and natural fractures with a description of the image fabric calibrated with derived openhole logs. Subsequently, lithofacies can be determined based on lithology variations compared to core description and pictures. Analysis of sedimentary features and vertical trend of lithofacies are used to construct a deposition sequence interpretation. As a result, defined lithofacies are grouped into facies associations corresponding to different depositional settings.

Considering data availability, a correlation between derived facies and conventional well logs is necessary to populate the model to offset wells with no core or image log data. This correlation describes the relation between porosity, density, photoelectric log response and the defined facies model. Consequently local facies frequency at every well capture low order changes in stratigraphy and assist in building a depositional conceptual model. In the absence of seismic data, the conceptual model can be adjusted to structural information about the area. This allows to create a model for facies trend by combining well log data and depositional environment knowledge that is serving as a supporting property for facies modeling. Multiple realizations for each facies can then be modeled to better predict rock distribution.

As a result, conditional simulation of petrophysical data restricted to facies association reflects the heterogeneity of the subsurface and provides valuable information leading to fluid flow and reservoir quality. Finally, to verify the constructed model, dynamic simulation and history matching may be required before model updates as and when new data becomes available.